HSCI2012

Proceedings of the 9th International Conference on

Hands-on Science

Science Education, Environment and Society; Reconnecting Society with Nature through Hands-on Science

17-21 October 2012

Akdeniz University, Antalya, TURKEY

The Hands-on Science Network

HSCI2012

Proceedings of the
9th International Conference on Hands-on Science

Science Education, Environment and Society;
Reconnecting Society with Nature through Hands-on Science
(Including 1st CHILDRENS' SUMMIT ON HANDS-ON SCIENCE & ENVIRONMENTAL EDUCATION)
17th-21st October 2012
Akdeniz University – Antalya, TURKEY

ISBN 978-989-98032-0-6
Online available on http://www.hsci.info

HSCI2012

Proceedings of the

9th International Conference on Hands-on Science

Science Education, Environment and Society;

Reconnecting Society with Nature through Hands-on Science

(Including 1st CHILDRENS' SUMMIT ON HANDS-ON SCIENCE & ENVIRONMENTAL EDUCATION)

17th-21st October 2012

Akdeniz University – Antalya, TURKEY

ISBN 978-989-98032-0-6

Online available on http://www.hsci.info

Program Commite

Manuel Filipe Costa (Portugal)
Mehmet Erdogan (Turkey)
Nilgün Erentay (Turkey)
Mustafa Erol (Turkey)
Jose Benito Vazquez-Dorrio (Spain)
Pedro Membiela (Spain)
Panagiotis Michaelides (Greece)
Sasa Divjak (Slovenia)
Armando Dias Tavares Jr. (Brazil)
Suzanne Gatt (Malta)
Pradeep Srivastava (India)
Fernando Ribeiro (Portugal)
Radu Chisleag (Romania)
Eva Trnova (Checz Republic)
Joseph Trna (Checz Republic)
Abhay Kothari (India)
Paulo Idalino Balça Varela (Portugal)
Jesus Blanco (Spain)
Clementina Timus (Romania)
Maria Ines Nogueira (Brazil)
Sonia Seixas (Portugal)
Ann Torsted (Danmark)

Local Organizing Committee

Mehmet Erdoğan, Akdeniz University, Antalya, Turkey (Chair)
Nilgün Erentay, Erentay Education Consulting , Turkey (Vice Chair)
Mustafa Erol, Bozok University, Yozgat, Turkey
Canel Eke, Akdeniz University, Turkey
Güler Duman, Akdeniz University, Turkey
Mahmut Sami Kılınç, Akdeniz University, Turkey
Murat Aydemir, Akdeniz University, Turkey
Hasan Kınay, Akdeniz University, Antalya, Turkey

Secretariat for HSCI2012

Güler Duman
Mahmut Sami Kılınç

Secretariat for the 1st Children Summit

Cihan Şen
Seray Altunöz
İlkay Ulugün

HSCI2012

Proceedings of the

9th International Conference on Hands-on Science

Science Education, Environment and Society;
Reconnecting Society with Nature through Hands-on Science
(Including 1st CHILDRENS' SUMMIT ON HANDS-ON SCIENCE & ENVIRONMENTAL EDUCATION)
17th-21st October 2012
Akdeniz University – Vogue Hotel Avantgarde
Antalya, TURKEY

ISBN 978-989-98032-0-6

Edited by

Manuel Filipe Pereira da Cunha Martins Costa, University of Minho, Portugal

José Benito Vázquez Dorrío, University of Vigo, Spain

Mehmet Erdogan, Akdeniz University, Turkey

Nilgun Erentay, Erentay Education Consulting , Turkey

Universidade do Minho
Escola de Ciências

The Hands-on Science Network

ISBN 978-989-98032-0-6

Printed by: M & M (Merkez Matbaa Hizmetleri, Antalya)
Number of copies: 250
First printing: October 2012
Distributed worldwide by *The Hands-on Science Network - mfcosta@fisica.uminho.pt*
Full text available online at *http://www.hsci.info*

The papers published in this book compose the Proceedings of the 9th International Conference on Hands-on Science. Papers were selected by the Conference Committees to be presented in oral or poster format, and were subject to review by the editors and program committee. They are exclusive responsibility of the authors and are published herein as submitted, in interest of timely dissemination.

Please use the following format to cite material from this book:

Author (s). Title of Paper. Proceedings of the 9th International Conference on Hands-on Science. Costa MF, Dorrío BV, Erdogan M, Erentay N (Eds.); 2012, 17-21 October; Azdeniz University, Antalya, Turkey. 2012. Page numbers.

The Organizers of the 9th International Conference on Hands-on Science acknowledge the sponsorship cooperation and support of these sponsorships and collaborations:

Universidade do Minho
Escola de Ciências

 ISBN 978-989-98032-0-6

Foreword

The core topic of our 9th Hands-on Science conference is "Science Education, Environment and Society; Reconnecting Society with Nature through Hands-on Science". Environmental and sustainable development are issues of critical importance. A widened awareness of the importance of preserving Nature to our life in today's' societies must be achieve. A sound use of the natural resources and monitoring and care of the environment and the different ecosystems that surround us, requires a sound widespread science and technology literacy. Science education, from very early ages and all along life, can and should have a major positive impact in this effort.

On these lines back in 2006 we organised the 3rd International Conference on "Hands-on Science. Science Education and Sustainable Development" with the aim to promote an open broad exchange of experiences on good practices, syllabus and policy matters, social factors and the learning of science, and other issues related to Science Education its development and the potential impact environment and natural resources preservation and sustainable development.

Six year after its time to again renew this discussion exploring newer ways of approaching science education in our schools and at society … reconnecting Society with Nature... by stressing the significance of discovering Nature through an enlarged use of indoor and outdoor hands-on science learning activities in classroom formal context but also in different informal or non-formal environments. Students are again invited to bring their insights to our conference. The 1st Childrens' Summit on Hands-on Science and Environmental Education (HSCI-EE) will be a first annual children's' summit where they will present and discuss their proposals for solving environmental problems and views on our relationship with Nature.

The improvement of the levels of quality and effectiveness in school science education can hardly be achieved in a non supporting environment, provided by societies with a low level of Scientific Literacy, and without an effective change in the way Science Education is traditionally approached in our schools. The method that drives the pursuit of scientific knowledge should be the starting driving and guiding basis of all process of in-school teaching/learning of science. Leading the students to a pro-active posture and an active volunteer commitment in hands-on experimental activities: by observing, analyzing critically, deducing, reasoning, defining, discussing, experimenting… "making" (learning) science as scientists do…

…towards a better Science Education...

Manuel Filipe Pereira da Cunha Martins Costa
HSci'2012 Chair

 ISBN 978-989-98032-0-6

© 2012 HSci. ISBN 978-989-98032-0-6

© 2012 HSci. ISBN 978-989-98032-0-6

© 2012 HSci. ISBN 978-989-98032-0-6

© 2012 HSci. ISBN 978-989-98032-0-6

© 2012 HSci. ISBN 978-989-98032-0-6

© 2012 HSci. ISBN 978-989-98032-0-6

© 2012 HSci. ISBN 978-989-98032-0-6

SCIENCE EDUCATION

© 2012 HSci. ISBN 978-989-98032-0-6

 ISBN 978-989-98032-0-6

THE CRITICAL BIOLOGY EDUCATION IN THE EARLY YEARS

S. Dale Tunnicliffe
Institute of Education, Univ. of London, UK

Abstract. *Noticing and understanding biology starts from a very early age, pre primary, but there is little research on how children construct this understanding or the cultural influences which affect such. The majority of researchers are involved in teacher training and secondary school research into assessment and general science issues not particularly biological in emphasis. It is essential for us to focus on understanding the early year acquisition of concepts of themselves and the everyday world as a baseline on which to build further research into biological education with older pupils and adults. The issue of public understanding and cultural interpretation of biological issues are also paramount in contributing to the understanding of scientifically literate citizens.*

Keywords: Early year, biology, observation, talk.

1. Beginning to learn biology- the emergent learner

Biology education starts from birth, yet there exists relatively little research about this fundamental and most critical stage where the 'teachers' and parents careers and others with whom the child come s into contact, and with whom interacts, talks and explores their everyday world above all learn for the first time. They are not officially formal educators. The emphasis in the biology education world is very much on secondary-school pupils on later concept and skills development, whose knowledge is based on the early foundation in pre-school and primary school. The research emphasis is also on assessment and formal curricula.

Children are intuitive scientist, particularly biologists from the earliest years

- They observe the world around them
- They are statisticians- they find patterns etc.
- They experiment - have hypotheses and try things out they do this without being told!
- They are hands on minds on- true IBSE
- Children learn through active experimentation, not as passive observers receiving information!
- Children form their own interpretation sometimes-alternative conceptions and do not coincide with that of science. It is whoever Important to remember their experience of world is less than ours but is the start.

2. How children learn-looking, listening, thinking, doing and talking

Children develop ideas about natural phenomenal before they are taught science in school' (Driver et al. 1994). I consider that this area of early years biology learning, emergent biology, is that upon which the assessment and curricula issues of later formal schooling are founded. Consequentially we educators in biology should be endorsing and encouraging more research to further the knowledge and understanding of biology teachers, researchers and site s of informal learning such as zoos and museums of the development of biological understanding in young children and its implications for teaching.

Literacy has 4 competes, talking, listening, reading and writing. Of these talking and, listening are the first and most important in a child's early years. Learning begins with talking. Talking is the pre- cursor of reading and writing. At the foundations of learning biology we need to be encouraging observations and narratives about the living world that children encounter and planning such experiences for young children. The starting point for biology is observation. Children are intuitive scientists (Gopnik, 2009). They observe, find patterns, hypothesize and try out ideas.

Children, we now know, need to talk, and to experience a rich diet of spoken language in order to think and learn. Reading, writing and number may be acknowledged as curriculum 'basics' but talk is the true foundation for teaching (Alexander, 2008).

Narratives are important in learning science. Ogborn et al. (1996) argue that science knowledge can be reworked into story-like forms, not merely to add to its 'liveliness' or 'interest', and not merely to show it 'applied' to some real context, but more fundament- tally to act as an involving, memorable and efficient knowledge carrier:

3. Children's narratives and development of understanding

A narrative produced verbally when a child is asked to tell the story of whatever. This may be when a child spontaneously tells the story as they see it out loud. Children develop a dialogue with a peer or adult at the child's instigation. Thus a dialogue ensues after a prompt from a 'significant other'.

The starting point for the learning of science and engineering is at this early age occurs in the immediate environment of the child with the people with whom s/he spends their time. These places are where they live and the immediate environment outside. In these locations children witness everyday activities such as cooking, cleaning, washing, various activities with materials such as textiles, wood, clay, as well as identifying and being involved with basic life processes such as moving, breathing, eating, and excreting and the human activities associated with the life processes and beyond. Children are immersed in their environment, built, human constructed or natural such as their village or neighboring biological phenomena which all; contain various amounts of technology and biodiversity from a simple coking vessel being used on an open fire to mobile phones; from natural denegation to manicured garden. Moreover, the natural environment is made from physical, geological and biological elements and features of this such as rocks, plans, water courses may be observed. Additionally the culture and particular uses of science and technology by the community with whom the children live are evident and noticed.

As children acquire early language they begin to label phenomena. This naming is an inherent human need (Bruner, Goodnow and Austin 1956). Additionally young children ask questions incessantly when given an opportunity (Tough, 1977), a behavior which often disappears in the formal educating environment where classis triadic dialogue take saver. However, there is a move towards developing dialogic talking in classrooms (Alexander, 2008).

4. Understanding real biology- the issues for learners and educators

Educators face a dilemma, (Tunnicliffe and Uckert, 2007), indeed many. One overriding one is the dilemma of biology teaching because a child's learning is measured by success on a mandated state exam, and they learn the 'word' that will get the mark. They do not understand the fundamental concept and ideas that the 'word' represents. The emphasis on testing has forced teachers to focus on 'how to' rather than 'what does this mean'.

The small amount of research about children's knowledge of plants and animals shows that children have an everyday knowledge, vocabulary and grouping, hence biodiversity and taxonomy, of living things. We should learn more about early learning of biology. We should note what the child and peer groups observe.

Young children may not have the vocabulary to share that which they see and experiences. If their adults try to 'teach' them using language of formal later stage education often driven by focus on passing exams and fact acquisition, they or they may misunderstand the words used and be disinterested. Modern educational practice of inquiry based science focuses on the child as learner, experimenter and inquirer but the process begins with awareness of the living world. It starts with first hand observations and questions, once a child can talk, and experiences of phenomenon. The adults of a child's early years, often its mother, is so important in these critical first years of learning about the living world. The observations and experience made at this young age provide the basis for later formal; teaching where information is readily given. For instance, when I asked a group of four-year-olds in the Foundation stage (4 yrs.) of their English primary school about plants it emerged that they only knew the word 'plant' as a verb, 'to plant; because they had planted seeds. They did not understand that the seeds were part of the plants and plants are green.

Experiences inside and outside that children have are important in developing their understanding of their environment and hence biology. Children, in our experience, enjoy collecting bio facts and artifacts, which they encounter in their environment. It is important that children direct their own learning even when the child is very young. As children process information and relate it to what they know and have experienced, they are becoming more aware of what can be found in their environment and the roles they play (Driver et al. 1994). Indeed annoyer dilemma is the lack of real first hand biology that children encounter in schools as opposed to the book biology learnt in the class room from various media resources (Kofiatis and

© 2012 HSci. ISBN 978-989-98032-0-6

Tunnicliffe, 2012).

Those who interact with children, from the earliest years, could be assisting them to develop their skills in observation, looking with meaning and accuracy rather than merely seeing. Guided science experiences outside of the formal classroom require children to think critically and to value their own experiences and ideas. We must recognize the vital role paid by careers, usually mothers, and other people who look after young children. They are keys to successful education and encourage ether to explore the living world with their children. We, formal educators, need to assist them in realizing the wealth of everyday science that they know.

Children need the hands on experiences and simple answers to tephra inquiries. Talking and Doing since in the early years is a vital process. Children do not need stories to introduce them to science. They need first hand observations and experiences, like planting seeds and seeing the outcomes. After that they can be read stories, about for example bean seeds, as in the fairy story of Jack and the Beanstalk, a favorite in early easy classrooms and use their own first hand experimental knows kedge acquired through growing and observing seeds developing into a plant, critique the story, not hear the story and then grown beans.

Young children use the appearance of an animal or plant to classify it and use exemplars, matching what they see with what they have experienced previously. They come to realize that the object represents a natural kind and thus the object has certain shared characteristics with other members of the same group and, therefore, shares membership. Much biology development is informal, with children learning from the world around them and not from formal teaching, and this creates conceptual problems as biological understandings (as other areas of science) are not always intuitive.

Another big problem occurs when children meet formal education. While teachers feel comfortable with biology (as compared with other areas of science), their knowledge can be more fragile than they realize. Upon visiting many primary elementary schools for the purpose of inspection or advising and working with people already in teaching situations with early years, we observe that a great many do not possess a grasp of the holistic concepts – the big pictures of biology. Thus, major concepts such as photosynthesis, metamorphosis, new life and parental care, are inadequately explained as core ideas and are thus likely to be problematic later in children's development because they are so misunderstood by teachers themselves in early years. Teaching 'bytes' of information without a linking of ideas can lead children to alternative conceptions – even the curriculum guidance implies that plants need sun, water and soil to grow and do not even mention air (Driver et al. 1994).

Educators working with children encountering the living world for the first time needs to think have teach phenomenon and identify the basic, key concept of such. For insigne e, all plants have some green parts; plants have some form that attaches them to a substrate from which they can obtain water and minerals. Mammals have ear flaps (expect seals) and chordates have post-anal tail!

5. Learning how children learn biology

We need to find out more about how concepts of biology are acquired and constructed. Children from about 4 years can make resemblances or images of known phenomena, like a tadpole man, stick, legged cats (Tunnicliffe, 2011)

This can be affected in my research experience by:

1. Using objects, plant or animals or fungi

- With a probe, everyday plants, insects
- Photo or drawings Understanding of natural phenomena- e.g. daisy pigeon,
- Using a word as a specific cue
- Posing a context question. In one minute how many different animals can you name?

2. Interviewing with open questions

- Invite to talk about.
- Invite to tell a story about e.g. dioramas- an interpretation narrative
- Finding as a starter- Tell me about… that you've found, what is it?
- Word as a probe.
- Can you tell me about that?
- Which do you like, why (nature table)

3. Inviting them to talk about an instance

- What are you doing? Why?
- What can you see? Hear?
- What are you doing? Why?

4. *Inviting children to draw or model*

- From real life draw from first hand

© 2012 HSci. ISBN 978-989-98032-0-6

- From everyday observation recall
- Looking directly focused on specimen
- After examination
- Something later from recall e.g. animal seen in a zoo
- From memory after some time
- From imagination e.g. imaginary rain forest

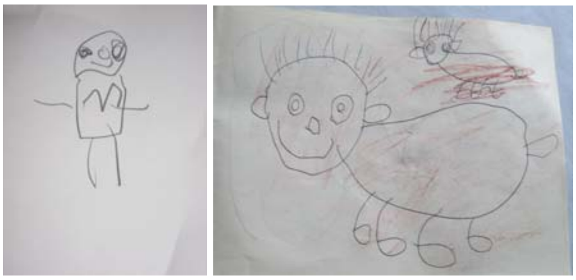


Figure 1. *Tadpole man drawn by 4 yr old boy and a drawing of his dog (note anthropomorphic features) 9 months later*

5. Incidental

- Asking 'why did you draw that?' From a drawing they have executed for some reason.

6. Invite them they draw what they understand

- Inside body
- Inside tree
- Inside another species e.g. dog

It is important to remember that a child's knowledge is built-up in stages. For example, inviting children to draw representations of where water goes inside them when they drink reveals that other youngest chidden draw indie a body shape a tube straight rough body and gradually cite representations increase in complexity as they begin to understand that although food and water enter via one orifice the remains, as it were, leave through two. (Tunnicliffe, 2004)

6. The way forward

Much of our word is listening to children but in eliciting their understanding we do use questions. I refer you to the analysis of forms of questions specified by Chin (2007) and about which if have spoken elsewhere in this conference Being aware of the different us e of questions helps us to structure work to achieve various outcomes as does the type of tool which we employ to obtain the expressed model of eh subject in which we are seeking to acquire the understanding of the child.

Through dialogic talk Alexander, 2008), to the self or to a person, an early learner may link existing concepts to some- thing they know, thus increasing their cognitive development in that area. Analysis of the personal narrative of a child about an observed biological phenomenon can reveal such accommodation and development as well as points, which can be clarified with them through teaching.

References

Alexander, R. 2008. *Towards dialogic teaching: Rethinking classroom talk*. Cambridge, MA: Dialogos.

Bruner, J.S., Goodnow, J.J. and Austin, G.A. (1956) A Study of thinking. New York, John Wiley, Science Editions, Inc.

Chin, C. (2007) teacher questioning in Science Classrooms: Approaches that stimulate Productive Thinking. *Journal of Research in Science Teaching*, 44(6) 815-843.

Ogborn, J. et al. (1996) *Explaining Science in the Classroom*, Milton Keynes, Open University Press.

Korfiatis, K.J. and Tunnicliffe, S.D. (2012).T he Living World in the Curriculum: Ecology, an Essential Part of Biology. *Journal of Biological Education.* On line September 2012

Tunnicliffe, S.D. and Uckert, C. (2007) Teaching biology – The Great dilemma. *Journal of biological Eductiton.*41 (2) spring 2007

Tunnicliffe, S.D. (2012) Visualization of animals, how do children see birds? *CEPS Journal*. 1 (4) 963-7

Tunnicliffe, S.D. (2004) Where does the water go? *Primary Science Review* 895, November-December pages 9-10

 ISBN 978-989-98032-0-6

A JOINT ENGINEERS-EDUCATORS PROJECT FOR ENABLING SCIENCE LEARNING IN RURAL HIGH SCHOOLS IN TANZANIA

N. Setter[1,2], D. Favrat[1], R. Mamlok-Naaman[3], K.M. O-Saki[4]
[1]*EPFL Swiss Federal Institute of Technology, 1015 Lausanne, Switzerland*
[2]*Talent Foundation, 1096 Cully, Switzerland*
[3]*Weizmann Institute of Science, 76100 Rehovot, Israel*
[4]*University of Dodoma, Dodoma, Tanzania*
nava.setter@epfl.ch

Abstract. *We report on a joint project between engineers and educators in which, to facilitate high-school science learning in rural areas in Tanzania, we developed infrastructure, prepared and implemented integrated science modules [ISMs], and developed and tested a program for in-service training of high-school science teachers. The infrastructure is composed of a 'technology package' containing solar-unit, beamer, and laptop. A typical ISM counts several lessons and few practical sessions: The lessons contain, in addition to frontal interactive teaching, an introductory video showing relevance of the studied subject in the context of a technology-rich environment and videos demonstrating the taught concepts, and simple classroom experiments. The methodology encourages inquiry-based learning. The in-service training unit introduces teachers to the ISMs. It could potentially expand into a nationwide distributed network of mini-centers for in-service training of high-school science teachers.*

Keywords: Educators-engineers cooperation, High-school science education, In-service training of teachers, Integrated science modules.

1. Introduction

There is a persisting inquietude in the technology-developed countries with regards to the low level of interest high-school students' show toward science studies [1,2]. The concern is about a near future shortage in scientists and engineers [3] professions that are crucial for the maintenance of a healthy and prosperous society. This problem is many-folds more severe in sub-Saharan Africa where a poor infrastructure impedes, almost prevents, access of youth to appropriate science education. Insufficient in-service training programs for science teachers further impede provision of adequate science education.

While the low interest in science presents a central debate among *educators* in Europe and in North America, science and engineering faculty are not yet fully engaged to contribute towards its resolution. The present authors believe that a cooperation of educators, scientists and engineers from both industrialized and developing countries can provide an effective way to approach the problem: By creating affordable science-labs, facilitating teachers training, and 'connecting' pupils to the curriculum, the use of modern science and technology tools to support science education programs can increase learning effectiveness in industrialized and developing countries alike. Accessible modern technology: mobile communication, internet, on-line videos, virtual science experiments are inexpensive and could alleviate some of the difficulties facing science educators in developing countries. Here we report on a project we undertook in this direction.

2. Background

In 2001 Tanzania launched the Primary Education Development Program, which raised enrollment at primary education level to almost 100% in 2004 [4]. Following this, the government launched the Secondary Education Development Program and enrollment reached 57% in 2007. This rise has been achieved by building many new community secondary schools, some of which are extensions from previous large primary schools [5].

This rapid expansion has led to a serious shortage of teachers and other basic resources such as textbooks, libraries and furniture. These problems accentuate in science education at the secondary school level. Here the most critical problems are two: (1) Scarcity in trained science teachers, and (2) lack of science laboratories and teaching resources. These difficulties are encountered in most of the public secondary schools and are the dominating problem in rural areas in the few already existing public high schools (A-level)*. Indeed the newly created public A-level schools avoid opening of science orientations (PCM – physics, chemistry, mathematics, and PCB – physics, chemistry,

*The education system in Tanzania is composed of primary school (7 years) and secondary school (Ordinary-level, called O-level includes Form I–IV and duration of studies is 4 years; Advanced-level, also called A-level includes Form V-VI and its duration is 2 years).

© 2012 HSci. ISBN 978-989-98032-0-6

biology) and limit themselves to other orientations (HKL – history, Kiswahili, languages, ECA – economics, commerce and accounting, etc.). In 2010 the total number of A-level public schools was 179 of which approx. 150 in rural and of those not more than 100 with PCM orientation. It is essential to enable science learning in A-level rural public schools.

3. The ENSCIECNE** Project (2009-2012)

Considering the large population of Tanzania, the provision of appropriate science education at the ordinary level ("Science for All") needs a huge effort on the national level. However, the timing of our project provided a rare and urgent opportunity to contribute to the shaping of the ***A-level science education*** in rural public high-schools in Tanzania, in which we could get involved in a significant way: The total number of students entering Form V in 2007 in Tanzania was 53'000, of which 33'000 were in public schools. We estimate that 25'000 students enter form V in rural public schools, which is our 'target population'. Here we define « rural schools » as schools that are located elsewhere then the centers of large cities. Of those 25'000 students, about 1'800 took the PCM orientation or some 60 classes. A projection to 2017 with optimistic doubling of this population every 5 years would give 240 entering classes or 7200 students. This estimation is compatible with the number of PCM classes that took the final A-level exams in Spring 2012 (170 classes, of which, ≈120 were in public rural high-schools). This number is much smaller than the overall population level for this age (≈1'000'000 youth in the age 17 to 18).

As only 60 Form V and 60 Form VI PCM classes (or 60 rural high-schools with PCM orientation) were operating in 2007, we focused our activity on **PCM *programs in rural high-schools*** aiming to support the creation of suitable learning conditions for the top graduates of the O-level secondary schools that are heading to the A-level core-science studies. Considering the rough living conditions in Tanzania, students who succeed in O-level (middle-school) final exams and are admitted to the A-level science orientations are inherently scholarly-strong and therefore with a high-quality A-level education they will be able to fill up existing gaps that might arise due to deficiencies in their O-level studies. These students will typically continue their studies to get university degree in science / engineering.

From point of view of the necessary hardware, the small number of classes means that the overall hardware cost is low. The need for qualified teachers is more problematic: The salary of high-school science teachers in public schools is hardly sufficient to cover bare living cost. It is substantially lower than salaries of science/engineering graduates who work in the private sector. Hence the profession of science teacher is unattractive to young people. In this situation, in-service training of practicing science teachers and well-prepared teaching material can be particularly helpful as both the current INSET for science teachers and the current teaching and learning materials are very limited. This was therefore the direction that the ENSCIENCE project undertook.

4. Hardware

Tanzanian students graduating successfully with A-level diploma in PCM orientation will typically continue their education at the University and will become the technical leadership of the country. For this reason, we conceive A-level science courses not only in the context of the immediate environment of the student but rather as providing the student with the fundamentals necessary for pro-active life in technology-aspiring environment. Considering such an environment is very different from the immediate one, the infrastructure we envisage includes 'equipment package': a projector (beamer), a laptop, and loud speakers. In case the school has more than 2 science streams, perhaps two packages are needed. If the school is not connected to the electrical grid – a solar system is to be added. We limited our project to PCM orientation, which is the most fundamental of the science orientations. The number of needed 'equipment packages' (at a cost of 1000 USD per package) for 2013 is estimated as 120 at most for all the rural high schools with PCM orientation countrywide. We estimate that 25% of those will need the solar power package (estimated cost 2000 USD per package, and going down quickly at present). Within the project we furnished 6 high- schools with equipment packages and as

**ENSICENCE – Enabling Science Learning in High schools in Rural Tanzania is a research-development-& implementation project financed by the Swiss Foreign Ministry with additional support from the EPFL - Swiss Federal Institute of Technology, from the Swiss TALENT Foundation and from the Tanzanian Ministry of Education.

© 2012 HSci. ISBN 978-989-98032-0-6

the schools were connected to the national electric grid, we added only dedicated generators for case of power cuts. The Kisimiri high school, where the teachers' training center was established (see below) was furnished with a solar photovoltaic power system. Here, in order to optimize the cost, the solar system was planned for a maximum of 3 days work without sun and a generator was connected in series for exceptional peak power needs. The package was designed by the engineering masterants (materials and mechanical engineers) that participated in the project taking into account published reports [6-8] and own design. The electricity consumption was calculated based on 2 projectors working in parallel, some 10 lap-top computers working in parallel (to train teachers in use of computers, power-point projection, etc.), and for illumination of classrooms, laboratories and dormitories (Fig. 1).

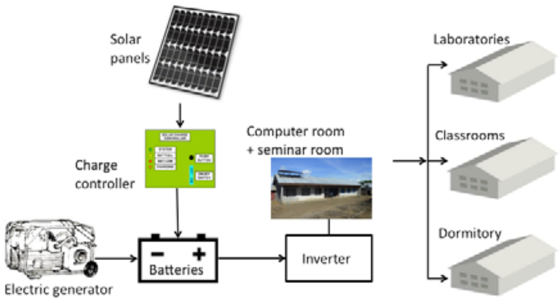


Figure 1. *Schematic presentation of the electricity package installed in the Kisimiri high school*

5. Integrated chemistry modules

The preparation of teaching and learning material in form of 'Integrated science modules' [ISMs] constituted a major part of the project. A typical ISM counts several lessons and few practical sessions: Each lesson contains, in addition to frontal interactive teaching, an introductory video showing relevance of the studied subject in the context of a technology-rich environment and videos demonstrating the taught concepts.

By elaborating the modules we aimed to reduce the following existing problems in rural high-schools: At present typical lessons are taught by 'chalk and talk' methodology where the students recite the material taught by the teacher. Lack of: books, illustrations and pictures, internet, radio, and television impede the assimilation of the taught subject in the context of real life. Laboratories hardly exist and where existing are poorly equipped. Moreover, schools have rarely laborants or technical staff. For this reason, the laboratory sessions (called "practicals", see below in a separate section) are given typically after completion of the A-level science lectures and before the national examinations and are not tied to the lessons of the same topic.

ISMs were developed for selected topics covering half of the chemistry curriculum of PCM orientation. The content is compatible with the existing A-level chemistry curriculum in Tanzania and follows the recommended syllabus. The selected part of the syllabus was divided into 10 modules, e.g. Module 1: Atomic Structure, Module 2: Bonding, etc. Each module included a number of 80 min lessons and 120 minutes practicals.

A typical 80 minutes lesson period are composed of the following components: ≈35 minutes - frontal presentation by the teacher, including (1) 3-4 minutes introductory video which ideally is a presentation of real life application of the subject of the lesson (2) a video, duration 3-4 minutes with a demonstration of the concepts of the lesson, or a filmed experiment, or a virtual experiment. ≈20 minutes – inquiry based activity of pupils (Fig. 2) (or sometimes a virtual laboratory experiment). .≈10 minutes worksheet solving by pupils. ≈10 minutes Q&A, discussion and clarification by the teacher. ≈5 minutes summary.

Figure 2. *Student group-discussion during implementation of an 'integrated chemistry modules' in Maslato Secondary School*

The lesson is presented using power-point slides. The slides guide the development of the lesson with several key words per slide. The intention is to guide the lesson without reducing the role of the teacher, the eye-contact, black-board etc.. The power-point presentation is particularly effective for projection of illustrations, for outlining the class room activity demanded from the students, for the projection of the videos, and presenting the questions that motivate the

© 2012 HSci. ISBN 978-989-98032-0-6

students to think and understand the lesson material. The slide with the video projection includes always questions, inciting the students to reflect while watching the videos. The videos were searched and then copied and inserted into the program by masterants (chemists and materials engineers). We were surprised with the difficulty we had to identify suitable videos on the Internet. Our search technique was apparently amateur. We found out also that a deep knowledge and much experience in chemistry is necessary in order to relate the various subjects taught with real life issues that are treated in form of videos on the web. For this purpose we further collaborated with professors and doctorants of chemistry and were assisted by them to find additional videos. We have also edited slightly the videos, adding, e.g. introductory slides. On the positive side – the quantity of videos available on the web is increasing immensely and this task is likely to be easier in the future.
Although we did not plan to develop own videos, we did produce some, included them in the CDs and displayed them also on You Tube. (Fig. 3)
Another unique component of the lesson is the 'class experiments'. We try to introduce in each lesson a class experiment done by students in group or by the teacher + 2 students in front of the class that, although not quantitative, makes one mind's wonder about the subject of the lesson
The teachers are supplied with a CD and a hard copy of the presentation, which includes essential notes as well. This is complementary material to the text books that are recommended by the Tanzanian ministry of education and to reference textbooks. The teachers are introduced to power-point techniques and could eventually adjust the content to their wish. In addition to the CD and the hard copy of the presentation and notes, another file contains the slide to be distributed to the students. Typically the class-representative will get one copy and students will copy this to their notebooks.
Detailed description of the utilization of the ISMs and initial analysis of their effectiveness is presented in ref. [9] of the proceedings of this conference.

Figure 3. *Video produced during the ENSICENCE project* [10].

6. Practicals

We use in the ISMs the practicals proposed in the Tanzanian science syllabus. The series of all practicals has been recorded and a CD with all the laboratory activity demonstrations is included in the materials that are distributed to the teachers. A written summary of each practical session is included in the module materials.

7. In-service training program of A-level science teachers

There is a very limited organized continuous training for A-level science teachers in Tanzania. After graduating from the university or college, graduate teachers are expected to be able to teach up to A level. Those graduating in science, including physics, chemistry, biology, mathematics are very few. This now means that almost all of them are posted to teach A level due to their scarcity. The training program in university produces only few science education graduates at present. Given poor practical experience in their school years, the newly graduated teachers lack confidence. No systematic program exists for post-graduation professional development. The Science Education in Secondary Schools (SESS) and Education II Programs have done some in-service training but it was only for teachers of O level.
Our approach was to design and implement a prototype for mini-centers for professional development for A-level science teachers. These mini-centers could be located in selected local high schools throughout the country and each

 ISBN 978-989-98032-0-6

one can cater to the science teachers of its region. In our project, the selected school was a rural school, Kisimiri High-school, situated near the scattered village of Kisimiri on the foothills of Mount Meru (60 km away from the Kilimanjaro mountain). The regions that could benefit from this center are Arusha, Moshi, and perhaps the Manyara region, a total of 33 public high schools out of 179 high schools nationwide. A workshop was organized for headmasters and officials of the education offices of the regions, in which the ENSCIENCE project and the ISMs were introduced.

Figure 4. *First workshop for A-level chemistry teachers held at KIASTE on October 2011.*

The first two workshops for teachers were held for A-level chemistry teachers (Fig. 4), introducing the Integrated Chemistry Modules with accent on inquiry based approach in teaching, integration of the laboratory practicals in the module, and use of the beamer for projection of class material, videos and illustrations. The workshop included also introduction and reflection on the competence bases syllabus in Tanzania, microteaching by teachers, and laboratory demonstrations. During the workshops the teachers got also training in using the internet and searching on it information. Six high schools, from which many of the participating teachers came, were furnished with beamers. All the participating schools were connected to the regional electrical grid. However, due to occasional problems of power-cuts, the schools were furnished with generators connected to the beamers, which could make operative in case of a power cut. A coaching period followed each workshop. During these periods two coaches visited the schools, planned the lessons with the teachers, observed the lessons and discussed the implementations. Evaluation of the program by the teachers was conducted after the first workshop and coaching period. The program was reiterated and a second workshop with a second phase coaching was undertaken. Details and a 1st evaluation of the program are given in ref. [11].

8. Remarks about the project

The research, development, and implementation of the project was done as a cooperation between masterants/doctorants in Science Education AND masterants of materials and mechanical engineering, physics and chemistry. While the formers had a dominant contribution in the elaboration of the concepts of the Science Modules and the INSET program for teachers and their evaluation, the engineering students benefited from the exposure to science education issues that are seldom raised up at strictly technical universities such as the EPFL. The engineering masterants and doctorants divided their time between scientific research in their own fields, and support of the development of the ISMs and the hardware design. Most of the participating engineering masterants continued/continue and pursue doctorate degree in engineering. Their increased awareness on science education issues is manifested in various ways; e.g. one of the masterants is planning to pursue a teacher’s certificate. The project might be therefore conducive in paving the path for enhanced interaction between technical workforce of the society and educators, for the benefit of the next generation.

9. Perspectives

The continuation of the program, e.g. completion of the elaboration of ISMs to cover the full A-level Tanzanian chemistry syllabus is uncertain as a further support of both the Swiss and the Tanzanian ministries is not assured. However, the Kisimiri mini-center for INSET of science teachers can continue to operate. The project identified ‘subject competence’ training as an important need. This can be answered by a continued collaboration with the EPFL and possibly other universities in Tanzania and elsewhere. Plans in this direction are underway.

10. Acknowledgements

We acknowledge the financial support of the Government of Switzerland through EPFL-SDC Fund. The Principal of Arusha Technical College Dr. Richard Joseph Masika and the Head of ICT Department, Mr. James Mmari, as well as Mr. Emmanuel John, head-master of Kisimiri Secondary School and Mr. Rickaldo R Romwald responsible for the ICT hardware and training in the Kisimiri High School are gratefully acknowledged for their support. We thank Prof. P. Dillenburg of the Pedagogical Research and Support Center (CRAFT) of EPFL for helpful discussions on pedagogical issues.

References

[1] Rocard M., Csermely, P., Jorde, D., Lenzen, D., Walberg-Henriksson, H., Hemmo, V., “Science Education Now: A renewed Pedagogy for the Future of Europe” EUR 22845. High Level Group on Science Education, Directorate-General for Research; 2007.

[2] Xie, Y., & Achen, A. Science on the decline? Educational outcomes of three cohorts of young Americans. Population Studies Center Research Report 09 – 684. Ann Arbor: University of Michigan, Institute for Social Research; 2009.

[3] National Research Council. N. R. Augustine et al. Rising above the gathering storm, revisited: Rapidly rising to category 5. Washington, DC ; 2010.

[4] Basic Statistics from the Ministry of Education and Culture, http://www.moe.go.tz/statistics.html

[5] For more details see paper by K.M. O-Saki “From Content-based into Competence-based Approach in Science Education in East-Africa” in the present proceedings.

[6] Banerjee R. et al, Optimum sizing of battery-integrated generators for remote electrification through design-space approach Energy (2008) 33(7): 1155-1168.

[7] Kubota S. et al. Thermal challenges deriving from advances in display technologies, Microelectronics Journal 2008; 39(7).

[8] Snyman D.B.,et al. Centralized PV generation and decentralized battery storage for cost effective electrification of rural areas. Renewable energy 1994; 4(1).

[9] For more details, see paper William F. et al, Introduction of Integrated Chemistry Modules (ICM) at Advanced Secondary Level : Lessons from Three Years Class-room Experience in Tanzania in the proceedings of the present conference.

[10] www.youtube.com/watch?v=asfB1VJOKRo [08/20/2012].

[11] Gabrielli P. et al. Teaching Science using Integrated Science Modules: Experience and Reflection on Training and Coaching of A-level Science Teachers in the Proceedings of the present conference.

TEACHING SCIENCE USING INTEGRATED SCIENCE MODULES: EXPERIENCE AND REFLECTION ON TRAINING AND COACHING OF A-LEVEL SCIENCE TEACHERS

P. Gabrieli[1], F. William[1], R. Mamlok-Naaman[2], N. Setter[3,4], K.M. O-Saki[1]
[1]*University of Dodoma, Dodoma, Tanzania*
[2]*Weizmann Institute of Science, Rehovot 76100, Israel*
[3]*Swiss Federal Institute of Technology EPFL, Lausanne 1015, Switzerland*
[4]*Talent Foundation, Cully 1096, Switzerland*
prospermosha@yahoo.com

Abstract. *Professional development of science teachers is a continuing process. In the case of A-level chemistry teachers in Tanzania, no formal in-service training exists yet. In addition there is a serious problem of lack of textbooks and laboratories, and lack of practical skills in lab work.*
In 2011, we established a small training center in a Tanzanian rural high school in possession of laboratories and initiated in-service training for A-level chemistry teachers of ten secondary schools. We used Integrated Chemistry Modules as the focus and ran two INSET (in-service training) workshops for the teachers. In the first INSET, the teachers were introduced to competency based teaching and learning, shown how to run selected modules, and did a micro-lesson task. The teachers tried the materials in their schools and were visited by us for first level coaching sessions. The INSET was improved and a second iteration was done after 6 months. After this we followed the teachers up with intensive coaching and introduced also peer coaching. During coaching we found the need to improve content coverage and help teachers to use educational technology, do simple lab demonstrations, and run class sessions involving discussions of laboratory experiments and video demonstrations. Collaborative coaching has potential to raise professional competence in practical work and classroom management.

Keywords: A-level Chemistry, In-service training of teachers, Integrated Chemistry Modules.

 ISBN 978-989-98032-0-6

1. Introduction

Teaching is a dynamic field with innovations in the subject content and pedagogies according to the development of the societies around [1]. These innovations require changes in the curriculum as well as teaching approaches. In this environment, effective and continuous professional development programs abreast teachers about new classroom practices and a means to change [2]. Joyce and Showers [3] provide a professional development guideline that allows us to better understand the components that need to be incorporated in a learning route for teachers who are required to learn new innovations and implement in their classroom practice. According to these guidelines, very essential components for effective professional development programs include: (1) theory of the new innovations, (2) demonstration of the new theory, (3) teachers' practices, and (4) the supportive feedback in a form of coaching.

Teacher professional development program in this study is focused in preparing teachers to implement Integrated Chemistry Modules (ICM) lessons in their classroom practice. The INSET program was organized into two phases: Phase I had a 3-days workshop and a coaching session. The activities in this phase were then revised, refined and improved to give rise to the activities of the phase II. In each phase, teachers were invited to the established resourced centre and (1) exposed to the ICM lessons, (2) observed a good practice from the facilitators, (3) rehearsed using ICM lessons, and then, (4) returned to their respective schools and to teach using ICM approach in the supportive environment in their schools. Joyce and Showers [3] contend that for effective professional development programs, these two phases are very important to equip teachers with a new innovation and ensure its successful and sustainable implementation in their classroom practice.

2. Context of the Study

This study took place in Tanzania, where the Ministry of Education and Vocational Training (MoEVT) took a number of initiatives to improve science education sector through the implementation of the Secondary Education Development Project (SEDP). Phase I (2004-2009) of the project has ended and the second phase (2009-2015) started. Major achievements of the phase I of the SEDP project were reported to be the increase in number of schools, increase in students' enrollment and the reform of the Chemistry syllabuses [4]. To serve this large numbers of students, extra facilities such as new buildings and new schools, teaching and learning resources that complement the new introduced syllabus are needed. Also, teacher preparation in both pre-service and in-service training to have enough and up to date teachers was envisaged. However, current studies [5], [6] and the SEDP review report [4] indicate absence of teaching and learning materials for the newly introduced competence based syllabus, and the large teaching loads that pushes teachers to go to the classrooms unprepared or use less interactive teaching methods. These studies and review reports also, indicate that very few teachers received in-service training. For example, Komba and Nkumbi [5] reported that school administrators including school heads, district officers and school inspectors are the ones who have been trained in this program but classroom teachers are yet to be trained. These entire shortcomings noted call for designing of competence based teaching and learning materials, and the effective in-service training of teachers.

We designed the Integrated Chemistry Modules (ICM) to be used as teaching and learning materials in Advanced level (A-level) schools in Tanzania. The ICM lesson materials were designed using the newly introduced competence based syllabus. The details on the ICM material are given in [7]. The teaching approach using the ICM lessons requires the use of a variety of activities such as videos, animations, power point presentations, classroom demonstrations, and laboratory experiments. Simple technologies such as computers and beamers have to be superimposed on the traditional teaching methods and on other learning resources. The A-level Chemistry teachers in Tanzania have to develop competences such as integrating computers, beamers, and the varieties of learning experiences during the teaching and learning process. Educational changes especially these associated with an overhaul in teachers' pedagogical skills require appropriate *INSET* program [7]. Therefore, for a significant, effective and sustainable change in teachers to occur, the *INSET* program to orient A-level Chemistry teachers has been done for the last 12 months.

 ISBN 978-989-98032-0-6

2. The Design of the *INSET* Program

Based on the Joyce and Showers guidelines for continuous and effective professional development programs described above, an INSET program for A-level Chemistry teachers was developed. The program consisted with two phases in which each phase has a 3-day workshop at KIASTE and one month coaching in their respective schools. Table 1 presents an overview of the 3-day workshop and the coaching program in the two phases of the INSET program in relation to the Joyce and Showers' guidelines.

As presented in Table 1, the focus of the activities in phase I and II are similar. However, in phase II, the activities are much more revised and refined to give teachers effective knowledge and skills. The study has been conducted around the developmental research design which allows the researcher to "learn by doing" which revolve around first designing the program, trying the proposed program (Phase I), modifying it based on formative evaluation results, and retrying it again (Phase II) till perfection is attained.

This design has been chosen because the implementation of the ICM lesson materials to A-level secondary schools in Tanzania seems to be a complex process for a reason that the introduction of the competence based syllabus and the subsequent design of the ICM lessons is a new approach for many teachers in Tanzania. Effective implementation of this innovation in the classroom requires teachers to change their pedagogical orientations and adopt new ways of doing things. According to [1], educational innovation is a complex endeavor because it is related to the change in teachers' belief, introduction of new curriculum materials and a change in teaching approaches. Because of this complex situation, under uncertain circumstances, timely and adequate information is required for the designer to make the right choice in such a dynamic situation. Developmental research design could be an appropriate approach in such a complex situation where the effectiveness of the intervention is unknown beforehand and its success depends on the implementation process within the wide variety of the contexts [8].

Phase	Stage	Main activities	Joyce & Showers Model
I	3-day workshop	1.Introduction to competence based syllabus in Tanzania 2.Introduction in basic skills to use ICM lessons in classrooms 3.Teaching using ICM lessons to facilitators and colleagues	Theory, demonstrations & rehearsing
	Coaching	1.Teaching using ICM lessons in real classrooms	Practicing and Feedback
II	3-day workshop	1. Introduction to competence based syllabus in Tanzania 2.Introduction in basic skills to use ICM lessons in classrooms 3.Teaching using ICM lessons to facilitators and colleagues	Theory, demonstrations & rehearsing
	Coaching	1.Teaching using ICM lessons in real classrooms	Practicing and Feedback

Table 1. *Overview of the INSET program in relation with Joyce and Showers guidelines*

3. The Focus of the Study

This study aimed at getting a better understanding of the INSET arrangements that are conducive for A-level teachers' learning to implement the ICM lessons in science classrooms. According to Guskey [9] the effectiveness of such INSET program for teacher learning should be visible in teachers' classroom practices and in students' learning. The

 ISBN 978-989-98032-0-6

indicators used to determine teachers' learning in this study were: (1) the extent to which teachers gained the ICM lessons after the INSET program (2) the extent to which teachers were able to use the knowledge about ICM lessons learnt during the INSET program in their classroom practices. The impact of the INSET programs on students' learning was not considered in this study since the use of ICM lessons was very new to the participating teachers and hence not yet appropriate to consider.

4. Methods

Respondents

Sixteen chemistry teachers from ten secondary schools located in Kilimanjaro and Arusha region were involved in this study. The teachers teach science subjects including Chemistry in A-level secondary schools in Tanzania. They vary in terms of their teaching qualifications, experiences, and frequencies of INSET attendance as presented in Table 2.
As shown in Table 2, the teachers vary in terms of their teaching experiences as well as the number of the workshops/seminar attended. Teachers had attended very few number of INSET program irrespectively with their teaching experiences. Any efforts to design INSET programs seems to be welcomed by teachers since these programs are very rare in the education sector in Tanzania.

Procedures

The INSET program was started by informing the district education officers and the heads of the involved schools in the meeting held at Arusha Technical College (ATC) in Arusha region. The technologies such as computers, beamers and generators that used in implementation of the ICM lessons were distributed to the involved schools. The INSET program itself had been conducted in two phases namely, phases I and II with 3-days workshop and coaching program in each phase. The 3-days' workshop in phase I of the INSET program was held in October, 2011 followed by the coaching program in Dec, 2011 to Jan, 2012. The 3-days workshop of phase II was conducted in April, 2012 and its successive coaching in May to June, 2012. During each of the 3-day workshops teachers were exposed to the new skills and knowledge about ICM lessons. They were given an opportunity to observe a good practice on how to implement the lessons and then rehearsed teaching using ICM lessons with peer and expert appraisal. All these workshops paved a way for coaching program where teachers implemented the lessons in the classrooms in their respective schools under the guidance of the facilitators (Coach). During the coaching program, two teachers were trained to coach (peer-coaching) and the participating teachers were free to move and visit their colleagues, made the observation to their classroom as they implement ICM lessons. Data collection took place just during and after both the workshops and the coaching program.

Teachers' Code	**Teaching Qualification**	**Teaching Experiences**	**Number of INSET attended**
A1	L'	06	00
B1	B	01	00
B2	L	01	00
C1	B	05	03
C2	B	03	00
D1	B	02	01
E1	B	03	01
F1	B	11	01
G1	B	03	00
G2	B	01	01
G3	B	(4)	00
H1	B	06	01
H2	P	16	02
I1	B	03	01
J1	B	18	00
J2	B	11	00

Table 2. *Teachers' characteristics*. Source: Field data (August, 2012). Key: (1) L'-licenced and VI leaver, L-Licensed having bachelor degree in other field, B-Bachelor in education, (2) Numbers in boxes are in years, the one in brackets are in months.

 ISBN 978-989-98032-0-6

5. Instruments

Interviews

Both informal and formal interviews were conducted to teachers. The interviews to teachers have been conducted to get the views of teachers before, during and at the implementation of the ICM lessons during the 3-days workshops and in coaching program in their respective schools. This assisted the researcher to know what teachers want, how they feel as they progress and how effectively they use the ICM lessons in their classrooms. The purpose of these interviews was to assess the attitudes, opinions, challenges encountered and recommendations of the teachers as well as assessing their ability and competences in using the activities suggested in the ICM lessons. The information from the teachers' interviews was analyzed by the researcher by comparing to each other to consider the appropriateness of teachers' opinions. Then, teachers' opinions were compared to each other in terms of their meanings and gathered, organized, interpreted under certain categories (themes). The voiced statements during the interview were also reported to simplify their interpretation.

Classroom observations

To assess teachers' ability and competences in teaching using the ICM approach, classroom observations were used. This provided the researcher with the first hand information about teachers' practices and attitude change towards the use of the approaches suggested in the ICM lessons. The researcher visited and observed three lessons of the INSET teachers when teaching using ICM lessons. During classroom observations, the researcher was a non-participant observer. In this kind of observation, the researcher sat at the back of the classroom to observe and noted down on the note book every event that is of interest in the study. Also, the observation checklists for teachers had been used by the researcher to award marks to the extent to which six parts of the ICM lessons (introduction, classroom experiment, frontal presentation, students' worksheets, summary and closure, and students' homework) were effectively performed by the participants during the implementation of the lessons. The average scores of each teacher in the three observed lessons will be presented in a table in form of percentages and compared with other teachers during the further analysis of the results.

Retrospective Questionnaires

Retrospective pre-test and post-test questionnaires were administered to the participating teachers after each of the 3-days workshop as well as after the coaching program in each phase of the INSET program. These questionnaires were used to assess the participants' changes in knowledge, skills and competences in using ICM lessons to illustrate the effectiveness of the INSET program. The participants were given the opportunity to learn much about the ICM lessons' approach prior to responding to a questionnaire. According to Rockwell and Kohn [10], when participants are asked to respond to a question about how much they know about a particular subject after they have some basic knowledge of the subject itself, they are more able to accurately reflect on the degree of change in knowledge and attitude. In using the retrospective pre-test post-test questionnaires, the instrument is administered only once unlike the traditional pre-test and post-test. This ensured that respondents use few minutes to complete the questionnaire and all the questionnaires were returned on time without loss or delay. The retrospective pre-test and post-test questionnaires were designed with the instructions at the top and numerous statements. The participants were asked to indicate their level of agreement with each statement before and after having been exposed to the ICM lessons' approach using four points, Likert-type scale after the INSET program. The number of teachers in each item in the scale were counted and represented in a table for further analysis.

5. Results

Knowledge gained by Teachers on ICM lessons

The INSET program aimed at orienting the participants to the conceptual framework of the ICM lessons and its philosophy in order to implement it in their classrooms. The retrospective post and then pre-test questionnaires required teachers to express their agreement after the INSET program and then referred back before the training was distributed to the participants. The total number of the respondents in each item in the Likert-type scale was calculated and presented in Table 3.

Table 3 shows that most of teachers (about 14-15

© 2012 HSci. ISBN 978-989-98032-0-6

out of 16) expressed high (H) and very high (VH) agreement after the INSET program with the facts that the ICM lessons assisted them to implement the introduced competence based syllabus, they can use it, demonstrate it to other teachers, and had understood the conceptual framework the ICM lesson. Also, the table shows that teachers had come to understand that the technologies can simplify their teaching roles and enhance students' learning.

	Agreement of the participants with the following:	Before the INSET program				After the INSET program			
		N	M	H	VH	N	M	H	VH
1	The ICM assists teachers in implementing the introduced competence based syllabus.	15	01	0	0	0	01	04	11
2	The INSET program helps me to understand the philosophy and the conceptual framework of the ICM	15	01	0	0	0	02	08	06
3	I can implement the video, classroom experiments, students' worksheets in my classrooms.	15	01	0	0	0	01	10	05
4	I can demonstrate to other teachers on how to implement the ICM effectively.	15	01	01	0	0	01	12	03
5	The use of computers, beamers and web simplifies teachers' work and enhance students' learning.	12	03	01	0	0	02	04	10

Table 3. *Participants' new knowledge gained.*
Source: Field data (August, 2012)
Key: N-no agreement; M-moderate level of agreement; H-high level of agreement; VH-very high level of agreement.

This was not the case before the INSET program where more that 75% of teachers (about 12-15 teachers) expressed no (N) agreement. This indicated that there were an increase in knowledge and skills among the INSET participants concerning the competence based syllabus, ICM lessons, integrating technology in learning as well as the competences in using and demonstrating the ICM lessons. Data collected from the teacher interviews indicates that there is relatively increase in knowledge and skills for the participating teachers concerning teaching and learning of chemistry using ICM lessons. Most of the participants disclosed that the INSET program was engaging and meaningful as far as their teaching roles are concerned. Some of their comments are:

"I didn't imagine if the ICM lessons can do such an interesting work at the beginning of the program. But look here! I have come to realize that the ICM lessons are the other teacher in the classroom….no more worries about competence based teaching!"

"Let me tell you something! I have 11 years teaching Chemistry in A-level, and I have never taught this topic. I usually consider it very difficult and confusing! But now, I have learnt a lot and I feel I can teach it now with easy".

"Myself, I have 18 years teaching Chemistry! I usually teach this topic but I have come to realize that didn't have enough knowledge about the concepts of wave-particle duality of matter especially on the double slit experiments presented by my colleague in lesson 8. The video and the pre-classroom discussion open up my mind and understand the concept properly".

"I can now connect a computer, a beamer and its accessories move the slides and play the video/animation clip when using power point presentation confidently as well as managing students' discussions and presentations; the thing that I used to consider to be very complicated before the training".

 ISBN 978-989-98032-0-6

All these revelations support the idea that the INSET program increased the knowledge and skills concerning the chemistry contents as presented in the ICM lessons. The INSET program made them possible to understand even the concepts usually troubled them and left them untaught in most schools. They expressed that they had learnt more practical skills in using computers and beamers during teaching process. This indicates that participating teachers learnt some essential practical skills in using the ICM lessons as well as increasing their subject matter competencies. All the information collected through the formal and informal interview of teachers support the fact observed from the retrospective post and pre-test questionnaires that teachers' gained knowledge and skills concerning the introduced competence based syllabus, the implementation of the ICM lessons, and their knowledge concerned the chemistry content were enhanced during the series of the INSET program designed.

Teachers' use of the ICM lessons

The ICM lesson materials had six major parts namely introduction that is supplemented with the introductory video, classroom experiments, teacher frontal presentation guidelines, students' worksheets, summary and closure, and students' homework. Each part was assigned a maximum score of 20 marks each except the last two (summary and closure, and students' homework) where the maximum score were 10 marks for each score. This gives maximum total scores of 100 marks for each lesson taught by a teacher in the study. The extent to which teachers were effective and competent in implementing each of these stages of ICM lessons were awarded by the researcher in each of the three lessons observed and the average scores of each teacher were calculated and presented in table 4. Teachers did relatively well in facilitating the introductory part, summary and closure, and assigning homework to students as suggested in the ICM lessons. At the introduction stage, teachers were really interested at the videos and so the students. Most of them prepared well in this part by viewing the video or animation clips to the extent that they became competent in engaging students to exploit the educative part of it. The summary and closure, and homework were straight forward and most of the teachers succeeded well to present it as suggested in the ICM lessons. Most of them read the summary and closure using the power point slides and they do prepare the students' home work in form of a print which was made available to students.

Table 4 indicates teachers vary in the competences during the implementation of ICM lessons. Generally, most of the teachers got average (50's), some got it above average (60's), and some others scored below average (40's). For example four teachers (A1, C1, D1, and J1) managed to score above average, five teachers (C2, F1, G1, G2, and G3) got below average, and the rest (about seven teachers) scored average in implementing ICM lessons. Most teachers (about nine of them) facilitate well (got 12 to 15 points out of 20) the introductory part that consisted with the brainstorming and the video/animation clip. The nature of the variation was similar in facilitating the summary and assigning students' homework, where most of the teachers scored highly (6 to 7 points out of 10). Different trend was evident during the classroom experiments, frontal presentation, and in managing students' worksheets. In these activities most of the teachers got average. The activities required teachers to demonstrate their pedagogical and content knowledge where most of the teachers experienced some difficulties. Generally the scores for the majority of teachers are not impressive, but when one considers the fact that the use of ICM lessons and its philosophy were new for most teachers involve in the INSET program, the average scores could be considered acceptable.

The further analysis of the notes taken during the classroom observations concerning the way teachers use the ICM lessons during the teaching and learning process supports the scores presented in Table 4. For example, the lessons for teacher A1, B1, C1, D1 and J1, who had relatively above average scores, were very motivating and interactive. These teachers succeeded to encourage students to learn from the video presented rather that considering it as a fun or entertainment. Most of the time when they invited students to view the video or animation clip insists them to watch carefully and be able to answer the list of questions suggested in the ICM lessons. After the video or animation clip, some of them and specifically teacher C1 from school C asked students, *"Have you entertained with the video?"* and the students answered in chorus, *"No, we had learnt"* Such questioning reminds and motivate students to be curious to learn when watching the video or animation clips.

 ISBN 978-989-98032-0-6

	Teachers' code															
	A1	B1	B2	C1	C2	D1	E1	F1	G1	G2	G3	H1	H2	I1	J1	J2
I	15	12	11	14	09	13	12	10	11	09	10	13	12	10	12	12
C	10	11	10	12	08	10	10	09	09	08	08	09	10	10	13	10
F	10	12	10	12	08	11	11	08	09	08	10	09	11	10	13	10
W	11	10	10	12	08	12	11	10	09	08	09	10	11	10	12	10
S	07	07	06	06	05	07	06	06	06	05	06	05	07	06	06	05
H	07	06	06	07	04	07	06	05	05	05	05	06	06	06	06	05
	60	**58**	**53**	**63**	**42**	**60**	**56**	**48**	**49**	**43**	**48**	**52**	**57**	**52**	**62**	**52**

Table 4. *The ave*rage scores by teachers expressed in percentage of the maximum scores. Source: Field data (August, 2012). Key: 1. I-Introduction, C-Classroom experiments, F-Teachers' frontal presentations, W-Students' worksheets, S-Summary and Closure, H-Homework

The teachers managed well the students' classroom experiments, motivate students to participate actively during the discussions and presentations, and moved around to provide guidance and assistance to students working in groups. The teachers also mastered well the subject content and had some books for making references. The teachers were ready and very free to visit and observe other teachers implementing the ICM lessons. The teachers were very cooperative and most of them liked the idea of being visited by the coach or other colleagues while teaching the ICM lessons in the classrooms. On the other hand the notes from the classroom observation indicated that teacher C2 and G2 were teaching other subjects or other classrooms apart from A-level chemistry. For example teacher C2 was teaching Chemistry form V, III and IV while teacher G2 was teaching Chemistry and Physics in form V. As the result they had a big teaching load and therefore they claimed to lack enough time to make some lesson preparations and practicing ICM lessons.

The data from the classroom observations also indicated that the majority of teachers who scored average or below average, lack subject competence in some of the lessons. This had been noted especially in general chemistry where some of these teachers skipped some lessons for the reasons that they don't know the concepts in it. Some of these lessons include the Atomic models, Atomic orbital, Electronic configuration and Wave particle duality of matter. Some teachers said that without this training they would retire their job without teaching these concepts. This supports the fact that some of the teachers lacked subject content competences and therefore difficult for them to facilitate classroom experiments, frontal presentation and managing students' worksheets that required them to be well informed about the concepts in the lessons.

7. Discussion

The study started with the assumption that teachers needed to learn how to adequately integrate new innovations, in this case ICM lessons. By using Joyce and Showers guideline [3], the INSET program for A-level Chemistry teachers was developed in Tanzania in which ICM lessons designed using the newly introduced competence based syllabus was a main component. In this study, we investigated to what extent teachers were able to apply what were learned during the INSET program using two teacher learning indicators: (1) teachers' gained knowledge and skills about ICM lessons during the INSET program and; (2) teachers' use of the new ICM lessons in their classroom teaching and learning process. Since the approach of teaching using the ICM lessons was new to the teachers in the study, the sixteen teachers demonstrated an acceptable level of using the ICM lessons in their classrooms. The teachers found it relatively easy to facilitate the introductory part that covers the brainstorming video/animation demonstrations, summary and closure, and the students' homework part of the ICM lessons. However, they experienced frontal presentation, classroom experiments and students' worksheets as relatively more difficult. Teachers seemed to lack important subject competence that would enable them to present the concepts of the lessons confidently, managed students' problems during performing demonstrations and in questioning students to probe and their inquisitive minds during students' worksheets. The findings illuminate that teachers need to be assisted in creating a nice environment such as provision of books and other teaching facilities like laboratory reagents and equipment to enable them to improve their knowledge in the subject content [6] Having these environment teachers will be able to implement effectively and in a sustainable way the ICM lessons in their teaching and learning process. The study demonstrated that teachers' are very inquisitive in learning more on how to use computers, beamers and other technologies using the ICM lessons in their daily classroom practice. Based on the indicators for teacher learning that were used in this study, we can conclude that the INSET program had impacted teachers ability to implement competence based education using ICM lessons, that was not yet part of their daily practice. A number of factors accounted for the impact of the INSET program: (1) the meeting of ICM experts and the education stakeholders, (2) the 3-days workshops and the successive expert and peer coaching program established, (4) The ICM materials and the technologies to implement the lessons such as computers, beamers, speakers and generators distributed to the schools under study enabled teachers to built confidence and competences in practicing ICM lessons, (5) the fact that the facilitators of the INSET were the chemistry experts and the developer of the ICM lessons, (6) the safe environment that was created for teachers in which they could benefit from peer-teaching through classroom observations and reflective discussion about their teaching and learning process. In this way, strong links were made to tie the personal teacher learning and the classroom context that is important for changing beliefs and practices.

8. Acknowledgement

The authors acknowledge the financial support of the Government of Switzerland through EPFL-SDC Fund. We would like also to extend our appreciations to the district education officers, heads of the schools, and the teachers from Kilimanjaro and Arusha for their time during the study.

References

[1] Fullan, M. (2001). *The meaning of educational change.* Toronto: OISE Press.

[2] O-Saki, K.M. (2007). Science and mathematics teacher preparation in Tanzania: Lessons from teacher improvement projects in Tanzania 1965-2006. *NUE Journal of International Education Cooperation, 2 (1), 51-64.*

[3] Joyce, B. & Showers, B. (2002). *Student achievement through staff development.* London: Longman.

[4] Ministry of Education and Vocational Training (MoEVT). (2010). *Education sector development program: Secondary education development program II 2010-2015*. Dar es Salaam: MoEVT.

[5] Komba, W. L., & Nkumbi, E. (2008). Teacher professional development in Tanzania: Perceptions and practices. *CICE Hiroshima University, Journal of International Cooperation in Education, 11 (3), 67-83.*

[6] Gabrieli, P. (2010). *Investigations on interaction of teachers and students of diverse learning styles during science teaching and learning in secondary schools in Tanzania.* Unpublished Masters of Science Education, University of Dar es Salaam-Tanzania.

[7] Francis, W., Mtabazi, S. G., Gabrieli, P., O-Saki, K.M., & Setter, N. (2012). *Introduction of Integrated Chemistry Modules (ICM) at Advanced Secondary Level: Lessons from Three Years Class-room Experience in Tanzania.* The paper

presented at HSci Conference, Turkey 16th -22nd Oct, 2012 and published in the present proceedings.
[8] Van den Akker, J. (2007). Curriculum design Research. In Plomp, J., & Nieveen, N. (Eds). *An Introduction to Educational Design Research pg. 37-50*. Netherland Institute for Curriculum Development: Netherland.
[9] Guskey, T. R. (2000). *Evaluating professional development.* California: Corwin Press.
[10] Rockwell, S. K., & Kohn, H. (1989). Post-then-pre evaluation. *Journal of Extension* [On-line]. 27(2). Available at: http://www.joe.org/joe/1989summer/a5.html. Retrieved on 10th April 2012.

FROM CONTENT-BASED INTO COMPETENCE-BASED APPROACH IN SCIENCE EDUCATION IN EAST-AFRICA

K.M. O-Saki
School of Curriculum & Teacher Education, University of Dodoma, Dodoma, Tanzania
kalafunja@gmail.com

Abstract. *In training of future scientists, the movement from a behaviorist approach towards a constructivist model influenced educators the world over. The main focus in recent years has been to ensure that learners develop scientific concepts from the scientific cultural contextual experience and build cognitive, psychomotor and affective competencies in the process. In East Africa this movement is taking shape slowly in Kenya, Uganda, Tanzania and Rwanda by curriculum revisions that re-focus students to develop basic competencies as they study various science topics. The earlier reforms, through projects such as School Science project, African Primary Science program and School Mathematics project had some impact but their focus on open inquiry were not very successful in building the competencies needed in a modern science, technology, engineering and medical research and have later made teachers to revert to a heavy content based and chalk and talk approach.*
We recently developed materials following a competency-based approach, which develop learner thinking from every day experiences and using class tasks, video materials and laboratory tasks. We shall trace past reforms and curriculum projects and describe the notion of competency embedded in our designed curriculum materials focusing on chemistry, which have been tested in several schools. We shall reflect on the implications of the competency approach to advanced level science education in East Africa and the challenges of scaling up this approach.

Keywords: Curriculum development, Professional development, Science competencies.

1. Introduction

This is a discourse about the journey of a region in providing science education experience to its people and in producing the required human resource to run the scientific activities for a period of fifty years. In a survey of an educational experiment of a developing country, it is not so easy to find a role model that one was expected to follow, or a prescribed strategic plan that was being followed and which now can be formally evaluated against its original objectives. Overstretching such a discourse may be unfair if one concentrates on what went wrong or right because either way one may overstate or understate what may have been done with good intentions but produced poor results, or without proper planning but somehow by luck produced good results. In this paper we shall attempt to focus on what was done in the region and its contribution to the state of affairs now and the challenges for the future.
Education in science is training in the acquisition of the skill and competency of reasoning and testing of truth generation and determination; so that one can continue using this skill to generate more truths, test claimed truths, and verify or reject them. Analysis of the education systems of all nations that have made serious economic progress indicates that first and foremost they developed a good approach to impart scientific method in its schools and encouraged a large number of its people to study science, technology and engineering and medicine (STEM). These people will determine truths about the weather and climate, the biosphere, the physical resources, and appropriate technologies needed in medicine, engineering, communication and so forth which are essential for development. If you have few or no trained people, or you have poorly trained ones, you must depend on other nations, just like a man owning a cow but cannot slaughter will have to request for help from a neighbor. As the neighbor slaughters, he might cut the best pieces and keep them aside for himself.

© 2012 HSci. ISBN 978-989-98032-0-6

2. Background

The context of competency in science education in East Africa

The state of science education in East Africa after independence is described in Cameron and Dodd [1] in very simple terms. African primary schools did general science which was designed following the Education for Adaptation proposal recommended by the Phelps –Stokes Commission for British colonies in Africa. In this arrangement, science was vocationalised and included a bit of theoretical knowledge but a lot more hands-on work in the gardens, carpentry, agriculture, sewing and cookery, so that it could prepare the youth for work in their African village environment. On entry into secondary school, science became more academic and was split into physics, chemistry, and biology and health science. After independence the curriculum remained the same but African children started attending secondary schools originally designed for Europeans and Asians. By 1967 it was found that given the racially segregated curricula running, there was need to overhaul the education system and curricula.

Education for Self Reliance

The framework for this overhaul was prescribed from the document *Education for Self Reliance* for all subjects and at all levels. The *Education for Self Reliance* (ESR) Policy document re-defined the purpose of education in the country. According to ESR, the purpose of education was to develop learners who had:

An enquiring mind; The skill to learn from others and to make relevant judgment on what to adopt or adapt from them; Ability to think critically and Good confidence and mental liberation (ESR Document [1])

These looked like broad goals which could have been refined into competencies but, as Komba (2006) [2] notes, this was not done systematically, leading to a failure to achieve most goals of ESR.

At that time, curriculum planners based at the Tanzania Institute of Education adopted science and mathematics curricula imported from abroad (developed in US and UK after the Sputnik challenge by the Soviet Union) and thought they would promote inquiry mind and critical thinking. Three curriculum packages selected included:

- *The African Primary Science Project* (later named Science Education program for Africa- SEPA) this developed materials for primary schools which focused on promoting thinking which was imported from the US where it was designed for Black Americans. In Africa this was adapted into a form called: "Thinking Science: Ask the Antlion" because it was based on an investigative study of the behavior of the *ant lion*. In Tanzania it was translated into the Kiswahili form: *Elimu ya Kufikiri: Mwulize Fukufuku.* (*Thinking Science: Ask the ant lion*).
- *The School Science Project (SSP)* This project, with books for physics, chemistry and biology and tried in secondary schools in Kenya, Uganda, and Tanzania, were adapted from Nuffield Science materials developed in the UK and were introduced from around 1968. Selected school teachers were trained to rewrite and adapt the Nuffield and SMP into a suitable form called the School Science Project (SSP) which covered Physics, Chemistry and Biology, training students to conduct nature observation, learn to write up experimental findings, and record and organize data.
- *School Mathematics Project (SMP)* for East Africa was also an activity based mathematics curriculum similar to the SSP and it gave students opportunities to prove theorems such as Pythagoras, the equations of the circle, etc. practically (See Kitta, 2004 [3]). Shayer (1982) [4] has criticized Nuffield materials for being too difficult for majority of students. So were the SSP, SMP and Entebbe Mathematics which were designed in a similar form.

3. Challenges of the Inquiry sciences of the 1970s

Though exciting for learners, these programs faced three main challenges as schools were expanded and student populations increased:

First, they were based on expensive laboratory equipment which could not be replaced after the UNESCO support ended and the economy could not support it. Second, most expatriate secondary school science teachers resigned from the schools as their contracts expired and the local teachers were appointed into government and parastatal managerial positions which had better pay. Third, around 1972, when Cambridge

Overseas School Certificate Exams Board were examining in most of Africa, there was lack of communication between the school managers and the Cambridge Examination Board on the exam requirements of the SSP, SMP and Entebbe Maths curricula then on trial in some schools. A traditional examination then was set for the students who had followed these curricula on trial for the four years, leading to their failure because it demanded knowledge of facts rather than processes. The poor performance of the students doing the experimental SSP and SMP curricula in comparison to the control group was interpreted as a weakness of the Inquiry curricula, through in fact, they had been given the `wrong` examination. A pressure group of conservative parents and others forced the closure of the SSP trial in mid 1970s. The Institutes of Education in Kenya, Uganda and Tanzania, therefore, abandoned the emphasis on Inquiry science, and continued to write textbooks that focused more on remembering facts and formulae instead of experimental and reasoning competencies and skills. A survey conducted in mid 1990s (Chonjo et al, 1995) [5] found that science and maths teaching had seriously deteriorated and reduced to copying and memorization for examinations. Practical work had virtually been stopped and an 'alternative to practical examination' introduced since the mid 1980s. The introduction of the alternative to practical examination was interpreted by most teachers to mean that there was no need for practical work and that it was possible to do a `theoretical practical exam` and hence teach the same way (See Knamiller et al, 1995 [6], Kibga, 2004 [7]).

Re-orienting teachers

The introduction of new ideas in the curriculum brought challenges in the school system due to lack of strategies to reorient teachers to address these new concepts, aimed at developing key competencies, such as:

- *Life skills curricula.* For some, life skills include environmental skills, personal health skills, job creation skills, social & community skills family skills, technology use skills etc all of which need some form of science and maths education (O-Saki, 2004 [8]). However most teachers only know to impart traditional knowledge of solving differential educations, using the microscope or the computer without linking these skills to life and the workplace.
- *Competency based curricula* have also introduced an unclear image of the objectives of science education. Some educators have been asking: are competencies the same things as life skills, or are there separate cognitive, psychomotor or value skills, and in what balance? This confusion (See Mafumiko & Tilya, 2010 [9]) means that schools are each interpreting the intended curriculum in their own way and since no serious training program exists, each in service trainer of teachers moves in his / her own direction. This may be a major source of further confusion. To address this state of affairs, we now have a project [ENSCIENCE] that tries to define competencies in classroom terms and develop activities that can promote and test those competencies.

Pre-service teacher education

In terms of teacher training, the introduction of the SSP, SMP and Entebbe Maths was accompanied by the intensive training introduced at the University of East Africa in 1968, funded by UNESCO. This was a three-year undergraduate training program which led to the award of the B.Sc with education degree and thereafter the graduates went directly into the schools. A parallel Bachelor of Education program also existed, with students majoring in one teaching subject and more courses in educational psychology, management etc. In 1990, in the TEAMS project (Teacher Education Assistance in Mathematics and Science) it was decided that the three year programs were too short to produce an effective teacher. They were revised and elongated to four years. The B.Ed students did more optional subjects in the fourth year while the B.Sc (ed) students did extra courses in their academic subjects to prepare for better teaching at advanced level. The TEAMS project also designed In Service Education and Training courses and a postgraduate program to develop capacity in science & maths curriculum development and research and introduced new pedagogy courses in year 4 to improve competency of teachers in the classroom (O-Saki, et al. 2004 [8], Ottevanger et al, 2005 [10]).

© 2012 HSci. ISBN 978-989-98032-0-6

4. Other projects addressing science and maths education

Three other projects were developed from 1995-2008 in the region to improve science competencies (O-Saki, 2007 [11]), including: The *Science Education in Secondary Schools* (SESS) (1996-2004) Education II projects (2001-2008) and the National In-service program (2007-2014) running in government schools in Tanzania and which was later mainstreamed in the Ministry of Education. The *Science Teacher Improvement Project* [STIP] which focused on a "starter experiment approach' and concentrated in church schools and SMASSE which operates until today in Kenya, Tanzania, Ethiopia and other countries in Africa, managed from Nairobi and funded by JICA. Currently the University of Dodoma, in collaboration with the Swiss Federal Institute of Technology and Weismann Institute of Science are testing a new curriculum initiative for A level chemistry named ENSCIENCE (William, 2012. forthcoming) Other members of this panel are discussing more about the ENSCIENCE project.

5. Challenges of running a competency based science program

The shortage of laboratories

Table 1 shows the state of laboratories in schools in Tanzania during 2010. A similar situation exists throughout East Africa. Laboratories are an essential resource if one wishes to promote practical competencies of handling apparatus to test hypotheses or verify claims. However when schools have no labs and the ministry of education blesses the practice, we can have serious consequences on scientific literacy of the graduates. Hodson, (1996) [12] notes that laboratory practical work enhances the eight aspects of science attitudes namely curiosity, open mindedness, objectivity, intellectual honesty, rationality, willingness to suspend judgment, humility and relevance to life. Although some systems administer an *alternative to practical examination*, the existence of the exam does not make laboratory practical work optional; only the examination can be optional because of the cost and management difficulties. In a situation when the cost of doing practical examination was high, an *Alternative to Practical Examination* was introduced in the Tanzanian science subjects. Most schools subsequently stopped doing practical work which were interpreted as `no need to practical work` because there is no practical examination (Kibga, 2004 [7]). This trend seriously watered down the science experience students got from the schools and as they went higher weakened the competencies associated with practical work.

Category	Total No. of Government Secondary Schools	Schools with Labs	Status of Labs in Schools		
			Good Condition	Need Rehabilitation.	Shortage
National Gov. Schools	88	88	-	88	-
Community Schools	3337	639	36	603	2698
TOTAL	3425	727	36	691	2698
Percentage	100%	21.2%	1.1%	20.2%	78.8%

Table 1. *Status of Laboratories in Public Secondary Schools in Tanzania in 2010. Source: MoEVT, Department of Secondary Education, December 2010*

Secondary Education Development program 2005-2010

In 2004 the Ministry of Education and Culture had launched the Secondary Education Development program, which involved a large expansion of the secondary sector to take in more students. As Ottevanger et al (2005) and the Education Minister's annual report (Tanzania, 2006) indicate, since January 2005 to-date the secondary school intake has more than quadrupled and hence the science pedagogy courses designed by TEAMS are of crucial importance in producing teachers and advisers for the system, although they have since been weakened. The demand for secondary school teachers has also more than quadrupled and the governments have taken the following measures to ensure that the system functions effectively:

- Increased the capacity of Universities to admit more undergraduates into the teaching degree programs. This has been done in Uganda, Kenya, Rwanda and Tanzania where both normal and evening classes are running in both undergraduate and graduate courses with large enrollments.
- The four year university degree programme at the UDSM was reduced to three years *under instruction* from the Ministry of Education from 2005. In Kenya the two year 'A' level program was abolished in the 1990s and undergraduate education raised to 4 years. There has been an impact on the quality of teachers overall (since practical's are not held, science lecturers are inexperienced, scientific method is not inculcated through practice) but the government seems less concerned with this at the moment.
- There is also a teaching diploma programme offered in Teachers' Colleges run by the Ministries of Education, which admits in the lesser qualified advanced secondary graduates, offers them a two- year diploma program, and these are posted to schools to teach junior secondary schools up to 'O' Level. Efforts are now under way to accredit these diplomas by university based faculties.
- Finally the Tanzania Ministry of Education also launched in 2005, a 'crash' training program for Advanced level finalists who prefer to join teaching immediately after completing form 6. This 'Induction Program' was run for one month from 2004-2010 and has produced over 10,000 'teachers' in 4 years but their quality is poor due to the program being too short and inadequately prepared. This program has since been terminated and its trainees have moved to upgrade to diploma and degree status (O-Saki, 2007 [13]).

6. Current status in schools

The Gender dimension

Table 2 shows gender difference in performance in science subjects in O level exams. Here the performance is bad for all and worse for girls. Fig. 1 shows performance in science subjects specifically for a period of 10 years in Tanzania in the O level examination. Note the low pass rates in these subjects hence reducing the numbers that qualify to join higher and tertiary science, technology and engineering (STEM) programs. An upturn appeared from 2010 as indicated in Fig. 2 below.

It is to be noted from Table 2 that performance seems to be improving in the science subjects, especially physics, chemistry and mathematics compared to previous year. There is need to reflect on the source of this `improvement`. One thing that comes to mind is the effort put in professional development of teachers to teach science more effectively. The past projects of SESS, TEAMS, STIP, Education II, SMASSE ZSEP, and the ongoing National Science INSET program may be producing fruits.

The review of the science teacher education programs at university level (TEAMS experiment) pioneered by the TEAMS project at UDSM has had an effect (Ottevanger, 2005). However, the revised program is not what is now running and may have been much diluted. A more rigorous tracer study is needed to verify this. We await the products of these students to university and do hope they will bring enthusiasm into the science programs again. However, for science to produce the researchers and practitioners that will feed our science education institutions, and research centers, we need to return to a science education that addresses the basics emphasized by the Nobel Laureate Harry Krotto [14]: maximum development of observation skills and use of the senses, ability to make predictions and design experiments based on learners predictions and development of skills of experimentation, correct use of instruments and reasoning with the data collected. This is the only way to assist our young people to arrive at the truth about our resources, our problems, and our needs; and to design technologies that can solve the problems we face. We should be able to develop a caliber of people that can turn East Africa into the middle level income country described in Visions 2025/2030 like the South East Asian *tigers* did during the last 40 years.

Year	2004		2005		2006		2007		2008		Total	
Sex	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys
%passed	8.58	21.29	6.72	16.73	23.45	37.69	15.73	28.94	16.1	30.99	**18.2**	**32.4**
% failed	80.02	78.71	93.28	83.27	76.55	67.31	84.27	71.06	83.9	69.01	**81.85**	**67.63**

Table 2. *Tanzania CSEE exam results in Maths from 2005-2008, disaggregated along gender*

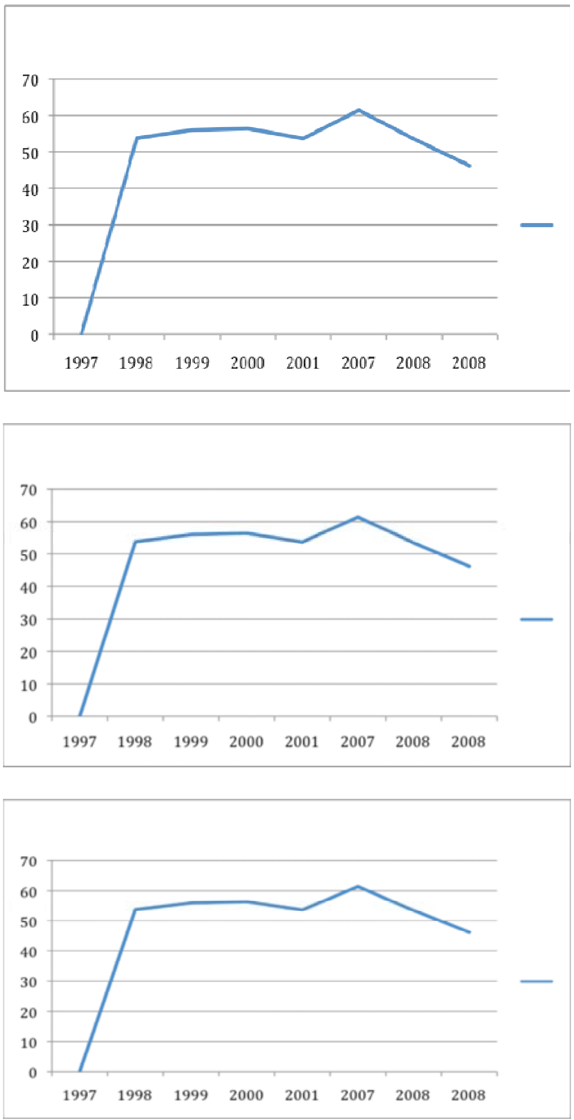


Figure 1. *Percentage failure rates for biology (top), chemistry and physics (bottom) at ordinary level in NECTA exams, 1997-2008*

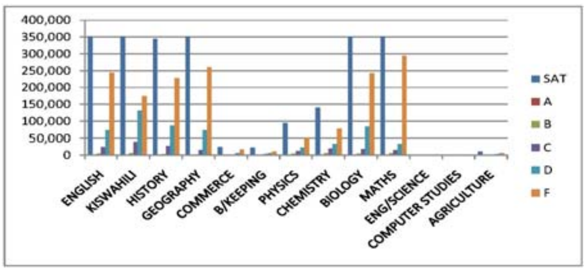


Figure 2. *Performance in CSEE: 2010*

7. Major issues and challenges

The following issues now face STEM education in the next fifty years:

- How can the region retain the best scientists in the business of science and technology education? We have lost many scientists into

 ISBN 978-989-98032-0-6

better paying jobs such as administration (of non science departments); politics and government `business`, better pastures outside East Africa, but still working in universities, business etc. How can we attract these back to assist in inspiring a future science education group of future leaders?

- How can the region attract young people to stay on studying science after O level? Many young people nowadays do not want to do science even if they have passed science subjects well.
- What type of curriculum can be more user friendly, diversified and recognize that learners vary a great deal and that a difficult curriculum for all is not going to attract those with little interest in science;
- What better teacher training and professional development can be developed for those involved in teaching at all levels;
- How can a more rigorous assessment system that encourages critical thinking and scientific reasoning than remembering and copying be evolved in the education system as a whole?
- What types of teaching strategies can encourage active participation and self discovery, and what research is needed to evolve and develop those strategies?
- What strategies do we need to forge closer link between learning and doing/working?
- How can our rulers be convinced to increase budgetary allocation to science and technology education and research? These are some of the questions we feel should guide a debate on the future of STEM education in order to improve competitiveness and abolish poverty.

8. Acknowledgement

We wish to acknowledge the financial support from the Government of Switzerland through the EPFL-SDC support.

9. References

[1] Nyerere, J. K. (1967). Education for Self Reliance. Dar es Salaam: Government Publishers.

[2] Komba, D. (2006). Reflections on Mwalimu Nyerere's Philosophy of Education for Self Reliance. A paper read at the International Seminar to Commemorate the 7th Anniversary of Mwalimu Nyerere. Dar es Salaam. Faculty of Education. University of Dar es Salaam.

[3] Kitta, S. (2004). Enhancing mathematics teachers' pedagogical knowledge and skills in Tanzania. PhD thesis. The Netherlands,University of Twente.

[4] Shayer, M (1972). Conceptual demands in the Nuffield 'O' Level physics course. School Science Review, # 54, 26-34

[5] Chonjo, P. N, O-Saki, K. M, Possi, M., & Mrutu, M. (1995). Science Education in Secondary Schools.Situational Analysis. Dar es Salaam: Ministry of Education and Culture & GTZ.

[6] Knamiller, G., O-Saki, K. M, with Kuonga, H. (1995). Tanzania teachers' understanding of the science embedded in traditional technologies: A study to inform teacher education. Research in Science and Technological Education, 13(1) 67-76.

[7] Kibga E (2004). The role of practical assessment in teaching and learning of 'O' level physics in Tanzania. MEd Dissertation, University of Dar es Salaam.

[8] O-Saki, K.M., Hosea, K., & Ottevanger, W. (2004). Reforming science and mathematics education in Tanzania: Obstacles and opportunities. Dar es Salaam: TEAMS project.

[9] Mafumiko, FM & Tilya, F (2010). The compatibility between teaching methods and the Competency based curriculum in Tanzania. In Papers in Education and Development # 29, 37-56

[10] Ottevanger, W.J.W., Feiter, L., O-Saki, K.M., & van de Akker, J. (2005). The TEAMS project in Tanzania: From intervention to capacity building, Journal of International Co-operation in Education, 8(1), 111-128.

[11] O-Saki, K. M (2007a). Science Teacher Education in Tanzania: The changing content and form of science teaching and teacher education. In: Richard Coll and Neil Taylor (eds) (2007). Science Education in Context. An international Examination of the influence of context on science curriculum development and implementation. Rotterdam & Taipei. Sense Publishers.

[12] Hodson, D (1996) Practical work in School science: Exploring some directions for change: International Journal of Science Education: Vol 16, pgs 755-760.

[13] O-Saki, K. M (2007b). Science and Mathematics teacher preparation in Tanzania: 1966-2006: Lessons from teacher improvement projects in Tanzania, 1965-2006. In: International Journal of Education, Naruto University, Japan. Vol 2, 51-64.

[14] Krotto, H., Why science education is an ethical issue; The Independent newspaper, (UK) 12 May, 2011

WOMEN, SCIENCE AND ENTREPRENEURSHIP. HOW THE ACADEMY CAN (OR NOT) CHANGE THEIR LIVES?

A.P. Marques, H.R. Moreira
Instituto de Ciências Sociais, Universidade do Minho, 4710-057 Braga, Portugal
amarques@ics.uminho.pt,
rmoreira@ics.uminho.pt

Abstract. *Entrepreneurship brings new and important challenges to the University that are related to their ability to develop an entrepreneurial mindset and entrepreneurial culture and innovation. In turn, the profile of the graduate in Portugal is mainly female in many areas of knowledge. However, according to a recent study on promotion of innovative women and entrepreneurship, one of the main obstacles that explains the lower participation of women in entrepreneurial activities of innovative nature are related to educational choices pursued in the formal education system, perspectives and traditional stereotypes about women, science and innovation. It is our goal to discuss how the academy can (or not) change the life of graduates considering the fact that social capital remains crucial in the choice of innovative sectors and of intensive knowledge for starting-up a business, and that women's options continue to remain anchored in the traditional sexual division of labor.*

Keywords: Entrepreneurial potential, Higher education, Social and sexual division of the labor market, Gender.

1. Introduction

The promotion of skilled female entrepreneurship policies, despite its economic and social relevance, is in an early stage of development in most of European States members. In terms of public policies in economic and business, promoting female entrepreneurship emerges as a factor of mobilization of women for active economic life, as well as a strategy to support business initiatives, particularly as factor conducive to the promotion of equality between men and women. According to a recent study on the promotion of innovative women and entrepreneurship [1], one of the main obstacles that explains the lower participation of women in entrepreneurial activities of an innovative nature are related to educational choices pursued in formal education systems and persistency of traditional stereotypes about women, science and innovation. Also, in comparison to men, women not only possess a lack positive attitude about their own personal capacities or inclinations for starting businesses, but also have less personal contact with entrepreneurs [2].

In Portugal, the situation doesn't present itself different. In fact, the main indicators available in the Operational Program for Human Potential (POPH 2017-2013) show an insufficient and unequal participation of women compared to men in the industries of high and medium high-tech, knowledge-intensive services and science and technology. Furthermore, the evolution of graduates in Portuguese universities in recent years reveals the growing demand for higher qualification on the part of women in specific scientific areas, namely, for instance, education, art, humanities, social sciences, law and health care. Moreover, since the 1990's, graduates and postgraduates have been facing major changes in the transition from university to the labor market and also in employability profiles, particularly female graduates [3].

This means that entrepreneurship brings new and important challenges to the University related to its capacity, together with other collective institutional actors (e.g. economic, social and political), to develop an entrepreneurial mindset and a culture of innovation in order to change the pattern of productive Portuguese specialization. Plus, entrepreneurship as an alternative professional career for young graduates could be an important way of facing current difficulties related to the access to the labor market as well as protecting against the (risk of) unemployment, especially for those seeking employment, or even for those who are in a vulnerable situation of potential exclusion from the labor market (e.g. females, young or older workers).

Current debates about the feminization of higher education and the modalities of flexible specialization and a productive economy have sustained the recurrence of "male imperialism" in

© 2012 HSci. ISBN 978-989-98032-0-6

domains linked to top technologies and innovating sectors and based on 'desirable' attributes such as income, prestige and job stability [4]. Therefore, facing a predominantly female graduate profile in many areas of knowledge of higher education, it is important to analyze the relationship between entrepreneurial characteristics, academic, social and cultural backgrounds, bearing in mind that the arrangements for access to employment, the development of a career and cultural patterns associated with organizations are still strongly dominated by a patriarchal and male rationality [5, 6].

In this paper, we make use of some empirical evidence focused on women, science and entrepreneurship in the scope of the ongoing project "*Potential for entrepreneurship at the University of Minho*. *Careers after higher education*" (2010-2012)[1] in which it was intended, firstly, to address the shortcomings of existing empirical studies on the topic of entrepreneurship, through a research of the entrepreneurial potentials of higher education graduates; and secondly, to understand the important role of higher education in developing knowledge and skills that influence the manner in which they shape the processes of professional transition.

The methodological design combined both quantitative and qualitative approaches. In the first methodological stage, an online survey was applied to a universe of 1,419 graduates from the University of Minho (North of Portugal), who terminated their course between 2002 and 2008. These graduates are from 43 courses that were grouped into six scientific areas, according to the Portuguese National Classification of Education and Training Areas (2008) as: "Education", "Humanities", "Social Sciences and Law", "Science and Computing", "Engineering" and "Health and social care". The obtained sample resulted in a 20% share quota, totaling 283 valid surveys. In the second methodological stage, in-depth interviews of the graduates who participated in the first stage of this research, especially those with "high entrepreneurial potential" (in total 8 interviews) took place.

It is our goal to discuss how the academy can (or not) change the life of graduates considering the fact that social capital remains crucial in the choice of innovative sectors and of intensive knowledge for starting-up a business, and that women's options continue to remain anchored in the traditional sexual division of labor. Specifically, we intend to analyze the contribution of both social capital and gender variables for the explanation of different perceptions and experiences in relation to employment and entrepreneurship.

In fact, to some extent, empirical results indicate that the intention of becoming an entrepreneur varies according to several factors, mainly by the sex of the graduates. Also, gender differences provide insight into how unequal they stand in relation to entrepreneurship, in particular on aspects such as the propensity for entrepreneurship, enterprising, the activity sectors and motivations for self-employment, among others.

This paper is organized in three main parts. In the first, we point out significant changes in the (re) configuration of higher education and in the professional transition process emphasizing the role of entrepreneurship education. In the second, the exploration of substantial information allows us to characterize the socio-graphical profile of graduates, including their main motivations and preferred sectors for an entrepreneur activity. In the third, we present the structure of disposition for entrepreneurial activity by graduate's profile perceptions in order to highlight two main portraits.

2. Entrepreneurship and transition to work

Entrepreneurship education and transition to work are central whether in the context of transnational processes of human resource qualifications and job creation whether in the framework of a de-regulation of wage relationships and the increasing rates of sub-employment and unemployment.

The expansion of higher education and the gradual increase of graduates have been followed by empirical evidence that points to the possibility of obtaining a qualified job linked to higher instruction levels. We may presume that many of these young workers in the beginning of a career and holders of high academic qualifications, base their professional performances on autonomy and creativity, and that they also hold high organizational and

[1] It is a study on the theme of entrepreneurial potentials among young graduates at the University of Minho (North of Portugal), developed by Spin-off Laboratory MeIntegra and CICS/UM (Research Centre for the Social Sciences, University of Minho). More information about the MeIntegra Lab in the website: http://www.meintegra.ics.uminho.pt/.

© 2012 HSci. ISBN 978-989-98032-0-6

professionals expectations, particularly in highly competitive and innovative sectors.
However, access to the labor market does not present itself as being uniform and stable to most young adults. Research on academic and labor markets tends to focus on both the persistency of gender segregation and on social inequalities in access to employment and career. As many research publications on socialization show, particularly those focused on family and school, young women have made and continue to make “bad” choices concerning degrees and/ or specialization courses, with obvious impacts on their employment [7]. Indeed, the largest and best academic qualifications attained by women have not reflected improvements in their participation in the job market, continuing to maintain horizontal and vertical segregation, particularly reflecting negatively, the access to managerial positions and equal remuneration. There are a huge proportion of females in humanities and social sciences, which clearly explains the strong link between gender and professional activities, closer to the traditional definition of feminine tasks (e.g. administrative staff, public relations, marketing, teaching, health care). Such choices have therefore led to the exclusion of women from positions of authority and responsibility in domains such as economics, finance and politics, or linked to top technologies and innovating sectors with economic and symbolic prestige
In fact, the majority of European countries have already pointed out a range of specific challenges and obstacles faced by innovative women in setting up, running and expanding a business, including within the science and technology sectors [1]. One of them is related with women’s educational choices, and women’s horizontal and vertical segregation in employment. For instance, the number or stock of women that could potentially set up a business in science and technology or turn an invention into a profitable market product is lower than the number of men. Also science and technology, innovation and inventions are concepts mostly associated with men and male areas making these fields less attractive to women, resulting in women-related invention and innovation being less recognized as valuable business ideas. Furthermore, many of the stereotypes about women’s credibility and professionalism mainly in male dominated sectors like in science and technology remain untouchable. In fact, there continues to persist, traditional points of views regarding women's roles in society and in private life, especially related to the domains of domestic and family responsibilities.
For that reason, in last few years at both the European and national levels, public policies have been directed towards promoting female entrepreneurship, in order: 1) to put an end to gender inequalities, 2) to overcome stereotypes in the labor market, promoting a better balance between work and private life and 3) to strengthen and promote equality between men and women. Actually, the European Commission has developed several initiatives that promote female entrepreneurial activities, such as, for example: European Network of Mentors for Women Entrepreneurs; Female Entrepreneurship Ambassadors; Law of SME (Small Business Act); Promoting opportunities through Women’s Entrepreneurship Portal (e.g. mentoring schemes to foster entrepreneurship among women graduates, fostering benchmarking exchange); and Financial support by specific programmes.
Additionally, it is important to include in this discussion the current (re) configuration of the professional transition processes of graduates which cannot be dissociated from the "new" emerging risks [8] of individualization, precariousness and vulnerability of employment relationship. Therefore, we are witnessing phenomena regarding the extension in the time of studies (initial training and lifelong learning), as well as intermediate and precarious positions until the achievement of a stable position in the labor market [3]. The duration of these processes becomes itself a structuring factor of occupational transition, defined by the diversity of situations, statutes or conditions (e.g. fellow researcher, trainee, independent worker) that prevail in recurrent situations of vulnerability and precariousness in relation to employment. Also, these practices and references related to professional transition extend through non-linearity, resulting in a desynchronization of the various axes of professional emancipation, personal and family life. In fact, the demarcation lines between work, leisure, education and care have been blurred, leading to increased mobility and flexibility, de-standardization of the course of life and to an overall focus on employability.
In this context, the instability, risk and uncertainty to predict or plan the future, as well as the increasing of flexibility/ precariousness of the labor market, have forced a change of

© 2012 HSci. ISBN 978-989-98032-0-6

attitudes in the career choices of young adults, providing a favorable environment for the creation of self-employment, which explains the renewed interest in entrepreneurship as an alternative for professional transition or facilitating the access of graduates to the labor market. The basis of their choices strengthen the motivation structures based on the difficulties in their integration into the labor market of their specific professional area, in the absence of specific enterprises and also in the attraction for autonomy and independence. Moreover, the lack of well-known reference models in society, the current image projected by the media regarding entrepreneurs and SMEs, and the weak encouragement from educators may be an obstacle to entrepreneurship by young people.

As a result, education institutions and more specifically higher education institutions play an important role in overcoming the barriers to achieving these options throughout schooling paths. In fact, substantial increases in qualified unemployment, the difficulties in accessing employment combined with the need to provide a higher employability profile to graduates, have forced higher education institutions to encourage and train not only good employees for organizations, but also good entrepreneurs able to create new companies and detect business opportunities. Therefore, as agents of change, these institutions can adopt a more systematic strategy of education for entrepreneurship, namely on one hand by encouraging the development of technical-scientific and cross-cutting skills through training activities (formal, non-formal and extracurricular), and on another hand by fostering an entrepreneurial and innovation culture in students or graduates that allow them to respond successfully to the challenges of the labor market [9].

3. Characterization of entrepreneurial potentials of graduates

Focusing our analysis on the entrepreneurial potentials of graduates, we depart from the social characterization of individuals, following by analyzing graduates' motivations for an entrepreneurial activity.

We have defined "high entrepreneurial potential" for those graduates who have thought/ wished in some point of their educational trajectory to be a business person (entrepreneur) or an independent work (self-employment).

The exploitation of socio-graphic data of graduates from the University of Minho confirms that we face a relatively young population with an average age around 29 years old. The structure of the sample by gender shows a significant difference between women (60%) and men (40%), revealing a high rate of feminization in courses at the University of Minho (North Portugal), following the current trend in national higher education. Indeed, the unequal presence of women in the entrance and exit of the higher education system can be explained by the prevalence of gender stereotypes, anchored in a process of "naturalization" of gender roles [10], contributing to a diversified presence of academic pathways by gender. As a result, this confirms the major presence of women in Education and Social Sciences, although there is a clear segregation by course, since the courses of English/ German Teaching (100%), Education (88%), Media (88%) Psychology (81%) and Sociology (80%) had a higher weight of female participation. However, there are courses where there is a more even balance between men and women as is the case of Optometry and Vision Sciences (both sexes with 50%), Civil Engineering (46% for males and 54% for females) and Management (47% for males and 53% for females).

The data collected in research allows us to assume a high entrepreneurial potential by the graduates, - the majority (73%) of graduates reveal that at some point of their academic path wish/think to create their own business or self-employment. However, this trend is different, even if not very large, by sex, with female graduates possessing a relatively lower propensity for self-employment (67,9%) as opposed to their male colleagues where this percentage rises to 79,8%. Female graduates of the "Humanities" area (50%) were those that demonstrated a lower propensity for starting-up a business project. The higher disposition for entrepreneurship has become more evident in the areas of "Social Sciences and Law" (77%), "Engineering" (75%), Education (73%) (Table 1).

It is also important to note that the higher education system remains selective by the social backgrounds of families, as well as by the sex of younger candidates. Indeed, more than 40% of the parents of young graduates have only four years of schooling and developed skills or unskilled activities namely as dependent employees. Young people whose families hold an academic degree still present a lower weight: father (17%), mother (19%) (Table 2).

Table 1. *Thought/ wished self-employment (only yes answers %). Source: Potential of entrepreneurship at UM Survey (2010)*

Scientific area	Education	72,9
	Humanities	50,0
	Social Sciences, Trade and Law	76,9
	Sciences and informatics	67,3
	Engineering	75,0
	Health and Social Protection	66,7
Sex	Male	79,8
	Female	67,9
		(N) 197

Table 2. *Entrepreneurial potentials by father's socio-professional categories (%). Source: Potential of entrepreneurship at UM Survey (2010)*

Parents profession	Yes	No
Businessperson, Leaders and Independent Workers	77,5	22,5
Professionals and Technicians Specialists	82,1	17,9
Traders and small sellers	38,9	61,1
Workers (labourers)	76,2	23,8
Unskilled Workers	53,3	46,7
Others (not classifiable)	75	25
Total	(N) 130	(N) 49

As result, it is possible to stress as a main feature of this sample a critical segmentation of graduates by course/ scientific area considering both sex and social backgrounds of families of the respondents.

Table 3. *Motivations for an entrepreneurial activity (%). Source: Potential of entrepreneurship at UM Survey (2010).*

Female	Male
Desire for new challenges (54%)	Desire for new challenges (61%)
Difficulties to find a job in course scientific area (31%)	Perspective of earning more money (48%)
Perspective of earning more money Reconciliation between work and private life (both 24%)	Idea for a new product or service (29%)

Finally, the motivation for entrepreneurial activity is also different by sex. Thus, the difficulty in finding a job (31%) and better balance between work and family life (18%) as important reasons for starting a company were more present in women than in men, in turn, when the base is the individual opportunity (desire for new challenges/be your own boss and the perspective of earning more money (instrumental dimensions of work), although there was no sex gap, this dimension gathers most significant weight in men (Table 3).

Regarding the sectors which preferred-oriented entrepreneurial activities, respondents chose the following: 29,4% in education, health and social care; 27,4%; in culture, tourism, communication, technology, marketing, biotechnologies, etc.; 17,3% in trade, accommodation and restaurants; 14,2% financial activities, renting and services to enterprises.

In the next section, we will deepen our knowledge related to the structure of gender-perceptions by using information gathered through in-depth interviews.

4. Entrepreneurship potential: two main portraits

Today, finding a job is also becoming more difficult for young graduates. However, the options for self-employment or starting-up their own company can be perceived as an alternative for inclusion in the labor market.

Based on a simple statistical analysis, we divided the potential entrepreneurs in two standard profiles. Table 4 summarizes the distribution of entrepreneurial graduates into different groups: traditional and innovative ones.

Profile 1 entitled – "Traditional entrepreneur potentials" - is mainly composed by women graduates from two scientific areas: "Social Sciences and Law" and "Education". This profile includes young graduates who belong to families of workers and not qualified workers, which have lower educational levels. The sectors more attractive for an entrepreneurial activity are feminized sectors, such as – "Education, Health and Social Work" and "Trade, Accommodation and Food Services". The difficulty to find a job in course and the better conciliation between work and private life, are the main reasons pointed out by graduates to advance into a self-employment project.

Table 4. *Structure of entrepreneurial dispositions by type-profile. Source: Potential of entrepreneurship at UM Survey (2010)*

	Profile 1 Traditional entrepreneur potentials	Profile 2 Innovative entrepreneur potentials
Gender	Female	Male
Social background	Lower educational level of parents From families of Workers and unqualified Workers	Parent's higher scholar capital From families of Business people, Leaders and Independent workers Middle and Senior Technical Staff
Scientific area	Social Sciences Education	Engineering
Preferential sector for self-employment	Traditional, unskilled and feminized sectors: Education, Health and Social Care; Trade, Accommodation and Food Services	Innovators, skilled and masculinised sectors: S&T; Financial Activities, Consultancy, Renting and Services to enterprises
Motivation for self-employment	Means to ensure economic survival: difficulties to find a job in course scientific area; better conciliation between work and private life.	Opportunity and Innovation, ambition to apply the knowledge acquired during the course: desire for new challenges; autonomy (being your own boss); perspective of earning more money; idea for a new product / service.

Otherwise, profile 2 - Innovative entrepreneur potentials – is mostly composed by young male graduates from Engineering courses. They belong to families of business people, directors/leaders and independent workers, and their parents have higher education levels. As its name suggests, this profile has graduates who aim to develop businesses in innovation domains, choosing to create their own business project in knowledge-intensive sectors such as, for example: "Biotechnology", "ICT – Information and Communication Technologies", among others. Their main motivation is opportunity – (the desire for new challenges, autonomy, being your own boss, earning more money) and the will to innovate (through ideas for new products or services).

From the in-depth interviews of graduates who participated in the first stage of our research, we intended to deepen some information considering three analytical dimensions: 1) projects and motivations for self-employment; 2) favorite activity sectors for self-employment; 3) perception of obstacles in entrepreneurial process.

Analyzing interview data we can check cleavages by gender in the motivations for self-employment as we have already explained in previous section. For example, in the 1st statement – this man stressed that the motivation for self-employment does not come from the lack of employment, but rather by the desire for new challenges. He underlined: "I can give several reasons to advance, but none is a matter of employability. It is really for enjoyment (…) I'm just not able to teach, I can do other things, and I have a talent for that (…)" (I2, Man, Biology/Geology Teaching).

In the opposite direction, the 2nd woman interviewed revealed that the choice for entrepreneurship appears as an alternative to unemployment: (...). Look... I'd liked, for example to start-up a FTA Leisure Centre (Free Time Activities), or a kindergarten. For now, because I really love children... and I think it is increasingly difficult to find employment (...) and I am going to have a son and I know it is increasingly difficult to find a kindergarten, for example, "(I3, Female, Sociology).

In the statement of another interviewed woman, it is possible to highlight the difficulty of taking risks alone, which explain the option of searching for a job and working for someone else. In fact, she said: "Alone I felt that I was not in a good financial position, nor personal, nor professional, to start-up a project by myself, so I chose not to do it and I opted to search for a job in a company" (E7, 30 year old female, Education).

Considering the professional sectors preferred for self-employment, the interviews corroborate the same trend of our typological essay. Men and women choose different options. Women choose traditional feminized sectors, mostly related to the care services; on the other hand, men tend to choose entrepreneurial activities in technological and innovative sectors. We can therefore underline this trend looking at the following statement obtained from a woman graduate in the Education course who wants to create a business in the cloth trading area. Her main propose is not to create anything new. In fact, she said: "My business sector is clothing, that is, creating a clothing line (...) we will bet on this project because we have a certain facility, in other words, financial facility, (this project) did not require much investment (...). This project is small, i.e., is not anything new... we are trying something and seeing if it works" (E7, 30 year old Female, Education).

In contrast, a man from an engineering course aims to provide environmental services in the area of training: "I chose to create a company related to environmental engineering services, because of the basic training and knowledge that I have in this area (...) I thought that we could foster better services. I also had personal research and development projects so it made sense for us to launch this service "(E8, 30 year old male, Environmental Engineering).

Finally, considering the perceptions of those interviewed about obstacles or critical factors for entrepreneurial activities, it is possible sustain those two portraits of entrepreneurial potentials.

In fact, the male interviewed from the Sociology area remarked that the only way to overcome obstacles is by taking risks: (...) you must not be complacent; you must always want new challenges, new experiences, learn a lot... learn more, even if you may need to take risks, I believe this is the only way we have to overcome obstacles, isn't it? Taking risks... " (E4, 29 year old male, Sociology). On the other hand, the other male interviewed from the Environmental Engineering area thinks that the main obstacles are related with the development of the business project (funding, clients, competition, etc.). He said: "These are issues of funding, to attract new customers, validation of our products and distinguishing them from the competition, issues of price, because there is some unfair competition in these technical services... essentially..." (E8, 30 year old man, Environmental Engineering).

The last statement by a woman from the Education course is very important because she has acknowledged the existence of gender stereotypes in the business world. About this, she said: "I think that when a woman presents herself (in the business world) and, in quotation marks, wants to assume leadership like a man... people are more receptive to a man than a woman, I think this stereotype is still accepted broadly in society however, there have been changes and mentalities will change (...) but... I'm not exactly afraid of that "(E7, 30 year old female, Education).

Based on these statements, in this paper we intended to answer the following question: How the Academy can (or not) change their lives? How do women and men who belong to different scientific courses perceive and justify their strategies regarding a potential entrepreneurial activity? This paper aims at deconstructing the main stereotypes, preferences, prejudices and entry barriers to the job market [4] that continue to influence women and men's "choices", which profoundly determine their relationship with employment and entrepreneurship.

4. Final Remarks

Entrepreneurship can play the logic of segregation (in horizontal and vertical) of the labor market and at the same time constitute an obstacle to innovation. Furthermore gender inequalities spill over into all aspects of life, raising significant questions regarding either the structuring of labor markets and its efficient utilization of human resources, or of the reconciliation of work and family life, and of wider social aspects such as justice and citizenship. It is also important to consider other factors besides the social background, such as gender and degree course (among others).

Given the information systematized in two main portraits of potentials entrepreneurs, namely traditional and innovative ones, it is important to highlight the following key ideas: first, there are cleavages by gender, scientific areas/courses and social background; second, opportunity vs. need to structure main motivations for the choice of entrepreneurial careers; third, gender-persistency of activity sectors more attractive to self-employment/business (male and female oriented sectors); perceptions of obstacles and critical factors in the entrepreneurial process (e.g. lack of companies/ jobs, insufficient support and financial incentives, infrastructures, models of organization and management and organizational culture) and the entrepreneurial education effects in career paths namely in decisions on future career alternatives.

Therefore, despite the growing feminization of the labor market, data on graduate profiles by course/ scientific area, as well as personal expectations regarding an entrepreneurial activity were exploited in this paper. However, this analysis reveals why it is important to move towards research designs that highlight how some activities (curricular and extracurricular) in an academic context can foster the

 ISBN 978-989-98032-0-6

entrepreneurial spirit, as well as contribute to reflections on the importance of higher education to foster the entrepreneurial potential and the development of cross-cutting skills for enhancing employability of graduates. In fact, further research and monitoring and evaluation mechanics are required regarding the relationship between the university and the labor market, productive/ professional and domestic/ family spaces in order to understand and explain structural, organizational, interactive, and symbolic-cultural persistency of social and gender asymmetries.

5. References

[1] European Commission Enterprise and Industry: Evaluation on policy: promotion of women innovators and entrepreneurship. Final Report, GHK, EC Enterprise and Industry; 2008. http://ec.europa.eu/enterprise/newsroom/cf/_getdocument.cfm?doc_id=3815 [18/03/2010]

[2] Kelley Donna J, Brush Candida G, Greene Patricia G, Litovsky Yana: 2010 Report: Women Entrepreneurs Worldwide; 2011.http://www.gemconsortium.org/docs/download/768 [28/07/2012]

[3] Marques AP, Alves, MG, editores, Inserção Profissional de Graduados em Portugal. (Re)configurações Teóricas e Empíricas. Famalicão: Editora Humus Lda./ CICS – Universidade do Minho; 2010.

[4] Bettio F, Verashchagina A: Gender segregation in the labor market. Root causes, implications and policy responses in the EU. European Commission's Expert Group on Gender and Employment (EGGE), European Commission, Directorate-General for Employment, Social Affairs and Equal Opportunities; 2009.

[5] La Domination masculine. Bourdieu P. Editions du Seuil; 1989.

[6] Hirata H, Rogerat C. Technologie, qualification et division sexuelle du travail. Revue française de Sociologie 1988; XXIX:171-192.

[7] Reimer D, Steinmetz S.TEINMETZ, Gender Differentiation in Higher Education: Educational Specialization and Labor Market Risks in Spain and Germany. Working Paper (99). Universität Mannheim 2007.

[8] Risk Society: Towards a New Modernity. Beck U. London: Sage Publications; 1992.

[9] Marques AP, Moreira, R. Empreendedorismo na Universidade do Minho. O potencial empreendedor dos diplomados do ensino superior numa perspectiva educativa. In Actas do II Encontro de Sociologia da Educação; Instituto de Sociologia FLUP e Secção de Sociologia da Educação da APS; 2011. pp 373-386. http://hdl.handle.net/1822/15247.

[10] Marques AP, Moreira, R. Transição para o mercado de trabalho: empreendedorismo numa perspectiva de género. In Actas do XVII Encontro Nacional de SIOT; APSIOT; 2011.edição em Cd-Rom.

PRI-SCI-NET AND THE IMPORTANCE OF TEACHER QUESTIONS IN INQUIRY BASED SCIENCE

S. Dale Tunnicliffe
Institute of Education, Univ. of London, UK

The essence of the PRI SCI Net imitative is inquiry based. The project aims to promote the Inquiry-Based approach in Science Education (IBSE) with young children of ages 3-11 years across Europe. It aims to achieve this through providing educational material as well as professional development opportunities for teachers in various ways. The project aims to achieve these objectives by developing hands on science activities, networking teacher and academies across Europe and recognizing and celebrating successful practice and research on IBSE with young children.

Involving learners in the active instruction of their understanding was brought to the attention of science educators by Driver (1983) in her seminal book. Thus Inquiry based science is not new. I was teaching primary and middle school science through challenge-based approach in the 1980s (e.g. Tunnicliffe, 1990). Inquiry based science is however found in a variety of forms ranging from teachers giving the learners an inquiry to follow directing their actions and the equipotent they use through guided inquiry here the resources are provided and an outline given through to real inquiry where the active learners have a challenge or problem and are free to think about what they already know devise an action plan including the human resource and logistic

 ISBN 978-989-98032-0-6

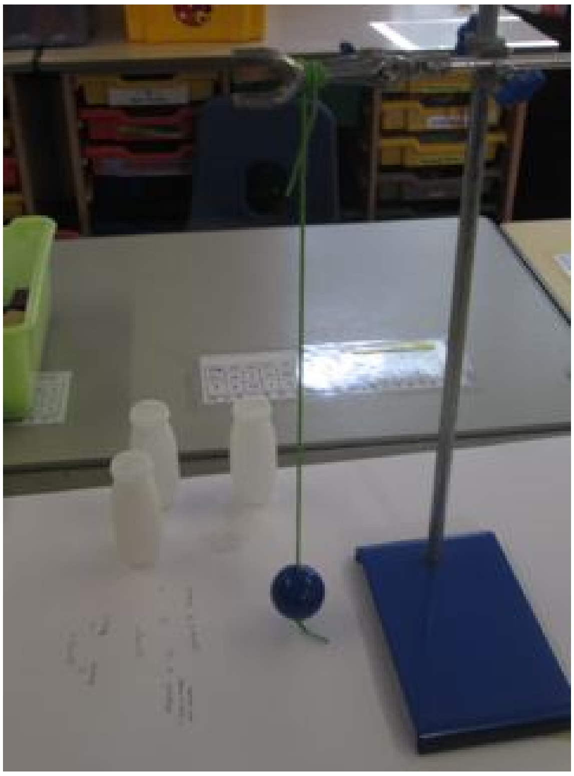
elements and carry it out. Being an active learner is crucial in Inquiry based sconce. Harlen and Qualter (2004) suggest that learners develop further their understanding through being active both mentally and physically employing skills in both areas to gather evidence about the issue. Learners are constructing their own learning but with scaffolding from the teacher and peers, and hence in a social cultural environment, and this approach and outcomes are shown in spontaneous questions and comment and in responses to teacher generated questions.

In science primary teachers as well as secondary teachers use questions as part of their pedagogical tools. Moreover, when children learn science they not only construct meaning but also develop their understanding s in a social context (Duet and Treagust, 1998). The learners are doing so in a socio cultural context, different for each locality. In teaching as Chin remarked, the use of questions by teachers is a technique frequently. As such they can encourage learner's thinking and answers can provide the teacher with information feedback about the understanding of the respondents.However, such questioning does have an influence of =n the journey of that learner being questioned thought the activity that they are investigating. Mortimer and Scott (2003) discussed the way in which the different types of interaction between teacher and learner in secondary classrooms affects the ways the learners made sense or meaning of the issue in hand hence their learning..The types of Questions used by teachers in science where the teachers used a sequence of questions to prompt learners to develop thermo ideas and guide their thinking, to elicit the learners ideas, develop their pervious ideas experiences and construct conceptual knowledge were identified by Christine Chin (2007). She identified how traditional teacher questioning differed from that used in constructivist teaching where learner assumes more responsibility for their thinking, teachers do not expect precise answers to questions and an answer is not wrong and teachers adjust their questions to respond the direction of the dialogue of the learner.

Chin identified 4 major areas of ways of using questions to stimulate thinking in leaners in science learning which is what we need in inquiry based since.

These are 1. Socratic questioning where a sequence of questions is used which bath guide and prompt the leaner who may generate ideas based on prior knowledge and thinking. This has three divisions, Pumping, where teacher strives to develop the talk of the élan ere in which they provide more information, Reflective toss which 'throws back' the question back to the other by replying to the leaner's responses to a previous question with another question. The last category of Socratic questioning is Constructive Challenge, which is aimed at encouraging the learner to reflect and reconsider an inappropriate answer.

The Verbal jigsaw category is focused on key words of science and is important for leaner with weaker language skills perhaps working in a second language/ verbal jigsaw can be a verbal cloze sentence where the teacher stops and the learner fills in verbally the missing words or associating key world/ phrases to reinforce the use of scientific vocabulary.



Semantic Tapestry is a category to help learners 'weave' a picture from a number of ideas and is useful with concepts. Such catbrier is seen in multi pronged questioning when the teacher asks questions from several standpoints of an issue. Multimodal thinking encourages learners to think in a variety of ways or modes such as visual or 3.d or in formulae. Focusing and Zooming helps learners think in terms of the big picture but also focuses ion on detail and the leaner can switch from macro to micro.

Framing is the fourth category identified and is used to assist the learner in realizing the link between a question and the information that may answer it, such as experimental data. There is what Chin termed Question-based prelude, which acts as an advance organizer to thinking which it faces. The Question based outline question strives to link the big question to subsidiary ones whilst the Question based summary recapitulates concepts learnt.

We trialed an activity for 3-5 year old children, The Swing Game. There were some cultural differences from those given in activity, which we were all sent.The school is a Church of England school and has 245 pupils from 4 to 11. The last OFTSED inspection remarked about the school he October report stated that the Christian ethos of the school was threaded through all its work and secured good relationships across the whole school community. It went on to say pupils' spiritual development is particularly strong and excellent examples of quiet reflection times demonstrate their thoughtfulness and care towards each other. Pupils are exceptionally well cared for on a daily basis and well known to staff. This creates a positive culture in which to learn and play. The Reception class and its Early Years Foundation stage is a real strength of the school, with good progress across many areas of the curriculum. Positive attitudes and behavior were given as the basis on which they build further skills in the infants.

The teacher had met with us and we discussed the activity previously. She had worked out a curriculum rationale of using different shapes on the string to that it fitted with the maths work.She had also identified appropriate equipment, as equipment suggested is not part of school equipment. We used clamps and stands as the equipment to which to attach the string and blobs. We used yoghurts containers for yoghurt drink as the skittles.

The teacher trialed it with several other groups before we arrived. She tried 4 children and found that was too many, she tried a group of 3 and found that one was isolated; she concluded two was the ideal number.

Comments about cultural adaptations etc. are included on an additional sheet.

This is a record of the dialogue that I heard.

T. We are just going to look at this game here.
Remember when you go to the park, what games do you play?
G It looks like a swing
T. Yes If we are going to have a game we must have rules
B. Knock the cartons over!
T. Good Idea!
G. Use this (a piece of card) to knock them over.
T. Good idea. Have you seen that?
G Could knocks them over with a tennis racquet.
T We've not got one with us
G. Use this
T. Good idea, where should we put the skittles?
B. Put them here.
G Swing
T. Easy, should we have some pointed?
G. Yes
T. Where shall we put them (skittles. containers)
B.At the back.
T.What about the rope, what can we do?
G. like this
T. that' a good idea, you do your plan.
G. Could also does it, like this (did it_)
T. What ways make it different Make it more of a challenge?
G. Do it *([pat the string)* at the side… like that
B. Could gets another bottle
T. What makes it a good swing?
G. It's a bit like playing bat and ball
T. What makes it so good?
G It's like hitting it with a bat.
B. And then the ball goes back and forwards
G. yeah, it does
T. How do you make it go back and forwards?
G. Put bottles like this s 0...0.she *rearrange d the skittles then moved the ball by hand no swing*
............0

Stand and ball

B. I've had another idea.
(He *got up and found another bottle that had been buried in the sand tray and put his with the other three)*
T. Why don't you swing the string? What else could you do instead of holding it?
B. You could put something on and drop the ball!
Arrange the bottles in a line like this

0

Stand and pendulum 0

0

(*He then used a piece of card as a bat to hit the ball and then ball wrapped the string around the upright of the stand.)*
T. Fantastic. What going to do with another shape?
I'm going to give you a different stand
B. Watch this!
(*He had a round magnet with a hole in (was passionate about magnets)*
G. I'm going to use some lids *(as bats she went and found some)*

© 2012 HSci. ISBN 978-989-98032-0-6

B They (*magnets)* is really heavy.
T. So you could change the weight on the string all together, here is a new string, it's not a pink one!
G. I like any color!
B.I can put piles by the corners
(he had collected counting cubes that clip together and made 4 piles each of tree which he placed at the corners of an imaginary square around the stand) could do it like this *(used hand to guide the pendulum)*
T. What happens if you let go of hand and let it swing?
T. (*to girl*) What are you going to put on your string? We need something to tie on…I'll do it for you (tied on string as girl repeatedly could not)
B. Put 3 counting blocks on the end over the ball and then did two magnets (*thus making a linger blob)*
B. I've had another idea, tie this on there and then swing it!
T. If you find it hard put on a lot at a time
B. Just has one.
The rest of the class returned
Girl was threading other things onto the sting, cotton reels etc
G. I don't know how to tie knot *(to tie it to stand)*
B Can you tie this on? Oh I've had another idea*. He pulled the string and blob away from the stand the string was put over the bar effectively making a simple pulley.*
Girl. Then put her contraption on stand (photo)
G. Look at this Miss S… looks at this!
T Well done!
B. Miss,S This is my new game.
T. Ah! What are the rules?
B. You have to tie it up then drop
T. Can you make it a different game? Can I see your game? What can you do to make it a different game?
G. Well use card to know it over
T. What other ways could you knock then over?
G. If you put a hole in the middle skittle could put it on a string!
T. What could you do with the string…? What's different about that? All the time you are playing this game what's happening tot eh string? Is it moving?
G. Yes
T. I'd have to think about what's happening to the string
B. Nothing
T. Does it stay still?
B. No
G. No it's swinging
B. Can't move it

However, I was curious to analyze the question formant, which the teacher sued. I use the analysis categories formulated by Chin. I only looked at the teacher questions, the context in which they were degenerated can be seen in the above transcript.

The transcript taken during the learners and teacher working on the activity 'Swing Game" was analyzed by read reread technique and the questions identified. There were 25 identified in this transcript. Each question was then matched with a category of Chin's questioning. The results are shown in Tables 1 and 2.

The largest category of questions used by the teacher in scaffolding the progress of the learners in this activity was of a Socratic form of which the Socratic challenge was the focus of over three quarters of the questions. However, where appropriate the teacher verbal 'throw back ' the response of the children to a first question in a 'reflective toss 'manoeuvre and, when appropriate, she framed questions as shown in Table 1.

These children were five years old, they did not understand the word 'Sconce' but they used their own experience and skills in a true Inquiry based science manner to meet the challenge they had been set. They took ownership of the activity and did not follow the proscribed sequence given in the activity by the project. Children at this stage in English Early year's classes are used to problem solving and using their own experiences. The message is for teachers with children introduced to this free exploring learning environment is to be flexible and encourage the children to use their knowledge skills and experience in solving problems or challenges. Technical language is not introduced except where appropriate. The activity was modified by the teacher to a) use equipment that was available, b) fit into the curriculum plan c) suit the children who were following this activity.

Table 1. *Summary of Chin's Question category and the questions used in the Swing game.*

Question	Category of Question (after Chin, 2007)
T. Remember when you go to the park, what games do you play?	Socratic- pumping
T. Good idea. Have you seen that?	Socratic reflective toss
T. Good idea, where should we put the skittles?	Socratic constructive challenge
T. Easy, should we have some points?	Socratic constructive challenge
T Where shall we put them (skittles. containers)?	Socratic constructive challenge
T.What about the rope, what can we do?	Socratic constructive challenge
T. What ways make it different,Make it more of a challenge?	Socratic constructive challenge
T. What makes it a good swing?	Socratic constructive challenge
T. What makes it so good?	Semantic tapestry Focusing and Zooming
T. How do you make it go back and forwards?	Socratic constructive challenge
T. Why don't you swing the string?	Socratic constructive challenge
T. What else could you do instead of holding it?	Framing Question based prelude
T. Fantastic. What is it going to do with another shape? I'm going to give you a different stand	Framing Question based prelude
T. What happens if you let go of hand and let it swing?	Socratic constructive challenge
T. What are you going to put on your string?	Socratic Pumping
T. Ah! What are the rules?	Socratic Pumping
T. Can you make it a different game?	Socratic reflective toss
T. Can I see your game?	Socratic pumping
T. What can you do to make it a different game?	Socratic constructive challenge
T.What other ways could you knock then over?	Socratic constructive challenge
T. What could you do with the string…	Socratic reflective toss
T What's different about that?	Socratic constructive challenge
T. All the time you are playing this game what's happening the string? Is it moving?	Semantic tapestry Focusing and Zooming
T. Does it stay still?	Socratic reflective toss
T. I want to take a picture of that for your learning journal. Did it work? Was it a good game? What are the rules?	Framing.Question based summary

In her professional judgment in, accordance with the assessment requirements of the English Early Years Framework she judged these pupils to be working at the highest level. Furthermore the children enjoyed the activity and it kept them focused for forty minutes. Moreover, other children had been involved earlier as the teacher's trialled the mignonette of the activity and later in the day other children requested to investigate the swing game, as did the adjacent class. Naming the activity a game resonated with the children and did not reproduce a barrier to interest and understanding.The activity developed literacy in talking and listening as well as drawing their achievements. The children gathered data as they experimented with blobs and the string. This is an essential element of early year science; it is recognizing that the science phenomenon, which will be taught theoretically at a later age in formal schooling, can be experienced at first hand in these early years providing the learners with a sound basis for learning theoretical aspects of pendulums at an appropriate stage in their formal science education.

Table 2. *The number and categories of questions generated in Swing Game*

Main Categories of questioning (from.Chin, 2007)	No N=25	Subordinate category of questioning	No
Socratic Questioning	20		
		Pumping	4
		Reflective Toss	4
		Constructive challenge	12
Semantic Tapestry	2		
		Focusing and Zooming	2
Framing Question	3		
		Question based prelude	2
		Question Based Summary	1
	25		

References

Chin, C. (2007) Teacher questioning in Science Classrooms: Approaches that stimulate Productive Thinking. *Journal of Research in Science Teaching*. 44(6) 815-843.

Driver, R. (1983) *The Pupil as Scientist?* New York. Taylor and Francis

Duit, R. and Treguast, D. (1998) Learning in Science. From behaviorism towards social constructivism and beyond. In B.J. Fraser and K.G. Tobin

B (Eds) International Handbook of Science Education) Dordrecht. Klewer Academic Publisher

Edleson D.N and Gordin, R.D (1999) Addressing the Challenges of Inquiry-Based Learning Through Technology and Curriculum Design. Journal of the Learning

Sciences Volume 8, Issue 3-4, 1999

Harlen, W. and Qualter, A. (2004). *The Teaching of Science in Primary Schools.* (4^{th} ed). London: David Fulton Publishers Ltd.

Mortimer. E.F., and Scott, P. (2003) *Meaning Making in Secondary Science Classrooms,* Maidenhead, UK, Open University Press

Tunnicliffe S. D. (1990) *Challenge Science - Living Things.* Pupil material and teachers book. Basil Blackwell. Oxford

INTRODUCTION OF INTEGRATED CHEMISTRY MODULES AT ADVANCED LEVEL SECONDARY SCHOOLS: LESSONS FROM A THREE-YEAR TRIAL IN TANZANIA

F. William[1], S.G. Mtabazi[2], P. Gabrieli[3], K.M. O-Saki[4], N. Setter[2,5]

[1]*University of Dodoma, Dodoma, Tanzania*
[2]*Swiss Federal Institute of Technology EPFL, Lausanne 1015, Switzerland*
[3]*University of Dodoma, Dodoma, Tanzania*
[4]*University of Dodoma, Dodoma, Tanzania*
[5]*Talent Foundation, Cully 1096 Switzerland*
Kyambo20001@yahoo.com

Abstract. *We report on a project focusing on the design, development and formative evaluation of an Integrated Chemistry Module (ICM) approach. ICM lessons focus on promoting classroom inquiry at "A" Level (17-19 year olds) secondary education in Tanzania where science at this level was originally taught in a disjointed, frontal approach. "A" Level education in Tanzania comprises Form Five (grade 13) and Form Six (grade 14). Objectives were: (a) Development of observational, recording, analytical, and co-operation competencies among chemistry students by including a variety of experiences in the classroom and encouragement of enquiry and participation in the classroom. (b) Assessment of the practicality, effectiveness, and efficiency of the ICM approach in promoting scientific inquiry.*

The study adopted a developmental research approach and used a quasi- experimental design, running in two schools where most of the prototypes were tested by the researcher in collaboration with the teachers. Students and teachers were highly interested and motivated by the activity oriented approach. Students' achievement test scores in the treatment group were significantly higher in the post test compared to the control group. These findings suggest that the ICM approach may be a better way of promoting scientific inquiry in "A" Level Chemistry and in developing the scientific method among "A" Level secondary school students.

Keywords: Integrated Chemistry Module (ICM), enquiry-based science-learning, educative videos, classic experiments.

1. Introduction

The government of Tanzania has recently expanded enrollment in all sectors of education. According to MoEVT [1] the following were the achievements by 2009. There was an increase in enrolment of Form 1 to 4 from 432,599 in 2004 to 1, 466,402 in 2009 (249% increase) and enrolment of Form 5 and 6 from 31,001 in 2004 to 64,843 in 2009 (109% increase). Gross Enrolment Ratio for Forms 1-6 increased from 9.4% in 2004 to 31.3% in 2009; Net Enrolment Ratio increased from 5.9% in 2004 to 27.8% in 2009. While making improvements in secondary school enrollment, the education system faced serious challenges on quality of teaching and learning especially in the rural schools. These challenges included large class size (Komba and Nkumbi, [2]), high student-teacher ratio, inadequate supplies of textbooks, laboratory materials and apparatus (O-Saki, [3]). These led to low performance in all science subjects. The problems include presentation of lessons as a rigid body of facts, theories and rules to be memorized and practiced (Stolk, et al. [4]). To change this approach, this project developed new lesson materials and improved the pedagogical approach.

2. Objectives

The objectives of this project were to:

(i) Develop exemplary Integrated Chemistry Modules (ICM) that included into the traditional approaches selected videos that showed classic experiments and life experiences of scientific processes, simple classroom experiments and worksheet questions for discussion in groups in order to enhance classroom inquiry Chemistry in 'A' Level schools.

(ii) Try-out the modules in selected schools in order to assess their practicality, effectiveness and efficiency in implementing inquiry Chemistry.

(iii) Suggest improvements in order for the materials to suit the objectives of the subject.

Remark: The materials were 'integrated' in the sense that they promoted a variety of methods including use of videos or animations that show classic experiments and life experiences of scientific processes, as well as classroom experiments and worksheet tasks that aimed at addressing classroom inquiry.

3. Methods

In this study we designed and developed ICM materials focusing on the current syllabus and addressing the observed challenges in "A" Level Chemistry. The lessons begin with a challenging discussion on learners experience given either in the form of a class discussion or a video, to focus on the topic, followed by a video presentation or animation of selected experiments that cannot be done due to lack of apparatus, and then there may be small individual or group experiments, which are later discussed by the class and concluded by the teacher. The experiments are designed to use cheaply available materials, chemicals and apparatus. To cut down the cost of chemicals, we adopted a Micro-Scale Chemistry Experimentation (MSCE) proposed by Mafumiko [5]. The design and development of the materials followed the design research and formative evaluation procedures (Nieeven [6]). Development of the ICM approach was based on the six levels of curriculum implementation (van den Akker, [7]). These six levels address curriculum implementation from: Intended curriculum (ideal or formal), implemented curriculum (perceived or operational) and attained (experiential or learned). In terms of Intended/written curriculum: The ICM materials were designed from the 2010 competence-based Chemistry syllabus to ensure the validity. In terms of the Implemented/operational, the classroom teachers were involved in the pilot and classroom trial of the designed materials to test for the practicality. In terms of the attained curriculum, the ability of teachers to adopt the ICM approach and ability of students to learn through the ICM approach were assessed using formative evaluation during the designs and try-out stages followed by field testing.

The study done by [5] was used as a model because it addresses a similar approach. Figure 1 shows a schematic representation of the design and prototype development model. The study started with an analysis of the "A" Level Chemistry syllabus followed by preparation of the design guidelines and specification of the materials. The Syllabus content was then divided into modular format, and lessons were delineated for each module. Lesson prototypes (see Table 1) were then developed, validated, piloted and a formative evaluation of the New ICM Approach was done in selected schools.

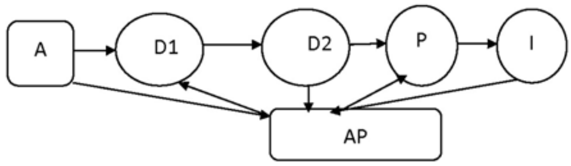


Figure 1. *Design and prototype development model.* ***K****ey:* ***A****=****A****nalysis of the syllabus;* ***D1****=Design guidelines and specification;* ***AP****=Appraisal;* ***D2****=Design of modules;* ***P****=Pilot study;* ***I*** *= Iteration*

Table 1. *Modules developed and evaluated following ICM approach*

No	Descriptions
1.	The atom
2	Chemical bonding
3	Gases
4.	Relative molecular masses in solutions
5.	Two component liquid system
6.	Energetic
7.	Chemical equilibrium
8.	Chemical kinetics
9	Electrochemistry
10	Acids bases and salts; solubility and solubility product

In field testing, this study used a Non Equivalent Group (NEG) quasi-experimental design. The intact groups of different sample sizes were used at the Pilot group (PG) and Iteration Group (IG) which had similar characteristics. Data was collected using a qualitative approach (mainly ethnomethodological) to study changes in the classroom culture of science teaching. The researcher spent at least 18 months in the field, working with the teachers and students and observing their cultural change during the design, classroom trial and development process through the new approach (see Denscombe [8]). Regular interviews, observations and reworking of the materials were done during fieldwork.

Context of the study

The study focused on "A" Level secondary education in Tanzania especially in rural areas because this level has not been researched enough in the past. "A" Level sciences in Tanzania prepare students for tertiary and higher education to study for a career and contribute to the economy. The initial prototype was piloted in a school in Dodoma region in central Tanzania, while the First Iteration was done in a specially

© 2012 HSci. ISBN 978-989-98032-0-6

selected project school (Kisimiri High School) in Arumeru district in Arusha region. Two Chemistry teachers, two co-researchers and the researcher assessed classroom implementation process in the PG. In the case of the IG, assessment was done by three subject teachers and the researcher. All Form Five students who were studying Chemistry in the PG and IG were involved in the study. There were 38 students in the PG and 27 students in the FIG.

Instruments

Non-participant observations were done in the PG and IG to check for the attainment of lesson objectives in relation to the use of educative videos, animations, classroom experiments and worksheet tasks. The ability of the teacher to adapt the new approach was observed during the process. Unstructured in-depth interview protocols were used in the PG and IG to collect factual information and opinions of teachers and students about the materials (see [8]). The in-depth interview protocols helped the researcher to obtain unique information or interpretations of the teachers and students on issues which the researcher was unable to observe during the classroom implementation process (Stake [9]). Both the pre-test and post-test were used to assess the students' cognitive gain before and after learning. The pre-test was used to determine baseline knowledge of the students involved. The post-test was used to assess the students' gain in cognitive ability after learning through the new approach. It was also used to assess the change in performance between PG and IG before and after learning by the new approach.

Procedure

The implementation of the new approach in the PG and IG followed this model (Fig. 2).

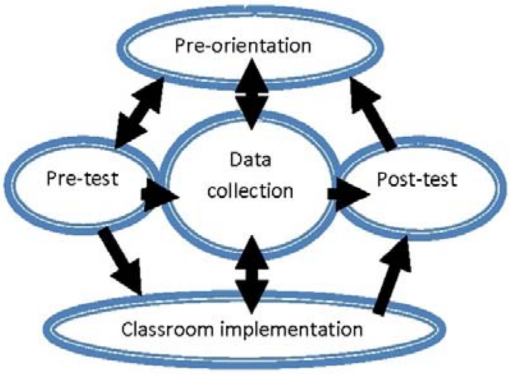


Figure 2. *Diagrammatic representation of the classroom Implementation model*

Orientation stage

Before classroom implementation of the new ICM approach the participant teachers were oriented to the new approach. This was followed by a plenary discussion that helped the teachers to acquire necessary preparation knowledge and skills of the classroom experiments. Such knowledge included familiarization with Micro-Scale Chemistry Experimentation (MSCE), techniques [5]. It followed a pre-test that assessed students' baseline knowledge on the module before the intervention.

Implementation

The researcher implemented lesson one and the teachers implemented the rest of the lessons in the module, while the researcher sat in the class to observe and support where needed.

Post-test

After the classroom implementation the students did the post-test, designed to assess students' cognitive gain after learning through the new ICM approach.

Data Analysis

Statistical Package for Social Science (SPSS) programme was used to analyze quantitative data collected from the tests. An independent sample t-test analysis was performed to test the difference in the mean scores of pre-and post-test between the PG and FIG. Significance tests for mean scores were performed to investigate any difference in the students' cognitive gain between the PG and IG. The responses from the interviews were subjected to content analysis. The information from the respondents was recorded according to the intensity with which certain words or terminologies seemed to be unique and important [8]. The information obtained through this approach was organized in quotations and inferred within the context of the study. Thereafter, analysis was done with regard to the category, relationship of words and concepts in relation to the research objectives and questions.

4. Findings

Findings from the Orientation Stage

Generally, both the teachers and students were satisfied with the new ICM approach. They thought that the content in the syllabus was well covered in the ICM modules. The teachers were

 ISBN 978-989-98032-0-6

eager to learn through the ICM approach as they explained the approach to be good in enabling the students to learn better and faster. Similarly, the students were positive with the approach as they seemed to enjoy learning through it. One challenge was that teachers had not used MSCE and hence had to learn how to use small amount of chemicals in preparing the students experiments. The teachers had little knowledge and skills on preparation of chemicals, and had plenty of unused and sometimes expired chemicals in their stores. For instance, MnO_2 in the schools did not work as a catalyst in the IG because it expired. Discussing with the teachers revealed that they were eager to learn how to prepare classroom experiments using small amount of chemicals as presented by the ICM approach.

In the PG some teachers remarked as follows:

"Just drops brought the changes in the reaction?...This is wonderful…Now, student can understand chemistry"

However, they initially thought that such use of small amount of chemicals and alternative materials like grid papers in plastic sheet could not bring feasible results. The teacher in the PG said:

"This new approach seems very good. But, where can we get such a Large amount of chemicals for the experiments while, the preparation for NECTA is waiting for us?" This underscores the habit of doing laboratory work close to examinations. The teachers appreciated ICM attempt to integrate theory with practice during the teaching and learning process. After the trial the teachers involved realized how students can develop interest through active learning during class experiments, videos and discussions rather than memorizing for examinations, claiming to 'save valuable time'. In the end both the researcher and teachers appreciated the superiority of the ICM approach and the fact that time was sufficient to do things this way. One teacher in the IG remarked during interview: "I can see. . . It is necessary for students to do simple demonstrations and experiments inside the classroom…I spent so much time than expected in the traditional approach. This new approach makes life easier".

During classroom implementation, the observations showed that teachers skipped some contents "like slow and fast rate", "relationship between rate of reaction and stoichiometry". The teacher in the PG said that he never taught the concepts that did not appear in the national examinations. However, they liked the ICM approach as it enabled them to understand the concept well. It was reported by the teachers in the IG that most of the concepts in the module were not taught because they were abstract. The teacher said: "I never teach this content (Lesson Two) because it is too abstract...the video have made it clearer and easier" Similar responses were given by the teacher in the IG who was recorder saying: "The reaction mechanism concept is difficult for the students to understand. The concept is necessary to be taught although it does not appear frequently in the examinations…I rarely teach it"

The teacher in the PG said: "I did not teach the concepts of stoichiometry because it confused. The ratios in the formulae confused students during the calculations. Also the concept rarely appeared in the final examinations". This showed that the videos and experiments in the new ICM approach was a means of raising teacher content knowledge and skills in chemistry.

Findings from the students

The students were highly interested in the new ICM approach. They were very active during the teaching and learning process (Fig. 3). Some students in the IG were recorded saying: "Nowadays I do not sleep during the lesson…the lesson made me active all the time"

Initially, the students in the two groups reported that they had difficulties in observing the videos because of English language. However, the observations showed that they were able to capture the video content. Some of the arguments recorded during implementation are as follows: "I see in the video there is collision of molecules…can elastic and inelastic concepts be related to the concepts of rate?"…"What is the difference between the strength and concentration as explained in the video? What makes the reaction of higher percent much faster than that of less percent?"

They showed to like most the experiments and videos experiments. The students were repeating experiments several times showing that they liked performing the experiments. They suggested some experiments that were demonstrated by the video to be done by themselves. The reason given by the teacher was that the students had not performed any experiments by that time although they were about to complete Form Five classes.

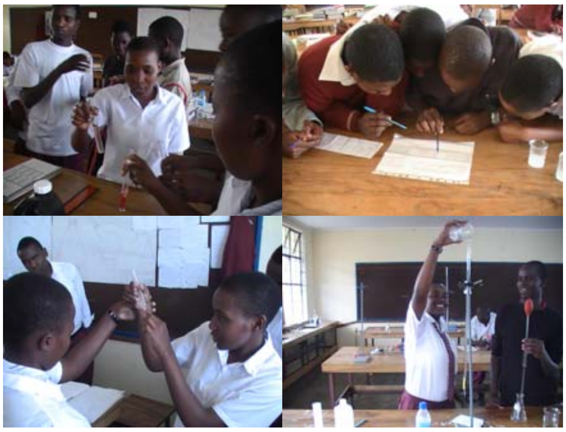


Figure 3. *Students performing classroom and laboratory experiments*

Findings of pre-test

Summary of the pre-test and post-test results in PG and IG are represented in Tables 2.

Table 2. *Summary of the results. Pre-test and post-test mean score (%)*

	Pre-test (%)	Post-test (%)
PG	14.05	68.01
IG	5.56	76.01

Table 3. *Findings from dependent and independent sample t-test in PG and IG. Key: M=Mean, SD=Standard Deviation, CID=Confidence Interval of Difference, L=Lower, U=Upper*

	Paired differences			
	M	SD	95% CID	
			L	U
post-test vs pre-test-PG	54	16	49	59
post-test vs pre-test FIG	71	11	66	75
posttest (FIG)-posttest (PG)	2	19	6	21

	T	Df	Sig. (2-tailed)
post-test vs pre-test-PG	21	37	0.000
post-test vs pre-test FIG	33	26	0.000
posttest (FIG)-posttest (PG)	4	26	0.001

The means scores of the pre-test in the PG (14.05%) and FIG (5.56%) indicated that, the students had not learned the module. The post-test results showed that IG scored higher (mean, 76.20%) than the PG (mean, 68.01%). Generally, the IG performed relatively better than PG showing that the developed materials in the new approach were improved. The statistical test of difference in the mean scores of pre-test and post-test results is indicated in Table 3.

Since, the calculated value of ($t(37)=20.91$, $p < 0.005$ and ($t(26)=32.64$, $p<0.005$) in the PG and IG respectively, then there was a significant difference in the mean scores between post-test and pre-test within the two groups. The t-value of the IG was bigger than the t-value for the PG indicating that the pilot had an impact on improving the materials.

5. Discussion

The positive feelings of the students and the subject teachers towards the ICM approach indicate that the approach addresses key challenges in "A" Level Chemistry. The educative video that demonstrated the experiments and classroom experiments enabled the teachers to replace the teacher-centered approach which has dominated science teaching and learning worldwide [4]. Traditional frontal teaching had been a serious problem in advanced sciences and this ICM approach may be a beginning for a change in "A" Level pedagogy. During the study, the involved Form Five students had not performed any laboratory work before. It is clear that such a group of students must be interested in active teaching and learning approach and this was indeed what was discovered during interviews. The findings reported here are in line with Osborne and Collins [9]) who clarify that students are not motivated by the traditional way of teaching. This is supported by Niaz [10]) who substantiate the proper science teaching and learning as the one that provides students with necessary knowledge and skills that can stimulate conceptual understanding in their physical and mental growth. It is obvious that students build up pictures of the world in their minds through simple activities) that motivate them especially when the activities bring their real life around.

The ICM approach contains diverse learning styles that provided Chemistry students with an opportunity to see, hear, do, talk and feel, to mention just few, that are the bases of concept development.

The ICM approach maximized the use of computers in teaching and learning process in Tanzanian context and in sub-Sahara Africa chantries (O¨zmen [11]). This is to say teaching and learning environment that is rich in technology motivates students and teachers as they provide them with a different science experience. In terms of use of videos, Chang and Yang [12]) have also found that well organized educative videos, chat rooms and interactive activities appear to be easier tasks during the teaching and learning process thus, can help students to visualize problems that are discussed in class. Real life educative videos can also create a community among the students as they discuss what they see. These encouraging findings were the evidence of the contribution of the educative video to promote conceptual understanding of complex 21st century skills (Dede [13]). The ICM approach also seemed to the teachers and the students as the means of furnishing the materials that could enable them to adapt the new competence based curriculum in Tanzanian context. Although the classroom experiments in the ICM approach were short (5-10 minutes), they enabled the students to develop concept understanding through observations, hypothesizing, testing the concept, collecting data, discussing the observed changes in the experiments and then drawing conclusion. This was complemented by the regular laboratory inquiry done after the lessons. The relatively better posttest result in the IG than in the PG was an indication of the pilot to be a means of improving the design and classroom practices.

6. Conclusion

Form these findings it can be concluded that videos, classroom experiments and worksheet activities can be used in "A" Level secondary schools in Tanzania to engage students into inquiry Chemistry teaching and learning especially in rural schools. It is therefore reasonable to argue that new ICM approach is one way of assisting teachers and students to implement both classroom and laboratory inquiry. One challenge is to do the exemplary demonstrations and record videos that are locally relevant. This will be the next stage of this research program.

7. Acknowledgement

We are grateful to the government of Switzerland through SDC - EPFL for financial support. We are also grateful to the District Education Office in Arumeru and the headmaster of Kisimiri High school for their support to get access to the schools, the teachers and the students who took part in this study.

8. References

[1] Ministry of Education and Vocational Training (MoEVT).Education Sector Development Programme: Secondary Education Development programme II. Dae es Salaam; July 2010- 2015.

[2] Komba, W. L. & Nkumbi, E. Teacher Professional Development in Tanzania: Perceptions and Practices. Journal of International Cooperation in Education 2008; 11(3): 67-83.

[3] O-Saki, K.M. Reflection on the State of Science Education in Tanzania. In : K.M. O-Saki, K. Hosea & W. Otevanger (Eds).Reforming Science and Mathematics in Sub-Saharan Africa: Obstacles and Opportunities; 2004.Dar es Salaam, TEAMS Project.

[4] Stolk, M.J., Astrid, M. W., Bulte, A. M. W., de Jong, O. & Pilot, A. Towards Framework for a Professional Development Programme: Empowering Teachers for Context-Based Chemistry Education. Journal of Chemistry Education and Research Practice 2009; 10: 164- 175.

[5] Micro-Scale Experiments as a Catalyst for Improving the Chemistry Curriculum in Tanzania. Mafumiko, F. Ph.D Thesis, University of Twente; (2006).

[6] Nieveen, N. Formative Evaluation in Educational Design Research. In: Tjeerd. P and Nienke. N (Eds). An Introduction to Educational Design Research; 2010. Netherlands, Netzodruk, Enschede.

[7] van den Akker, J. Curriculum Perspectives: An Introduction. In: J. van den Akker, W. Kuiper & U. Hameyer (Eds.). Curriculum Landscapes and Trends; 2003. Dordrecht, Kluwer Academic Publishers; p. 1-10.

[8] The Good Research Guide for Small-Scale Social Research Projects. Denscombe, M. England Open University Press; 2010.

[9] Osborne, J. & Collins, J. Pupils' Views of the Role and Value of the Science Curriculum. An International Journal of Science Education 2001; 23 (5): 441-467.

[10] Niaz, M. How to Facilitate Students' Conceptual Understanding of Chemistry?: A History and Philosophy of Science Perspective. Chemical Education International 2005; 6 (1).

[11] Ozmen, H. The Influence of Computer-Assisted Instruction on Students' Conceptual Understanding of Chemical Bonding and Attitude toward Chemistry: A Case for Turkey. Computers and Education 2008; 51 (1): 423-438.

[12] Chang, C, & Yang, F. Exploring the Cognitive Loads of High-School Students as They Learn Concepts in Web-Based Environments, Computers and Education 2010; 55: 673-680.
[13] Dede, C. Emerging Influences of Information Technology on School Curriculum. Journal of Educational Studies 2000; 32(2): 281-303.

FACTORS WHICH DETERMINE STUDENTS' LEVEL OF ENVIRONMENTAL EDUCATION IN THE REPUBLIC OF MACEDONIA

M. Ismaili[1], M. Srbinovski[1], I. Jonuzi[3]
[1]*Institute for Environment and Health, Ilindenska nn Campus Bildg. 304.10, 1200 Tetovo, Republic of Macedonia*
[2]*29 November, bb, 1200 Tetovo, Republic of Macedonia*
murtezan.ismaili@seeu.edu.mk, m.srbinovski@seeu.edu.mk, *ibromedical@yahoo.com*

Abstract. *The subject of this research is to identify the strength and direction of the influence of the social factors on students' level of environmental education. This will contribute to a comprehensive explanation of the strength of the influence of some factors and the conditions which lead to positive students' attitude toward the environment. We used the instrument "Scale of subjective assessments of the influence" on the sample of 4472 students from 80 schools in Republic of Macedonia. The sample of this research is composed by students from final classes in the primary and secondary schools, because the students learn environmental issues during all grades. The research has shown that the family has dominant position among the social factors in the field of environmental education. The most important is fact that in the researching period (1995-2009), the influence of the family on the students' level of environmental education has a tendency of small decline.*

Keywords: Environmental education, factors, schools, students, Republic of Macedonia.

1. Introduction

Students' behavior in the environment is controlled by many (internal and external) influences. Some of them have a positive impact and some negative on the proper relation between students and their environment. From that, arises the need for their determination and selection. We must bear in mind that their impact is mutual connected. So, at first glance it seems to be very difficult to determine the share of each factor separately.

This study is an attempt to determine the influence of the main social factors (family, school, media, and street buddies) on the students' level of environmental education (EE) in Macedonian schools.

All issues concerning the education system in The Republic of Macedonia fall under the competence of the Ministry of Education and Science (MOES, formerly the Ministry of Education and Physical Culture). The Pedagogical Council, the Pedagogical Institute of Macedonia, and the Inspectorate are part of the Ministry. The State Education Inspectorate supervises the implementation of the laws and other acts, the provision of quality education, and the implementation of educational standards [37].

2. Materials and methods

The purpose of this research is to identify the strength and direction of the influence of the some social factors on students' level of EE. The factors were: schools, families; media; street and friends. This will contribute to a comprehensive explanation of the strength of the influence of some factors and the conditions which lead to positive students' behavior toward the environment.

We used the instrument "Scale of subjective assessments of the influence" on the sample of 4472 students from 80 schools in Republic of Macedonia in 1995-2009. The sample of this research is composed by students from final classes in the primary and secondary schools, because the students learn environmental issues during all grades.

Students expressed a degree of contribution of these factors to their level of EE by 5 modalities: very large, large, medium, small, and very small. We assume the school has dominant position among the social factors in the field of EE.

3. Results and discussion

Numerous theoretical frameworks have been developed to explain the gap between the possession of environmental knowledge and environmental awareness, and displaying pro-environmental behavior. Although many hundreds of studies have been undertaken, no definitive explanation has yet been found [1]. This indicates that the question of what shapes pro-environmental behavior is such a complex one that it cannot be visualized through one single framework or diagram [38]. Although we point out that developing a model that tries to incorporate all factors is complex field, we feel that it is very important to illuminate the influence of the main social factors on students' level of EE.

Macedonian students consider that the family has the largest impact on their EE, and the school is on the second place. It is very important that family's impact slightly decreased in the period 1995/96 -1999/2000, and subsequently recorded a slight growth. Impact of the street is in last place.

These results are almost identical to those obtained by Srbinovski [25] [26] and Kundacina [14]. Namely, the first author found out that only 30% of respondents thought that the school meets its goals in the field of EE.

In order to explain the reasons why students do not consider school as a dominant factor in the field of EE, we will give the results of some earlier studies.

An insightful analysis conducted by Srbinovski M. [8] showed that the teachers evaluated the influence of the school on a higher level, as opposed to their students. Statistically significant differences between the teachers' attitudes and students' ones were obtained for the media (χ^2 = 11.331, C =.168), the friends (χ^2 = 28.221, C =.167) and the school (χ^2 = 18.928, C =.138), but not for the family (χ^2 = 8.694, C =.083).

Speaking of teachers, we need to point out that they do not leave a good impression at their students about the realization of ecological material. Namely, students find that only about 16.79% of the teachers are interested in the environmental lessons. On the other hand, the majority of students (87.89%) feel that their teachers are not trained to teach environmentalism contents [8]. Although teachers generally had positive attitudes toward EE, most lacked the commitment to actually teach EE [19].

Srbinovski M. explored the influence of factors within the school as a social institution on students' level of EE. About 65% of the teachers feel that they were sufficiently informed about environmental issues. On the other hand, concerns the fact that about 80% of the teachers did not attend ecology classes [8]. However, perhaps one of the biggest problems in our educational institutions is the lack of space conditions, cabinets, etc.

Some previous studies have shown some weaknesses in the field of EE in the Republic of Macedonia in terms of curriculum content and supporting materials [8], [31], [24], [20], [30], [21], [23]; didactical conditions for EE [8], [29], [31], [28], [34], learning in the field of EE [8], [11], [21], [22], [27], [32] and so on. Even more importantly, most of these weaknesses in the curricula are encountered in the new ones, as well. Bearing in mind the needed time for their revision, we cannot expect an improvement of the situation for a short period of time.

Studies on the teaching of EE have shown that the implementation of EE in schools makes teachers encounter various barriers: lack of time, funds, teaching and learning materials and knowledge [16]; lack of knowledge, lack of lesson time, lack of teaching and learning materials and the issue of the safety of learners when the teacher wants to take them out to provide them with field experience, especially when there are many children in the class [4]; lack of time, lack of resources, lack of school support and lack of knowledge and motivation among teachers [2]; large class size (which is an obstacle in using active teaching methods), lack of teaching and learning materials, and lack of environmental knowledge on the part of the teacher, lack of adequate pre-service and in-service teacher training in EE [5], [9], [35], [36]; lack of competence on the part of the teacher [7], [10]; lack of teaching and learning resources, time and large class size [13]; globalization [33] etc. With the coming of globalization, many governments have reoriented education to focus on the preparation of workers to compete in the new global knowledge-based economy.

Newspapers and television emerged as most frequently used media, but other media were preferred for believable information. Educated segments of the sample used television less for environmental news than did less educated

segments and tended to reject television as a believable source, preferring print media other than newspapers as believable sources of scientific information on the environment [18].
A postal survey on a random cluster sample of 1032 secondary school students in Hong Kong was conducted to investigate what and how much students know about the environment and how their knowledge is related to use of mass media. Results indicated that students were very knowledgeable on general and local environmental issues. The average score for environmental knowledge was 60.7 on a 100-point scale. There were some indications that students' environmental knowledge was shaped and limited by the reporting of environmental news in Hong Kong. Television news viewership had positive correlation with students' environmental knowledge while Chinese newspaper readership had a positive but weak correlation [12]. An analysis reveals that television news and nature documentary use are predicted by environmental concern and contribute to pro-environmental behaviors, whereas three forms of entertainment television use are not consistently linked to these variables [17].
In many families and cultures conversations between parent and child are often one-sided, with the parent frequently acting as the “expert.” This may be particularly unfortunate in the case of EE, where children’s knowledge is often more up-to-date than that of their parents [3]. In a study of 6th-grade students, it was found that ecologic and moralistic attitudes toward the environment correlated (among other) with talking about the environment at home [15]. Statistically significant difference between students’ level of the EE and some characteristics of the family was found out [14]. The data reveal that although environmental information may be transferred in some families and conditions, this transfer is generally rare and situation-specific, and environmental educators should not assume that adults are routinely reached by information presented to children. The authors recommend that more emphasis be placed on non formal EE programs that target adults. They also suggest ways to increase the likelihood that adults are exposed to environmental information presented to children [6].

4. Conclusion

Macedonian students consider that the family has the largest impact on their EE level, and the school is on the second place. There are many reasons for that. Family’s impact slightly decreased in the period 1995/96 -1999/2000, and subsequently recorded a slight growth. Impact of the street is in last place.
We must become aware of the total range of factors which affect the ability of individuals to learn and teach, as well. The implementation of EE in schools makes teachers encounter various barriers. These barriers seem to be common among teachers in different parts of the world. The authors recommend that more emphasis be placed on non formal and informal EE in the Republic of Macedonia.

5. References

[1] Kollmuss A, Agyeman J. Mind the Gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? Environmental Education Research 2002; 8 (3): 239-260.
[2] Ballantyne R. Teaching environmental concepts, attitudes and behavior through geography education: findings of an international survey. International Research in Geographical and Environmental Education 1999; 8 (1): 40 – 55.
[3] Ballantyne R, Fien J, Packer J. Program effectiveness in facilitating intergenerational influence in environmental education: Lessons from the field. The Journal of Environmental Education 2001; 32(4): 8–15.
[4] Chi-chung Ko A, Chi-kin Lee J. Teachers Perceptions of Teaching Environmental Issues within the Science Curriculum: A Hong Kong Perspective. Journal of Science Education and Technology 2003; 12(3): 187 – 204.
[5] Cutter-Mackenzie A, Smith R, Gauging Primary School Teachers’ Environmental Literacy: An Issue of “Priority”. Asia Pacific Education Review 2001; 2 (2): 45 –60.
[6] David SS, Sam HH. Child-to-Parent Transfer of Environmental Ideology in Costa Rican Families: An Ethnographic Case Study, The Journal of Environmental Education 1992; 23 (3): 9-16.
[7] Dillon J, Teamey K. Reconceptualizing environmental education: taking account of reality. Canadian Journal of Science,

Mathematics and Technology Education 2002: 2 (4): 467 – 483.
[8] Environmental education. Srbinovski M. Prosvetno delo Skopje; 2005.
[9] Fien J, Corcoran P.B. Learning for a sustainable environment: professional development and teachers' education in environmental education in the Asia-Pacific Region. Environmental Education Research 1996: 2 (2): 227– 236.
[10] Gough A. Education and the environment: policy, trends, and the problems of marginalization. Melbourne: The Australian Council for Educational Research. 1997.
[11] Jonuzi I. High school students' environmental education in the Republic of Macedonia, Master thesis, SEEU; 2009.
[12] Kara KW Chan, Mass media and environmental knowledge of secondary school students in Hong Kong, The Environmentalist 1998; 19 (2): 85-97.
[13] Integrating environmental education in primary school education in Tanzania: teachers' perceptions and teaching practices, Kimaryo LA. Åbo Akademi University Press; 2011.
[14] Faktori osposobljavljanja ucnika za ucenje u zastiti zivotne sredine, (doktorska disertacija). Kundacina M. Filozofski fakultet Univerziteta Kiril i Metodij Skopje; 1991.
[15] Paul FJE, Robert D. Factors Influencing Children's Environmental Attitudes. The Journal of Environmental Education 1999; 30 (4): 33-37.
[16] Pulkkinen K. Teacher Thinking and practice in Environmental Education: Finnish North Carelian Primary School Teachers as Environmental Educators. In S. Tani, (Ed.). Sustainable Development through Education, Proceedings of the International Conference on Environmental Education; 2005 June 14; Helsinki, Finland, Helsinki; 2005. p. 143 – 154.
[17] Lance RH, Nojin K, Shah DV. Environmental Concern, Patterns of Television Viewing, and Pro-Environmental Behaviors: Integrating Models of Media Consumption and Effects. Journal of Broadcasting & Electronic Media 2003; 47 (2): 177-196.
[18] Ronald EO, Jill LP. A Public's Environmental Information Sources and Evaluations of Mass Media, The Journal of Environmental Education 1987; 18 (2): 9-17.
[19] Sam HH, Daphne RS. Barriers to Environmental Education, The Journal of Environmental Education 1988; 19 (2): 17-24.
[20] Srbinovski M, Abazi A, Ismaili M. Environmental Education for Sustainability in Macedonian High Schools: An analysis of new curriculum content. Abstract book of the 5th World Environmental Education Congress; 2009 May 10-14; Montreal, Canada; 2009. p. 3.
[21] Srbinovski M, Erdogan M, Ismaili M. Environmental Literacy in the Science Education Curriculum in Macedonia and Turkey, Procedia - Social and Behavioral Sciences 2010; 2: 4528-4532.
[22] Srbinovski M, Ismaili M, Abazi A. The Trend of the High School Students' Level of the Environmental Knowledge in the Republic of Macedonia, Procedia - Social and Behavioral Sciences 2011; 15:1395–1400.
[23] Srbinovski M, Palmer J, Ismaili M, Abazi A. Environmental Education in High Schools: An Analysis of New Curriculum Content, Environmental Science and Technology Proceedings from the Third International Conference on Environmental Science and Technology; 2007 August 6-9; Houston, USA; 2007. (2) p. 441-446.
[24] Srbinovski M, Palmer J. Environmental Education in Macedonian School: An Analysis of Curriculum Content and Supporting Materials for Teaching and Learning; Ecology, Biology and Biotechnology 2008; 4:19-30.
[25] Srbinovski M. Students' level of environmental education from Kiril Pejcinovic High school- Tetovo. Prosvetno delo 1996; 5: 66-81.
[26] Srbinovski M. (1997). Environmental education of the students included in the PEKSNAS project. Prosveten rabotnik 1997; 845.
[27] Srbinovski M. Affective Relations of the Students towards the Environment, Pedagogy 2006; 2:198-204.
[28] Srbinovski M. Are the basic didactical conditions for environmental education in schools fulfilled, Prosvetno delo 2005; 4: 61-67.
[29] Srbinovski M. Valuable environmental component of the students from the Republic

of Macedonia, Prosvetno delo 2005; 3: 41-49.

[30] Srbinovski M. Environmental issues in the didactic material of the primary and secondary schools in Republic of Macedonia, Ekologija 2003; 38 (1-2): 41-54.

[31] Srbinovski M. The environmental education in the primary and secondary schools in the Republic of Macedonia from biological aspect, PhD dissertation, "St. Cyril and Methodius" University, Skopje. 2001.

[32] Srbinovski, M. The relationships between some cognitive and affective environmental educational areas, SEEU (South-East European University) Review 2005; 2 (2): 223-239.

[33] Stevenson RB. Schooling and environmental/sustainability education: from discourses of policy and practice to discourses of professional learning. Environmental Education Research 2007; 13 (2): 265 – 283.

[34] Srbinovski, M. Environmental Contents in the Textbooks of the Primary and Secondary Education in the Republic of Macedonia, 9th International Conference on Hands on Science (HSCI'2012), including 1st Children's Summit on Hands on Science and Environmental Education (HSCI-EE); 2012 October 17-21, Antalya, Turkey (in press).

[35] Tilbury D. Environmental education within pre-service teacher education: The priority of priorities. International Journal of Environmental Education and Information 1992; 11 (4): 267 – 280.

[36] UNESCO-UNEP. Environmentally Educated teachers the priority of priorities? Connect UNESCO-UNEP Environmental Education Newsletter 1990; XV (1): 1 – 3.

[37] NESCO-IBE. World Data on Education, 7th edition;2010/11. http://www.ibe.unesco.org/en.html [8/23/2012].

[38] Kollmuss A, Agyeman J. Mind the Gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? Environmental Education Research 2002; 8 (3): 239-260.

AN INVESTIGATION ON THE RELATIONSHIP BETWEEN STUDENTS' CONCEPTUAL UNDERSTANDING AND THEIR GRAPH DRAWING AND INTERPRETATION SKILLS

N. Gültepe
Çankırı Süleyman Demirel Fen Lisesi, Turkey
nejlagultepe@gmail.com

Abstract. *This is a qualitative study guided by purposive sampling method with the aim of analyzing high school students' graph drawing and interpretation skills and exploring how they relate these skills through their conceptual understanding. The sample was formed by 63 students studying in the 11th grade of a science high school. Four questions were prepared for the aim. Considering the findings, 20 students were interviewed. Students' answers were analyzed and we found that students having a good level of conceptual understanding also have strong graph drawing and interpretation skills and misconceptions underlie the challenge students' encounter in graph drawing.*

Keywords: Conceptual Understanding, Scientific Process Skills, Skills of Drawing and Interpretation Graph.

1. Introduction

Science is about examining natural events. Scientists obtain findings through observation and measurements. Presenting the findings to the science community provides the impartial analysis of other scientists' experiments and data. Visualizing data in an understandable way is basically important in all branches of science. These presentations can be data graphs which show relations between variables to organize and analyze quantitative data. Graphs help scientists make estimations to support and rebut their hypotheses; provide the complex relations (dual, triple, quadruple or more) between multivariable data to be shown clearly and the presentation of the results in the fastest way and; simplify the assessment and analysis of data [9]. Graph drawing, analyzing and interpretation are natural components of science practice from science lessons to advanced experimental and theorical research [5]. Since showing the relations between context related variables is important in science, science education researchers put additional emphasis on students' skills of representing scientific events in graphs and graph

© 2012 HSci. ISBN 978-989-98032-0-6

interpretation [9]. Many researchers believe that inadequacy in graph skills is a serious barrier in comprehending science concepts [11]. In this respect; students should gain and develop graph drawing and interpretation skills in the first place to prepare for further subjects and classes. Because, students have difficulty in drawing graphs and interpreting them in a scientific language [4]. The difficulties students have while drawing graphs and interpreting them were listed as: (a) inadequacy in comprehending concepts in context; (b) inadequate knowledge about graph language and its rules or inadequate skill in putting knowledge into practice; (c) problems in defining variables and connecting graph with variables [11].

In this respect the problem of this research- in which graph drawing and interpretation skills of students were analyzed and how they related these skills with their conceptual understanding was examined- was defined as “Is there a relation between students’ graph drawing skills and their conceptual understanding?”

2. Methodology

2.1. Research Design

This study is a qualitative one that was carried out making use of purposive sampling method based on data resolution methodology with the aim of analyzing high school students’ graph drawing and interpretation skills and exploring how they relate these skills through their conceptual understanding.

2.2. Sample

The sample of the study was formed by 63 (30 girls, 33 boys) students. In the study carried out with the four different branches of the same grade level of a science high school. In the classes where the research was conducted, chemistry lessons were mostly taught through teacher-centered methods.

2.3. Data Collection

2.3.1. Question Cards

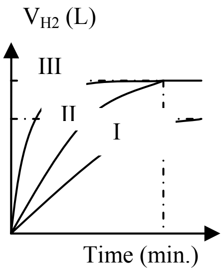
For the aim of the study, four questions formed with open-ended, multiple choice, paper-pencil performance assessment types were prepared based on “factors affecting reaction rate, reaction mechanism and Le Chatelier Principle” topics. Content of the questions was prepared to assess students’ skills of defining variables while interpreting or drawing a given graph about subjects of the study, comparing variables, determining relations between variables and generalizing.

Three independent questions related with reading and interpreting data graph about factors affecting reaction rate and reaction mechanism were asked. In the fourth question students were asked to draw a graph showing the changes in reaction rates when the temperature and volume of a balanced reaction drawn in particular level were changed. The question about reaction mechanism was quoted from [3]’s study. Other questions were developed by the researcher through examining the 11th grade science course books and especially misconceptions that peer students have in literature [6]. The first question which required graph interpretation skill was prepared as multiple choices and was about the effects of surface area and concentration of reactants on reaction rate (Fig.1). The second question was about the effect of temperature and catalyst on reaction rate and the students were asked to analyze a graph belonging to Maxwell-Boltzmann energy distribution and to interpret it explaining what changes were made in the reaction and its reasons through collision theory. (Fig. 2). The third question was about reaction mechanism and the aim was to establish students’ adequacy in basic concepts such as reaction mechanism, slow and fast steps in the mechanism and reactive intermediates, and whether they could interpret the graph related (Fig.3). Fourth question was about the application of Le Chatelier principle and the students were given a system at equilibrium drawn in particular level. They were asked to determine the change in the system that would occur when the volume and temperature of the system were increased; to show the change on the rate of forward-reverse reactions drawing a rate-time graph (Fig.4).

After doing the lessons which involved the subjects of the research, each question was prepared as question cards and handed to students and response time was determined as 30 minutes. At this stage of the research, students were required written answers and they studied individually. For the content validity of the questions, opinions of 3 chemistry teachers and 2 university instructors were received. Each question was prepared as question cards and handed to students with these concepts

© 2012 HSci. ISBN 978-989-98032-0-6

Question 1 a)



Al components in same mass are put to HCL solutions separately with equal volume and temperature and reactions are elicited

$Al_{(s)} + 3HCl_{(aq)} \longrightarrow AlCl_{3(aq)} + 3/2H_{2(g)}$

In this reaction took place at full yield, the change in the volume of hydrogen gas obtained in time is as in the graph. Which one(s) about the graph below is (are) true?

Options	[HCl], (M)	Surface area of Aluminum
a)	I>II>III	I: in sheets II: in sheets III: in sheets
b)	I=II=III	I: powdered II: in pieces III: in sheets
c)	I=II=III	I: in sheets II: in pieces III: powdered
d)	II=III>I	I: in sheets II: in pieces III: powdered
e)	III>II>I	I: powdered II: powdered III: powdered

b) Which graph shows the change in the rate of the first reaction in time? (R.R.: Reaction Rate (M/min.) t: Time (min.))

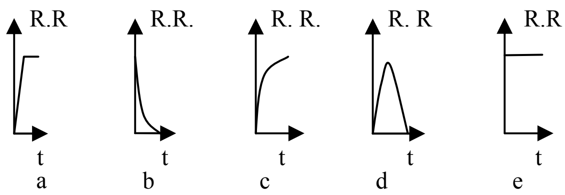


Figure 1. *Question card 1*

Question 2. The graph below is a Maxwell-Boltzmann energy distribution curve which shows average energy distribution. In the graph; curves shown in continuous lines (___) change into discontinuous lines (------) through reactions taking place in certain circumstances. (a) Explain the reason for the change in the graphs briefly. (b) Define X and Y, then compare their size. (c) Comment on the parabola in X state on the left side graph considering the particular level and energy variables.

Ea: Activation Energy N. P.: Number of Particle

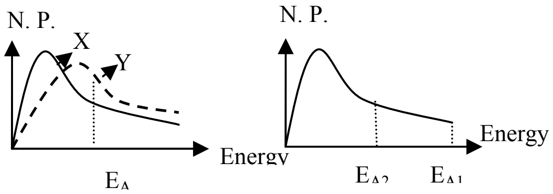


Figure 2. *Question card 2*

Question 3. The reaction of X substance decomposing and turning into Q substance reaction is as below:

$$X \longrightarrow Q \quad \Delta H > 0$$

Some scientists experimented to find the mechanism of this reaction. They measured the concentration of the substances within the reaction until the reaction came to an end and drew a graph with the findings. How many stages are there in the reaction of this graph? Define J.

☐ J is a reactive intermediate ☐ J is a catalyst
o ☐ J is an activated complex

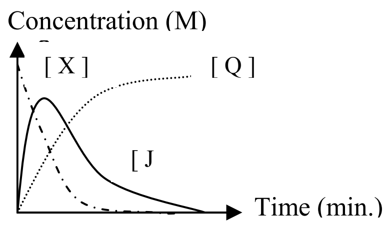


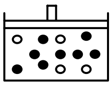
Figure 3. *Question card 3*

© 2012 HSci. ISBN 978-989-98032-0-6

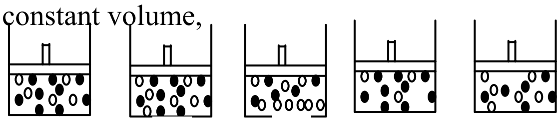
Question 4.

2 ○ ⇌ ● + *heat*
(gas) *(gas)*

reaction reaches equilibrium as shown below after a while it starts.



I) When the volume of the container is tripled in constant temperature,
II) When the temperature is increased in constant volume,



A B C D E

which one of these cases A, B, C, D, E represents the newly formed equilibrium condition above?
Show the rate changes in forward and reverse reactions in the new equilibrium through a *rate-time graph*.

Figure 4. *Question card 3*

2.3.2. Interview

Considering the findings obtained from the answers of the students, 20 students were interviewed chosen as advanced, medium and lowest level (Table 1).

Table 1. *Criteria used determining the students to be interviewed*

Success Level of Students	Coding
The ones who answered all questions fully and correctly	A1, A2, A3, A4, A5
The ones who answered two of the questions fully and correctly	B1, B2, B3, B4, B5
The ones who answered one of the questions fully and correctly	C1, C2, C3, C4, C5
The ones who answered all questions incorrectly or insufficiently	D1, D2, D3, D4, D5

Semi-structured interviews were had in order to find out the challenges students encountered while drawing graphs and interpreting them; figure out to what degree they applied the knowledge they had; establish what their ideas and beliefs about these issues were; and besides increase the reliability of other data. Interview questions were prepared on the basis of students' previous answers to the applied questions before. Interviews were finished in two weeks and an interview with one student took 10-15 minutes.

3. Findings

In this section findings obtained from students' answers to the four questions prepared to establish the conceptual understanding of students and their graph drawing and interpretation skills and the relation between these skills and their conceptual understanding; and findings obtained from interviews had with 20 students selected according to these answers were discussed. Descriptive analysis method was used in the analysis of data.

Findings of Question 1

Percentage distribution of students' answers to the first section of this question is given in Table 2. It was observed that most students chose (d).

Table 2. *Results of the question 1a*

Question	A	B	C	D	E	D & E*
1a	-	7.9	14.2	66.7	-	11.1

That is to say; students thought that the reason of the small amount of hydrogen gas volume coming out in the first parabola was the metal in pieces used in the reaction and low concentration of the acid solution. They related the equal amount of hydrogen in second and third to the surface area of the metal. Students were asked to design an experiment to form a graph of the data. The experiments students designed were parallel with their written answers. Below are the examples of these experiments:

B1: Concentration of HCl used in first experiment is lower than second and third. Concentration of second and third is equal. If the metal is in pieces in second experiment, it is in finely powdered in third one.

B2: Reaction taking place with 100 mL 1 M HCl solution in 10 g metal in sheets
Reaction taking place with 100 mL 2 M HCl solution in 10 g metal in sheets
Reaction taking place with 100 mL 2 M HCl solution in 10 g metal in tiny powdered

These students could interpret the graph correctly but weren't able to consider all the alternatives (such as the different concentration of all solutions) while analyzing the reasons of the obtained data at the end of the experiment.

Seven students chose (d) and (e). During the interview with student A1 and A2 who also answered this way, they expressed that whereas concentration was efficient in both rate and amount of product, surface area was efficient in only rate, therefore concentration of solutions in second and third experiment could be equal or third solution could be more concentrated. They said that (e) could occur if third solution was more concentrated than second solution and if the metal was limiting reagent.

9 students (eg., C2, D1 and D3) chose (c). During the interviews they explained the difference in reaction rates only through surface area variable.

C2: As surface area of metal increases, rate increases. However, the amount of product formed after a while is the same. Since solid couldn't decompose in I., H_2 volume became less in time. Rate of production in II. is slower than III, because surface area of metal is less. In first reaction, hydrogen volume can reach the equal level in more time.

Just like C2, D1 also expressed that equal amount of hydrogen gas could be obtained in first reaction in more time.

It came out that D3 had misconceptions like *"surface area of bigger pieces is more than small pieces"* and therefore *"as surface area decreases rate increases"*. Student expressed that the fastest reaction belonged to the parabola III and the slowest one was in I.

Five students (eg., C4) chose (b). These students couldn't understand what the variables in the axis (hydrogen gas that came out) meant. C4 took the volume of the hydrogen gas obtained on axis y in the graph for the volume of the container that the reaction took place; therefore expressed that the slowest reaction would be third one. The reasons why this student misinterpreted this graph were both misconceptions and misdescription of the axis in the graph.

C4: Volume and rate change inverse proportionally.

Researcher: Why?

C4: In rate expression, we take the concentration of the ones that enter. As volume increases, concentration decreases. Third parabola would be slower, I suppose. If so the surface area of third one must be the least. The surface area of metal in sheets is big but little. Accordingly, the second is faster, the first is the fastest. Then the surface area of metal used in the first experiment must be the most. It must be the smallest to have the most surface area.

Before skipping to the graph in question 1b, students were first asked about the definition of reaction rate and then asked to explain the reasons of their answers relating them with collision theory. Dialogue examples with students who chose (b) are as below. These students defined reaction rate as "the change of the amount of substance that reacts (e.g., A1 and B2) in time".

A1: Concentration of hydrochloric acid will decrease in time. Hence collision number will decrease. Since it is directly proportional with the cube of concentration of HCl acid, there should be a graph decreasing parabolically not one decreasing linearly.

B2: A higher concentration of reactants leads to more effective collisions per unit time which leads to an increasing reaction rate, but since it decreases in time, reaction rate will decrease parabolically compared to the first and will come to an end. When we take a look at the volume of hydrogen produced, as it increases parabolically, rate will decrease parabolically, too.

As students develop deep conceptual understanding, they interpret the graph in detail and correctly.

The result of the second section of this question is given in Table 3.

Table 3. *Results of the question 1b*

Question	A	B*	C	D	E
1b	1.6	46.0	9.5	39.7	3.1

Most of the students who chose (c), (d) and (e) expressed that the reaction rate would increase at the beginning, when the reaction came to an end its rate would be zero or no change would occur.

D1: The rate of the reaction is the rate of formation of hydrogen, the answer is c, because the volume of hydrogen coming out during the reaction and reaction rate go parallel. As the reactants are consumed, formation of products increases. Reaction rate increases until all the reactants are consumed. When the reactants consume, reaction rate becomes constant.

D5: Reaction rate is the time that passes until the reaction is completed. If there is no effect like catalyst from outside, reaction rate won't increase or change. I think the answer is e.

These students chose the wrong graph since he was inadequate about concepts and they had

© 2012 HSci. ISBN 978-989-98032-0-6

misconceptions. C1's opinion that "it gradually slowed down and decreased" showed that he read the parabola in the graph correctly and used the graph language properly.

C1: The rate of the reaction is the rate of formation of hydrogen. Increase in the volume of hydrogen indicates that the reaction rate is very fast at the beginning but then it gradually slows down and comes to an end (answer is d)

Findings of Question 2

In second question most students stated that temperature was increased in parabola I and catalyst was used in parabola II.

Students were asked to interpret about the parabola I of first graph but just four students (eg.A2) could answer. When students have high conceptual understanding, they can explain the reasons for the changes in graphs scientifically.

A2: The curve in second position in the graph moved to the right. So, kinetic energy of particles increased and temperature was changed. There occurred more efficient collisions since there was an increase in the number of particles that exceeded activation energy. Reaction speeded up. Therefore, temperature was increased. In second graph, the curve didn't change, only activation energy decreased. That's why catalyst was used.

A question about what kind of an outer effect caused this change in first graph and what kind of changes occurred on the reaction rates with those effects were asked and nine students gave answers as temperature, surface area and volume.

D3: Activation energy didn't change. Only catalyst can change it. Surface area of substance may have been. The surface area of substance decreased since number of particles decreased, because more substance reacted. The parabola on Y is faster, I suppose.

Six of these students answered that parabola Y had low temperature. During the interview C1 stated that since temperature increased, particles reacted more; therefore, number of particles decreased. When the answer of the student were analyzed, it was found out that he misunderstood the meaning of number of particles on y axis, misinterpreted the distribution of curve and had concepts that weren't detailed or deepened which were only memorized.

That most of the students gave correct answers to this question was related to the end-unit exercises. The graphs were familiar to students however it was understood that they didn't question the concepts which were the basis of the graphs and besides what the distribution of parabolas meant in the graphs.

Findings of Question 3

Students were required to estimate the possible reaction mechanism of a given graph in this question. Students' answers and percentage of them are as in Table 4.

Table 4. *Results of the question 3*

Answers	Answer Percentage
One step reaction. J is an activated complex.	6.3
One step reaction. J is a catalyst.	20.6
Two step reaction. J is a catalyst.	44.4
*Two step reaction. J is an intermediate reactive.	28.6

C2 who said the reaction was one step and J was an activated complex explained that since J formed and didn't take place at the end of the reaction, it could be defined as an activated complex.

C2: It is an activated complex. J was formed at first and then consumed.

Researcher: Can't it be catalyst or intermediate reactive?

C2: It can't be catalyst; it will change the reaction mechanism. It should have been multi-step mechanism… It can't be intermediate reactive; as I have mentioned the reaction is one step.

Researcher: Why is it one step mechanism?

C2: Because J should have been formed while X was being consumed and then Q should have been formed while J was being consumed. The graph couldn't be this way. All were occurred at the same time I mean X was consumed and J was formed; J was consumed and Q was formed.

The reason why C2 misinterpreted the graph was his misconceptions about catalyst (increasing reaction mechanism) and unperceived memorized knowledge about the formation of activated complex (its formation in one-step reaction, not the formation in reactions with mechanism).

The students who defined J as catalyst first indicated the forming and then consumption of J. C4 interpreted his answer relating it with reaction rate.

C4: J is a catalyst. When we look at the curves in graphs X, Q and J, we can see a parallelism. That is to say; J reacts as X is consumed and Q is

 ISBN 978-989-98032-0-6

formed. After all, the reaction moves fast at the beginning and then slows down.

C4 related the slopes of the curves in the graph with rate correctly. However, he mentioned that "J is consumed in parallel with the consumption rate of X and meanwhile Q is formed". He interpreted the increase in J as consumption.

Answers of A2 are proper examples indicating that when students have correct structures on their minds they develop deep understanding.

A2: I think J is an intermediate reactive and the reaction is two-step. The first step is fast but the second one is slow. In the first step X was consumed and J was formed faster. In the second step J turned into Q and this step occurred slowly…

Researcher: Well, can't J be a catalyst?

A2: No. Because it was first produced during the reaction and then consumed. OK, all was consumed and it won't take place during the overall reaction but... I don't think so. It is an intermediate reactive, because it was first formed.

Findings of Question 4

For the equilibrium question %30,2 of the students answered correctly, most of them (% 68,2) centered upon both c and e. 4 students (%6, 3) chose (c) for the part I and (a) for the part II. During the interviews with students it was found out that the ones who choice both (c) and (e) couldn't transfer Le Chatelier principle beyond theoretical knowledge since they weren't able to relate chemical equilibrium with collision theory and reaction rate. Also they couldn't relate equilibrium expression with these concepts.

D5: When volume is increased equilibrium will move on the reactants side. Hence the number of reactants will increase and the number of products will decrease; (c) and (e) enable this. Since it is exothermic reaction, when temperature is increased, equilibrium will move to the left side. Number of reactants will increase and the number of products will decrease so the answer should be (c) and (e).

It was observed through students' interpretations during interviews that they reflected the misconceptions they had on the graphs they drew (Fig. 5). Some of the important findings were established from their drawings are below:

— *Not setting connections between collision theory, rate and Le Chatelier principle*. Students had the opinion that when there was an outer effect on a reaction at equilibrium, it speeded up towards the direction the reaction moved, and reverse reaction slowed down towards that direction (eg., C4, D5).

— *Not comprehending chemical equilibrium concept.* The forward and reverse reaction rates of the system which reached equilibrium again were drawn different level (eg., D5) or the rates of the first and new equilibrium were drawn the same level (eg., C4).

—*Drawing of the graphs linearly, not parabolically* (eg., D5).

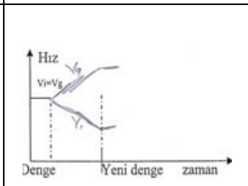
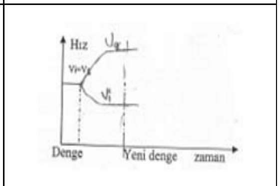
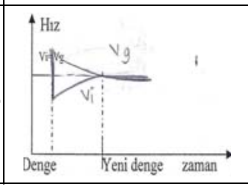
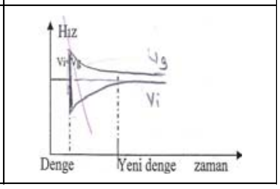
	When Volume Is Increased	When Temperature Is Increased
D5		
C4		

Figure 5. *Examples of graph students drew I*

Some of the students could interpret this question correctly with a scientific language (eg., A2 and B2).

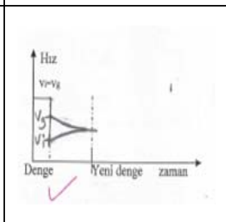
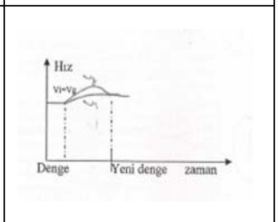
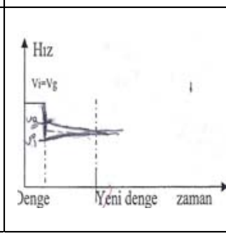
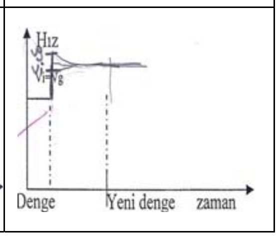
	When Volume Is Increased	When Temperature Is Increased
A2		
B2		

Figure6. *Examples of graph students drew II*

That these students used convex and concave states of the parabolas in the graphs correctly was an indicator that they develop their concepts correctly and deeply. The graphs students drew are in Fig. 6. The answers A2 gave during the interviews and the graphs he drew were parallel to each other as below.

 ISBN 978-989-98032-0-6

A2: When volume is increased, gaps between particles will widen therefore the probability of the collision of two particles will decrease. When volume is increased concentration decreases. According to coefficients, equilibrium will move to the side where the total of gas coefficients is more. Equilibrium constant won't change since temperature doesn't change. Equilibrium constant of the first system is ½. (e) enables this.

Students may be insufficient in transferring their knowledge to the graphs. For example during the interview with student B2, he expressed that when volume was increased, rate of each reaction would decrease however forward reaction would slow down more and when temperature was increased, rate of each reaction would increase but reverse reaction would speed up more. He expressed that reaction would move to left side in order to balance rates in both situations. According to the answer of the student during the interview, it was found out that he didn't have misconceptions but he had difficulty in transferring his knowledge to graphs. The student drew about the decrease in the rates of forward and reverse reactions when volume was increased; the increase in the rates of forward and reverse reactions when temperature was increased; the unequal state of reaction rates of the first equilibrium compared to the reaction rates of the new equilibrium; and equal rates of forward and reverse reactions in equilibrium; however, he couldn't transfer the changes in the rates of forward and reverse reactions at the stage of the forming of the new equilibrium to the graph correctly. Below is Fig. 7 including the graph student B2 drew.

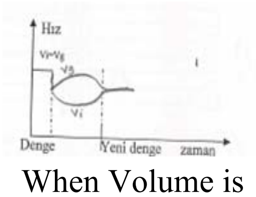
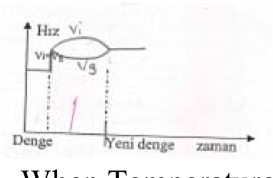
	
When Volume is Increased	When Temperature is Increased

Figure 7. *Example of a graph B2 drew*

The results of the exams applied to assess student's academic proficiency; quality of students' answers in these exams and in-class activities showed that application of achievement tests and short-term and long-term oral and written feedback activities such as interviewing with students had positive effects on students' interpretation, graph, reasoning skills and their conceptual [1].

5. Discussion and Suggestions

Drawing and interpreting graphs are difficult skills requiring cognitive stages because interpreting a graph, deducing about an experiment or research using graphs require reasoning of knowledge, using existing background information, interaction with learned concepts and scientific thinking skills [2, 12]. There is a positively important relation between students' advanced graph skills and their high performance in maths and science [4]. For example, students A2 and B2 who were academically highly successful students also had high conceptual understanding levels on graph drawing and interpretation skills. These students' performance on graph draws and interpretation and supporting their answers using all the hypotheses were indicators of their scientific thinking. Below; difficult situations while drawing graphs, interpreting a given graph and interviews that student's encounter, the reasons underlying these and steps to be taken in order to prevent or overcome these were discussed.

Insufficiency in their conceptual understanding and misconceptions may mask students' graph drawing skills. To prevent this, teachers should be much more careful about teaching the concepts that the students are not familiar to. Moreover, they should be aware of students' misconceptions about these concepts.

In multivariable graphs students have to think about more than one factor. Most students are able to define variables in simple graphs whereas they have difficulty in defining and interpreting the relations between them in graphs with more than one variable [2, 4, 8].

To prevent this, classes should be organized towards improving students' concept-related graph drawing and interpretation skills. Students should be provided with written and oral opportunities with activities. Teachers should both help students comprehend the content of science programmes and improve their scientific process skills which are the basic components of scientific literacy [8]. If process skills are determined clearly and activities and exams are applied proper fort his aim, their learning gains will increase [1, 7, 10].

6. References

[1] Ardaç D, Muğaloğlu, E. Bilimsel Süreçlerin Kazanımına Yönelik Bir Program Çalışması; 2002. V. Ulusal Fen ve Matematik Eğitimi Kongresi-ODTÜ, Ankara.

[2] Bowen, GM, Roth, W. Why students may not learn to interpret scientific inscriptions. Research in Science Education. 2002; 32, 303-327.

[3] Çakmakçı, G., Leach, J. Turkish Secondary and Undergraduate Students' Understanding of The Effect of Temperature on Reaction Rates. Paper presented at the European Science Education Research Association (ESERA) Conference, Barcelona, Spain.2005; August 28- September 1.

[4] Colvill, M., Pattie, I. Science Skills-The Building Blocks. Artı Investigating. 2003; 19 (1). August, 21–23.

[5] Friedler, Y,, McFarlane, A. Data logging with portable computers: a study of the impact on graphing skills in secondary pupils. The Journal of Computers in Mathematics and Science Teaching, 1997; 16(4), 527 – 550.

[6] Gültepe, N. Bilimsel tartışma odaklı öğretimin lise öğrencilerinin bilimsel süreç ve eleştirel düşünme becerilerinin geliştirilmesine etkisi (Yayınlanmamış Doktora Tezi). 1995; Gazi Üniversitesi, Ankara, Turkey.

[7] Harlen, W. Purposes and Procedures for Assessing Science Process Skills. Assessment in Education.1999; 6(1), 129–144.

[8] Handelsman, J.,Ebert-May, D, Beichner, R., Bruns, P.,Chang, A.,DeHaan, R., Gentile, J., Lauffer, S.,Stewart, J. Tilghman, S.M., Wood, WB. Scientific Teaching. Science,. 2004; 304, 521-522.

[9] Kelly, D., Jasperse, J., Westbrooke, I. Designing Science Graphs For Data Analysis and Presentation: the bad, the good and the beter. Department of Conservation technical Series 32. 2005; Department of Conservation, Wellington.

[10] Koray, Ö., Köksal, Mustafa S., Özdemir, M., Presley, Arzu İ. The Effect of Creative and Critical Thinking Based Laboratory Applications on Academic Achievement and Science Process Skills. Elementary Education Online, 2007; 6(3), 377–389.

[11] Lapp, DA, Cyrus, VF. Using data-collection devices to enhance students' understanding. The Mathematics Teacher. 2000; 93(6), 504 – 510.

[12] Roth, W. M. (2004). Emergence of graphing practices in scientific research. *Journal of Cognition and Culture*, 4, 595-627.

DEVELOPING THE COURSE OF "PRACTICAL THEORETICAL PHYSICS" FOR HIGH SCHOOL STUDENTS

M. Tyntarev
Lyceum "Physical-Technical High School"
8/3 Khlopina str., St.Petersburg
194021, Russia
www.school.ioffe.ru
tynt@mail.ru

Abstract. *The course of "Practical Theoretical Physics" for high school students is being described. The aims of the course are: to teach the general methods of theoretical physics, estimations, approximate methods, using mathematics understandable enough for high school students; to demonstrate how scientists work; to use the methods of physics to explain the world around us.*

Keywords: Approximate methods for solving differential equations, physics teaching, theoretical physics in high school.

1. Prehistory

"The last real physical problem, which has a simple rigorous solution, had been solved more than 100 years ago." This was the first thing I was told by Professor Alexej Pilia, famous theorist from Ioffe Institute. I was at the time a second year University student, desiring to participate in the Theory Department research. Of course, I was overloaded with all the complicated mathematical methods which were supposed to help me in my future professional activity. But it turned out that my university mathematics did not work directly, because none of the problems I was given had a rigorous analytical solution. So my practical education began with studying the art and the craft of

© 2012 HSci. ISBN 978-989-98032-0-6

making estimations and approximations. And all my further work at the Theory Department showed how necessary these skills were.

2. Locus in quo

I developed the course of "Practical Theoretical Physics" three years ago and have been teaching it as an elective one at the Lyceum "Physical-Technical High School" in St.-Petersburg. The Lyceum is a department of Academic University. A lot of its graduates continue their studies taking university courses in physics and mathematics. About one half of the teachers are part-time university scientists. School pupils, university students and scientific researchers work and study in the same building.
School curriculum includes a great number of elective courses in science and humanities.
My course is meant for the students, who desire to become physicists and are interested in theory.

3. What does it mean "practical theoretical physics"?

The course is desired not to tell stories about the physical theory but to give the pupils an opportunity to feel themselves real researchers.
The problems they are suggested to solve at the lessons look very simple (as opposed to purposely complicated ones from a book of problems), but none of them can be solved by direct use of some formula. It is required to explore some natural phenomenon completely in order to obtain the answer.
Thereby every lesson becomes a model of the work of a scientist: we discuss the object qualitatively, create a mathematical model, make estimations in order to simplify our equation, solve the equation approximately by different methods and with different orders of accuracy, and even make an experiment to prove (or to disprove) our calculations.

4. How it works

I worked out a system of problems based on very simple phenomena of nature, such as mathematical pendulum (nonlinear, of course), water run-out from a vessel through a hole, body falling from some altitude in the air and so on. All these problems require differential equations but very simple ones with only one independent variable.
The sequence of problems is organized in such a way that each of them requires some new method of approximations and we "invent" this method step by step.
We learn how to estimate the order of magnitude, to make series expansions, to use the successive approximations method.
We even use the Wentzel-Kramers-Brillouin (or semi-classical) method, a very powerful tool for solving wave equations. Of course we do not examine the partial differential equations, but the study of the pendulum with the variable string length gives us a good possibility to learn this approximate method.

5. General ideas

At every lesson I speak about two main ideas.
1. To know physics means not to remember all the formulas but to understand the laws. There are a lot of formulas for all the special cases but only few general laws of nature. And when we use this or that formula we must be sure that it is applicable to our particular case.
2. The aim of the analytical solution is not to obtain the most precise result we can get. If we want to obtain desired quantity with a lot of significant figures we should use a computer to solve the equation numerically. But if we want to understand the essence of the matter and to explain all the correlations we have to solve the equation analytically and our solution must be fairly simple. So the order of accuracy is enough when all the parameters we are interested in appear in the final solution.

6. Let us go to a lesson

A problem is given. There is a barrel full of water. And there is a little hole in the bottom. What is the velocity of water flowing out through the hole? The viscosity is a negligible quantity.
The first thing the pupils do they think of the Bernoulli's formula. It helps us to obtain immediately the result: $\mathbf{v} = \sqrt{2gh}$, where **v** is the velocity of water flowing out and ***h*** is the height of the level of the water in the barrel. It is a very good result, but does not the velocity actually depend on the area of the hole? Our intuition tells us that it does. Maybe the Bernoulli's formula is not suitable here?
Let us begin from the beginning. Here – from the energy conservation law. At first it seems that the result is the same, but when we take into consideration (it usually takes some time for pupils to find it) all the terms including the small change of the kinetic energy of all the water in

the barrel the equation becomes very complicated. Now it contains the velocity of the water level descending, which is, obviously, the first derivative of h. There is no explicit solution to the differential equation obtained. But we have a small parameter. It is the ratio of the whole area to the area of the bottom. The zero-order approximation (it means we neglect the small parameter at all) gives us Bernoulli's formula. Using the method of successive approximations we can simply obtain the 1-order result which contains the area of the hole. Is it necessary to look for the 2-order approximation? Definitely not, because we now know approximately how the desired velocity depends on all the parameters. The 2-order solution will provide some more precision but no other qualitative information.

This thought experiment can be followed with the real one. The only difficulty is to make a hole with variable size in the bottom of a vessel.

7. Another lesson

Let us explore the mathematical pendulum. Dissipation can be neglected. Obviously, the motion is periodic. What does the period depends on? The pupils usually name the gravitational constant and the string length. Sometimes the amplitude is named too. We discuss qualitatively the oscillations and then write down the equation of motion given by Newton's law: $\ddot{\varphi} = -\frac{g}{l}\sin\varphi$, where g is the gravitational constant, l is the string length and φ is the angular coordinate. This equation has no explicit solution so we have to solve it approximately. There is no small parameter and we cannot make the approximation which is correct at every value of coordinate φ. So we try to solve the equation for small φ. The 1st-order approximation, when we assume $\sin\varphi \sim \varphi$ immediately gives a well-known solution with period $T = 2\pi\sqrt{\frac{l}{g}}$. This solution does not contain amplitude so it is a reason to use next approximation.

Before doing this we discuss how the period can depend on the amplitude, comparing the graphs of $\sin\varphi$ and φ. Usually, somebody finds out that the period is slowly increasing with amplitude.

Than we approximate the right-hand side with more accuracy assuming $\sin\varphi \sim \varphi - \frac{\varphi^3}{6}$ and solve the equation, carrying out the series expansions before taking the integral. We obtain period $T = 2\pi\sqrt{\frac{l}{g}}(1+\frac{\varphi_0^2}{16})$, where φ_0 is amplitude.

After my fist lesson with this problem my students asked me, whether we are going to make the experiment. The dependence on the amplitude is too small and I was not sure it is possible to observe it, but we tried. We attached the string to the ceiling but failed to catch any effect with the stop-watch. But if the pupils want to do something they will do it! Finally a long rope was attached to a handle of a mop which lied across the banister and the pendulum was hung up in the stairwell. We proved experimentally that the nonlinear effect is observable when the string length exceeds 12 meters!

8. Conclusions

I can state several results:

a) It is possible to create a consistent course of the methods of theoretical physics for high school pupils;

b) The pupils become sure that they can solve any physical problem even though approximately;

c) Experiments in class are very interesting even for the pupils who are especially interested in theory and mathematics.

The feedbacks we receive from our former students now studying at University prove the importance of such a course.

 ISBN 978-989-98032-0-6

MODERN TEACHING AND ASSESSING MODELS, METHODS AND PRACTICES, AND EDUCATIONAL COMPUTER GAMES

I. Stoica
Tudor Vianu National High School of Computer Science, 10, Arh. Ion Mincu Str. Bucharest, RO-011358, Romania
istoica4143@gmail.com

Abstract. *In order to transform the student into an active person which, guided by teachers, discovers and scrutinizes new knowledge territories, there are new teaching strategies in agreement with the student's learning manners. This bold aim can be reached by using educational computer games in the teaching-learning-assessing process. I focus upon the advantages of this method taking as example such an educational game. The aim of these educational computer games is to support student's hands-on learning of science and inspire the next generation of engineers and scientists, by delivering hands-on activity resources to educators.*
The main goal of the author is to describe an unconventional teaching-assessing way, an alternative for the classical teaching-assessing process. Learning more about Modern Physics could make a fun way to spend some great and informative time!
This paper stands up as an argument for a broadening of the assessment methods used in the science teaching process

Keywords: Computer game, cosmic rays, Higgs boson, unconventional assessing method.

1. Motivation

In my opinion, in a modern society teachers have gotten a new role, which is that of promoting mainly student-centered teaching/ learning methods.
The main goal in an active and interactive teaching learning process must be to help the students to discover the pleasure of inquiry and learning, which leads to increase confidence in their forces.
So, in the last years I focused my activity the manner in which the unconventional teaching way can provide outstanding results in the teaching process. Particularly I was concern with the manner in which the new assessing method can be implemented in the Romanian science curriculum and the ways in which they can improve it.
I think that teachers who want to encourage creativity in the classroom should make sure that they are giving their students a lot of choices and different options when it comes to assignments and projects.
Therefore, in the last years, my pedagogical activity focused on the developing of a number of educational projects and software. Throughout my entire career I could not help noticing that students love computer games. So, what does the juxta-position of the words "game" and "elementary particles" makes you think of?
Primarily, it is about a pleasant, interactive, playful activity, a hands-on way of teaching, meant to harmoniously shape and develop the student's personality. He or she discovers the pleasure of searching and finding new things to subsequently use further on. These successive inquiries, when conducted into a scientific environment, become more and more interesting but also difficult, thus the satisfaction getting even more rewarding.
Secondly, I have in mind the elementary particles physics and nuclear interactions, which describe the laws governing our universe.
Being what I am, namely a teacher in a computer science high school, I settled myself on devising a scenario for a 3-levels computer game.
This computer game is entirely interactive, and we could use this opportunity to try to become active promoters of curriculum changes in Romania.
In my opinion it's a really good opportunity, because in Romania, the 10-graders study electricity, and our textbooks present everything in a dull, unattractive way. Of course, the game will be developed in a rigorous manner.

2. Introduction

In the last few decades there has been an ongoing struggle to develop this field and make new discoveries. Sadly, the textbooks do not reflect, not even superficially, these efforts [1].
Hands-on training has always been considered an essential part of experience in the Physics teaching-assessment process. The recent teaching-assessing research papers have introduced ideas and stimulated thinking on various alternatives to the traditional didactic lectures and repetitive "cookbook" practices [2]. Obviously the effective management of educational change is crucial, but there was overall a willingness to explore the possibilities, despite cultural and traditional barriers to change [3]. For some, too, such new approaches represent significant threats to the authority of

the teacher, but many warmly embraced the ideas and debated a variety of strategies that would assist students to control their own learning [4].

The method clearly reflects a commitment to a student-centered approach and represents one form of active learning. Students faced with a problem presented to them in a group situation must work together to identify the issues and find a resolution to the problem that is presented to them [5].

The integration of the PC in the Physics education opens new perspectives and allows achieving outstanding performances.

As any good teacher knows, all students do not learn in the same way [6]. In addition, it is common for a class of students to be at a variety of levels in any particular subject. Teachers need to use different teaching methods in order to reach all students effectively. A variety of teaching strategies, knowledge of student levels, and an implementation of which strategies are best for particular students can help teachers to know which teaching methods will be most effective for their class.

The first step to choosing a teaching method is to assess the students. This assessment can be formal or informal. Formal assessments include standardized tests, tests from the textbook or curriculum being used, or teacher-created tests. These assessments can give you an idea of the previous instruction that the students have received as well as their academic level [7]. The students in your class may have undergone various teaching methods and quality of instruction in previous years. There are many, many teaching methods. If the teacher finds the best teaching method for a particular group of students, the students are likely to learn more quickly and be more engaged. In addition, using a variety of teaching methods will keep children from being bored, and help them encounter the information in new and exciting way. The main goal in an active and interactive teaching learning process must be to help the students to discover the pleasure of inquiry and learning, which leads to increase confidence in their forces. The usage of modern technologies and educational software is a must of the modern educational process. Students, teachers, schools and parents can all benefit from accurate knowledge of a child's skills early in that child's educational career. However, traditional assessments of skills are labor intensive and can invoke anxiety in the children. This project tested the idea that computerized assessment games might work as a support tool for teachers, providing useful information about children whilst avoiding almost all the problems associated with traditional testing [8].

Tremendous progress has been made in the field of assessment in the last 30 years. We have witnessed the introduction of the concept of criterion-referenced assessment for assessing competencies, and now that concept is now well developed (for everything from defining the competencies to developing the assessments and validating them for use), and widely applied today in education, industry, and the military. We have seen the transition from classical to modern testing theory, methods, and practices (perhaps the theory is better known as "item response theory" and the impact has been worldwide and highly significant. I have noticed the expanded use of computers in assessment, and this use holds great promise.

Modern test theory was introduced by Georg Rasch from Denmark and Gerhard Fischer from Austria, along with Fred Lord and Allen Birnbaum from the United States.

3. Objectives

The main objectives of this educational game project are:

• Supporting students' hands-on learning of science;

• Inspiring the next generation of engineers and scientists [9];

• Delivering hands-on activity resources to educators;

• Offering online training in the aria of design process to educators;

• Learning more about Physics in an unconventional way;

• Pointing out of anchor-knowledge necessary in the teaching of new concepts, and training the students in the field of conceptual and operational structures constructions;

• Equal treatment of all the students, without any discrimination and prejudice, regarding their individual self-esteem and respect, their candid and systematic evaluation, their commitment toward the duties in the line of work, and so on;

• The integration of the achieved knowledge and intellectual strategies into a derived general scientific frame.

• Integrating the achieved knowledge and intellectual strategies into a derived general scientific frame.

 ISBN 978-989-98032-0-6

• Uncovering areas of special need that may be difficult to identify without special assessment
• Exploring how multi-sensory needs may be accommodated within a game assessment framework.

4. Content

The game has a 3-level structure.

4.1. The first level

The first level introduces some basic concepts regarding elementary particles, such as: atom, nucleus, electron, proton, neutron, quark and so on [10]. At this level, the student gathers information and coins. The coins can be transformed in energy, and used at the next level, to buy hints, answers or different goodies (useful information for the next levels, and so on).

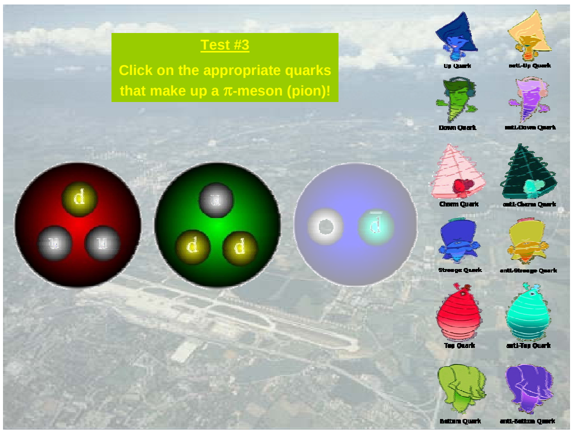


Figure 1. *A screenshot taken from the "You Too Can Search For the Higgs Boson" educational software*

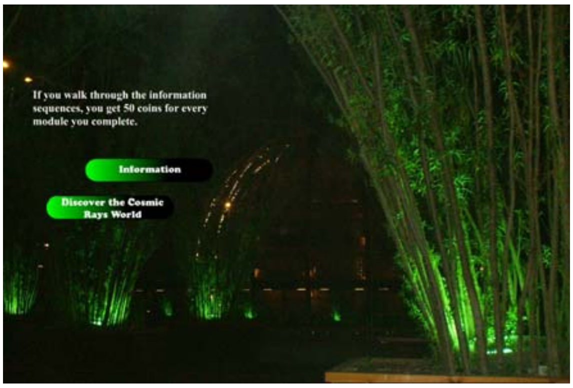


Figure 2. *The opening page of the "You Too Can Search For the Higgs Boson" educational software*

Upon completing this module, the student will receive a reward in coins and additional information sources. At this first level, we want the student to get acquainted with elementary particles. In order to reach this goal, the majority of the modules will be developed accordingly:

4.2. The second level

The second level treats rather simply things regarding: detectors, accelerators, and components assembling.
There are simulations involving notions regarding the movement of charged particles in electric and magnetic fields [11].
The student has to vary the parameters influencing the movement of the particle. In order to gain access to the next level he/she must determine and set the parameters so that the particle be accelerated to a given energy, and exit the field through a given point of coordinates (in our opinion, math is playing a main part in Physics).
Also, by drag-and-dropping, the student will assemble particle accelerators: LINAC, Synchrotron, and Cyclotron.

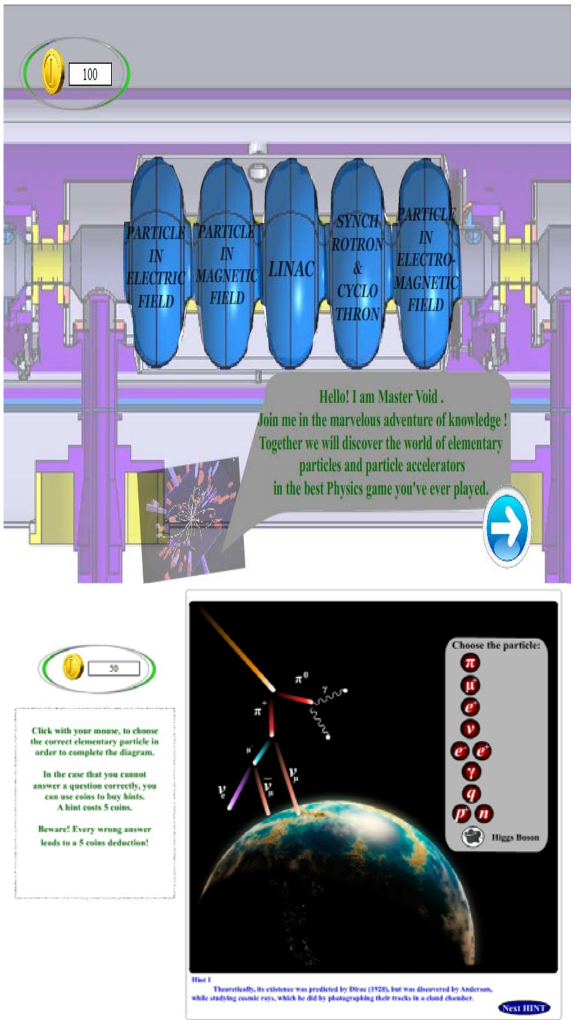


Figure 3. *Finding the right answers in the "You Too Can Search for the Higgs Boson" educational software*

© 2012 HSci. ISBN 978-989-98032-0-6

4.3. The third level

The third level is a virtual tour of the CERN.
• At the end, the student will find out what energy does the Higgs boson have and whether he or she managed to discover it or has to start the game all over again.
• When the final energy is converted into mass, if the student gets a value between 124 and 200 GeV/c2, he or she will receive the message: "Congratulations! You found the Higgs Boson".
• If the energy is lesser than the first value, the message will be: "Sorry! Keep searching!"

5. Design

Each moment of the game contains key words pertaining to the basic concepts, work tasks addressed to the student, goodies and/or clues (hints), and lovely animated simulations (in the working zone).

6. The advantages of educational software usage

The use of computers and software ICT tools in classrooms and laboratories provides much more effective and efficient environments for teaching and learning, making physics science easier to understand [12]. The advantages of using simulation software in conjunction with classroom teaching are well known. It is generally accepted that the use of interactive teaching tools, which provide instant feedback to the student's inputs, improve and accelerate the learning process. The use of simulation and ICT tools as secondary education is not a new concept [13]. However, the traditional teaching methodology used in secondary education is based mainly on oral speech and use of blackboard [14].
In line with a number of researchers in ICT education teaching approaches that are based on the understanding of software principles for problem solving involve three major components:
A. It is important to generate understanding using specific examples, visualizations, and dialogues
B. Students use software principles to construct solutions to the problem through involvement in realistic task-based activities
C. Students get the opportunity to raise questions regarding the specific problem solving process or more general problems related to software use.

The advantages offered by the educational computer game include: unconventional tests allowing for an optimal feedback; user-friendly working environments; individual and/or team work; stimulation of the creativity and of the competitive spirit by pursue of different modules; visual support which gives rapid understanding of even the most subtle and complex scientific themes.
For a more intense involvement of each student into the learning process, the educational computer game provides animation and the possibility of replay [15]. This kind of activities allow the student to learn by playing, by varying different parameters and quantities in a rigorous, mathematical way, because mathematics, creativity, logic, and originality are all needed to improve technology [16] [17] .
Also, this computer game allow the students to present a sensible and revolutionary subject such as elementary particles Physics in an attractive, accessible, yet rigorous manner.
This way of learning has a big advantage: the flexibility, the fact that each student can set his or her own pace of study. One the other hand, it invites the students to find out more by individual study, exploring the interactive lessons and taking the challenges [18].

7. Conclusion

We are not pleading for a rebuttal of the traditional teaching methods, especially in the first years of school, when the personal touch of the educator remains of utmost importance, but we strongly believe that the usage of modern technologies and educational software is a must of the educational process, an addition to the classical methods, appealing to the individual character of each student.
The enhancement of student-student and student-teacher communication skills will raise the interest of the partners in education. This way, the lesson focused on the student becomes reality, the student, as well as the teacher, being interested in the outcome of the didactic activities. A modern teaching process must give the students many quality and modern resources, including educational games. I have always had the desire to offer more than usual text book can offer, to go beyond what one studies at school in some subjects, to combine fields. These applications give me this opportunity! On the one hand, this educational game can be used very well in classes, to improve the lessons. One the

© 2012 HSci. ISBN 978-989-98032-0-6

other hand, it invites the students to find out more by individual study, exploring the interactive lessons and taking the challenges.

I argue for a paradigm shift because the traditional teaching methods cannot deal appropriately with the avalanche of new knowledge and with the accentuated dispersion of the activity domains and jobs. We are not pleading for a rebuttal of the traditional teaching methods, especially in the first years of school, when the personal touch of the educator remains of most importance, but we strongly believe that the usage of modern technologies and educational software is a must of the educational process, an addition to the classical methods, appealing to the individual character of each student. Well-designed games can allow students to be assessed without them being aware of that, thereby avoiding the anxiety that traditional testing can induce.

Game-based assessments can provide information on possible hearing issues, color blindness, and emotional [19] recognition which may not necessarily be picked up in class until some way down the line. They can also provide information about how students perform on various cognitive skills as well as higher level skills like literacy and numeracy [20].

Engaging the students in helps them to develop a better grasp of the scientific concepts, an appreciation of "how to know" what we know in science. In order to implement this assessing method in the teaching-assessing process, I compared the students' performances before and after the activities and I noticed that the learning performances have risen. I have set a group of 150 students, the results being shown in the picture below.

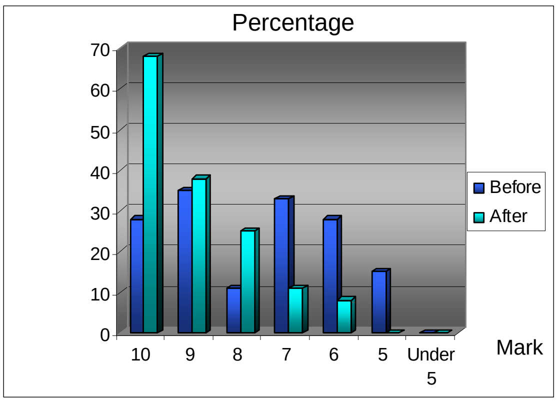


Figure 4. *Evolution of the learning progress before and after using this educational game*

I am not pleading for a rebuttal of the traditional teaching methods, but I strongly believe that the usage of modern technologies and educational software is a must of the educational process, an addition to the classical methods, appealing to the individual character of each student.

7. References

[1] Aaronsonhn E. Going against the Grain: Supporting the Student-centered Teacher; 1996.

[2] Roemer DK. A Learner-centered Approach to Teaching Regents Physics. Workshop presentation at Science Council of New York City; 1996.

[3] Felder R, Bret R. Student-centered Instruction; 1996.

[4] Galbureanu S. Pregatirea profesorilor, conditie a succesului integrarii TIC in educatie. www.elearning.ro

[5] Gell-Mann M. The Quark and the Jaguar: Adventures in the Simple and the Complex. Henry Holt and Co. 1995. p. 180.

[6] McCombs BL, Whistler JS. The Learner-centered Classroom and School Strategies for Increasing Student Motivation and Achievement; 1997.

[7] Silberman M. Active Learning; 1996.

[8] Nave R. Quarks. In: HyperPhysics. Georgia State University, Department of Physics and Astronomy; retrieved 2008-06-29.

[9] Sakurai JJ. Modern Quantum Mechanics (revised edition). Addison-Wesley Publishing Company; 1994. pp 361–363.

[10] http://virtualquarknet.org/CosmicRays.html

[11] Moraru S, Cherciu R, Stan F, Dobrescu C, Stoica I. Using Information Technology in the Modern Educational System. Proceedings of the International Conference on Hands on Science – HSCI; Ljubljana, Slovenia; 2004.

[12] Moraru S, Cherciu R, Stoica I, Bujor A, Chiperi M. Implementing ICT in Science Education. Proceedings of the International Conference on Hands on Science – HSCI; Ponta Delegada, Portugal: 2007.

[13] Moraru S, Miron C, Stoica I. Modern Techniques of Evaluation and Teaching. In: Analele Universitatii Bucuresti, Fizica, vol LV; 2006.

[14] Srednicki M. Quantum Field Theory. Cambridge University Press; 2007.

[15] www.jersey.waregon.edu

© 2012 HSci. ISBN 978-989-98032-0-6

[16] Fowler M. Modern Physics. Spring 1999 class virginia.edu
[17] Feynman R. Six Not So Easy Pieces. Basic Books; 1997.
[18] Gierl MJ, Leighton JP, editors. Cognitive Diagnostic Assessment for Education: Theory and Applications. New York: Cambridge University Press; 2007.
[19] Gewirtz H, Wolf JS. Sat II Physics, 7th edition. New York: Barron's; 1999.
[20] Microsoft Encarta Encyclopedia Deluxe. Physics-Waves; 2006.

INITIAL IDEAS OF PROSPECTIVE PHYSICS TEACHERS CONCERNING TEACHING AND LEARNING DURING A SEMINAR FOR DEVELOPING PCK

V. Grigoriou, G. Kalkanis
University of Athens, Pedagogical Department P.E., Science Technology and Environment Section, Science Technology and Environment Laboratory, Greece
vgrigor@primedu.uoa.gr, kalkanis@primedu.uoa.gr
e_site: http://micro-kosmos.uoa.gr

Abstract. *The purpose of this qualitative research was to discern the beliefs that Greek student Physics teachers hold at the beginning of a seminar concerning professional knowledge and instructional practices.* Six postgraduate student teachers who were at the second year of their master degree at Science Education participated and semi-constructed interviews were conducted in order to capture their views. Epigrammatically the conclusions show interesting consistency among each other's beliefs but inconsistency between their own. Students mention that they prefer an inquiry based instructional strategy, focusing especially on hands-on experiences, but later on they refer to actions that reveal a transmissive nature of instruction.

Keywords: beliefs, PCK, Physics teachers, prospective.

1. Background, framework

1.1. The concept of Pedagogical Content Knowledge

The concept of PCK (Pedagogical Content Knowledge) is an evergreen topic at the field of teaching and learning Science for more than thirty years, having led to a rising interest in what are important aspects of professional action competence of Physics teachers and how they develop.

It was proposed by Lee Shulman at the mid of 80's as "a special amalgam of content and pedagogy that is uniquely the province of teachers, their own special form of professional understanding" [16]. He further proposed several key elements of pedagogical content knowledge: (1) knowledge of representations of subject matter (content knowledge); (2) understanding of students' conceptions of the subject and the learning and teaching implications that were associated with the specific subject matter; (3) general pedagogical knowledge (or teaching strategies); (4) curriculum knowledge; (5) knowledge of educational contexts; and (6) knowledge of the purposes of education [17].

After the initial intromission of the concept of PCK has become a widely useful and used notion and a lot of proposals have been made as didactical strategies that can materialize this basic concept. Although there has been no consensus on the PCK models and components, all scholars agree on Shulman's two key elements - that is, knowledge of representations of subject matter and understanding of specific learning difficulties and students' conceptions [19].

1.2. A seminar for developing PCK

The notion of PCK arises as one of the most crucial subdomains (e.g. [11], [17]) of teachers' professional knowledge and it becomes more appealing when it has to do with prospective Physics teachers as the demand to broaden their PCK is even more intense.

Motivated from previous research efforts ([7], [8], [9]) which imply that Greek prospective Science teachers form only a very primitive PCK, emerged the need to provide them appropriate educational support in order to expand their professional knowledge.

Therefore, a seminar was designed in order prospective Science teachers being sensitized to the notion of PCK and to align better the content matter to be taught with pedagogy so that the content might be better understood by their students. Thus, the seminar was aiming at the development of their teaching in ways that might be described as more meaningfully directed as a result of their better understanding and valuing of their PCK.

 ISBN 978-989-98032-0-6

The seminar draws attention to the value of student-teachers participating in experiences that might contribute to the development of their PCK. Its syllabus contains concepts of general didactics, educational use of technology and authentic opportunities of instruction ([10]).

Clermont, Krajcik, and Borko [5] have studied the effects of a short, intensive workshop on specific teaching strategies (i.e., chemical demonstrations). They found that the PCK of preservice science teachers participating in this workshop developed towards that of expert teachers. Van Driel J., De Jong O. & Verloop N. [20] mention that "specific courses or workshops during teacher education have the potential to affect PCK, for instance, by extending preservice teachers' knowledge of students' preconceptions or their knowledge of specific representations of subject matter."

1.3. Participants views on teaching and learning

The investigation of participants' initial perceptions about teaching and learning becomes a focal point within the context of design and implementation of a training program aiming at the development of prospective Physics teachers' PCK. Research shows that beliefs about content, about pedagogy, and about teacher education are central to teachers' development [23]. Brickhouse & Bodner [2] report the importance of beginning science teachers' beliefs about science and science teaching on classroom instruction. Britzman [3] suggests that teachers come to the classroom with deeply held beliefs about what teaching is. Wentworth & Pinnegar [21], report that teachers often made projections from their past experiences as students about how they would be or want to be in the future when they would be teachers. Older beliefs are the most resistant to change because, when they are tested, individuals tend to recall information, however conflicting, in a way that will sustain their own beliefs [15]. It is not surprising then that classroom instruction and teacher practices are consistent with the beliefs that teachers hold ([4], [6], [13]). These perceptions have already shaped their knowledge bases and direct their lesson enactment therefore their study could provide a greater insight into ways in which those views affect their teaching practices.

Thomas and Pedersen [18] stress that the prior beliefs act as a filter. Previous life experience impacts on the way preservice science teachers perceive science courses. When new information is presented to prospective teachers, only information in agreement with their prior knowledge is likely to be accepted and alien ideas will be rejected. Gullberg et al [12] underline the importance of science educators providing opportunities for prospective teachers to highlight their personal theories and beliefs and reflect upon them. Also, studies show that student-teachers are commonly disappointed with their teacher education programmes ([14], [22].

2. Purpose and research questions

The purpose of this qualitative research was to discern the beliefs that student Physics teachers hold at the beginning of a seminar concerning professional knowledge and instructional practices. The intent was to capture and succinctly portray the general views of teaching and learning held by each participant before they were introduced to PCK

Specifically, our research survey concerns:

- Prospective Physics teachers views on teaching.
- Prospective Physics teachers views on learning.
- Prospective Physics teachers views on teaching science.

3. Methods

In order to answer the research questions, we conducted a semi constructed interview in five Prospective Physics teachers. As semistructured interview protocols, the interviews deviated from the set questions when necessary, in order to allow each participant to add their own rich flavor to their responses.

3.1 The sample

The sample consisted of five Greek student teachers during their master degree at Science Education, who were voluntary offered to participate and had expressed their will to follow Science teacher carrier. The students would next attend the educational seminar which aims at the development of their PCK. All of them didn't have any teaching experience at all in school context, apart from tutoring high school students.

3.2 The interviews

All interviews were conducted individually and in a quiet location and generally took about an

© 2012 HSci. ISBN 978-989-98032-0-6

hour each. They were audio-recorded and also during the conduct researcher kept notes.

Interview had two parts: questions about the participants' background in science teaching; and then, questions on their views of teaching and learning. The background questions primarily investigated the participants' prior experience in teaching and learning science.

The second part of the interview consisted of questions which were designed to be open-ended to stimulate and encourage teachers to discuss and share their views. Teachers were asked to provide broad responses about what the terms 'learning' and 'teaching' meant to them. They were also asked: what are the indicators that student learning has occurred?; what knowledge and skills do successful teachers need in preparing to teach?; how has your teaching changed with experience?; how does the notion of reflection influence your views of teaching?; how do you value the role of being a professional teacher?; They were also asked whether content influences their teaching approach, how and why?; if they vary their teaching approach for certain concepts in Science or is the whole unit taught the same way?; and what difference does it make when they are teaching content that they are familiar with as opposed to content that they are not familiar with?

3.3 Analysis

Once all of the five participants' first interviews had been completed and fully transcribed, the data were organized and analyzed in individual cases.

In analyzing the data, a funneling approach was adopted [1]. Initially, the data were collated and fragmented under major views or themes for each participant and then, through the funneling process, more detail in each major view or theme was extracted. In undertaking this process, sub-themes and sub-views emerged and these were created for some of the major views and themes, thus providing a more elaborate analysis.

4. Results

For each one of the participants a comprehensive description is presented.

4.1 Jim

Jim completed a Ptychion degree (four years studies) of Physics and now he is a student at a Master degree programme at Science Education. He especially admitted that gas theory remained a difficult content area for him. It was clear from his interview that he really wanted to become a Science teacher "I wanted to become a teacher since my childhood".

Jim saw teaching as a path that will lead students to new knowledge: "I believe that (teaching) has to do with leading children's minds from their beliefs to a knowledge, which is right". He was very determined with the effort to have students the big picture of the content and not just fragmented mathematical knowledge "I don't want them just to tell me the definition or the equation. I want them to make connections". Believing in such approach, he was also aware that an important part of teaching was the method or approach used in conveying knowledge. He proposed using hands on experimentation as a prominent tool for an inquiry based learning.

It appears that Jim considers that teacher should not act as a transmitter of knowledge; he should become a facilitator of learning. Teacher should be able to transform scientific knowledge to that form that would be easily accessible from his particular students: "Me as a teacher I should make the appropriate transformation to the content. I should present it to them in a way that they can understand it, having in mind the difficulties that they make face". This remark is rather interesting because it describes quite accurate the notion of PCK, although Jim has never listen before anything about it.

When Jim was asked to describe what the term "learning" meant to him, he answered that it means conceptual change from a prior state of knowledge to a more scientific one. He wanted to link learning with students' ability to explain the real world and all these been seeing from the angle of the scientific methods: "I should provide students the right 'accoutrements' and knowledge so that they can interpret phenomena that happen in their environment. It is not (learning) just a matter of equations".

Jim believes that the experience that a teacher gains throughout the years, affects directly teacher's practices, expanding his professional knowledge: "I have learnt a lot from all these years as a tutor. Now I can see details that in the past seemed meaningless to me. I have also learnt a lot from my colleagues".

4.2 Bill

Bill more or less shares the same background with Jim as both of them have attended the same studies. He stated that he likes Physics but he is not very keen on Chemistry and Biology. Later on he continues saying: "To be honest, I believe that Physics is more important than other disciplines".

What he likes about teaching is that he can lead students to format a framework of explanations with a wide field of application. For him it is of high priority to familiarize students with scientific method, which he considers to be the most valuable tool to explain the world and it can be used in a great variety of circumstances, not only for the natural world: "Science has a particular structure and use specific methods that I really want students to learn. It is useful for them; they can use it anywhere". He mentioned that a good teacher should make appropriate links across disciplines and everyday life, helping students to appreciate Science accordingly.

Bill recognized that teaching is difficult. He believed that teacher must have a very well developed content knowledge, which is much more important than the pedagogical knowledge "If you have the content, then the rest will follow". Later on he expressed the opinion that content doesn't make any difference at the instructional approach, as long as teacher is suitably prepared at the content knowledge; "It doesn't matter if you have to teach electricity or mechanics; you will use the same method. All it matters is to know the subject".

Bill described learning as acquiring new knowledge and handling adequately the scientific method. Learning has to do with what a student experiences: "Learning is what a student experiences, so it has to do with students". He placed a great emphasis on students' misconceptions especially at the actions that he should take in order to address them and less at the required actions to expose them. The most supportive tools to this direction were experimentation and putting triggering questions: "When students start experiments, you can define their misconceptions. Also, you can ask them questions in order to reveal them".

He felt rather comfortable with technology and he believed that it could promote students' learning, especially simulations: "It is easy for me to make a quick simulation e.g. to show chemical bond at the molecule of water and then explain why water is such a good solvent". He believed that teaching should be more inquiry-based rather than having students rote learn

4.3 Jenny

Jenny was also a postgraduate Physicist who is continuing her studies for a master degree at Science Education. She doesn't feel very confident with her content knowledge, nor with the pedagogical knowledge that is required to teach in primary school, recognizing that she feels more comfortable with a traditional instruction with exercises and equations rather than 'teaching for understanding'. She states that University faculties don't provide to their students the required professional knowledge in order to become successful teachers.

Jenny said that she enjoys teaching but not in the way that she had experienced in her childhood or during tutoring high school students. She believes that teaching is interesting because the teacher has to know his students and engage them with Science: "Teaching means that you have to understand students, trying to find what they are thinking and how you can help them". Jenny specifically pointed out that the teacher's role has to do with organizing appropriate strategies in order to structure and sequence teaching in a way that might enhance the learning process. She recognizes that students face difficulties in certain topics of the content and she is very conscious about their misconceptions.

Learning for Jenny is the process that students experience in order to expand their knowledge. Learning has to do with the student. When it comes to the point to mention some indicators of students learning, she answers: "Their ability to apply their knowledge". She also declares that learning has happened when students maintain for a long period their knowledge.

4.4 Julia

Julia was the only participant who wasn't a Physicist. She was a Geologist who was also continuing her studies for a master degree at Science Education. She had also made some studies in drama, which she considered quite useful for her professional knowledge.

At the interview she mentioned with enthusiasm that she really enjoyed teaching "I really like teaching! Yes!". Julia said that she likes to contribute to students' learning and that she finds

© 2012 HSci. ISBN 978-989-98032-0-6

Science stimulating for both the teacher and the students, contrary to other lessons such as language. For Julia it is important her students to recognize her efforts: "You see, I would like my students to remember me in the future, as their favorite teacher".

Julia appeared to subscribe to the view that learning is a personal issue which means that the teacher has to personalize his teaching in order to facilitate each one student and to recognize the difficulties he might face. She considers that learning happens when students are becoming able to apply their knowledge in everyday problems and link it with other principles: "For me, I assume that a student has learnt when he can link his knowledge with other facts, when he can answer questions from real life".

Julia viewed teaching as a 'facilitating action' that teacher should make the appropriate decisions in order to engage students with Science. She mentions that teaching must be interesting and that could happen with interactivity: "Teaching as telling is much more bored as opposed to teaching for learning."

Teaching is for her an action which requires an expanded content knowledge, alongside with self-confidence and experience. She reverts to experience later on when she mentions that she had expanded her professional knowledge more because of her gaining experience as a tutor, than because of her studies at the master degree programme: "I compare myself know with myself five years ago and I find her much better, leaving apart my studies. Experience is a very important factor (for teaching)". She recognizes teaching as a demanding procedure, which during the ages as teacher gains more experience becomes easier to perform.

When she is called to describe what knowledge and skills do successful teachers need in preparing to teach, she is referring to actions such as self-reflection, producing his own educational material and above all to consider his students. For Julia is important that the teacher would take seriously account the conditions that take place in the classroom and therefore change his planning according to the circumstances. Thence, she plumped for a flexible teacher who ranks higher students stimulation and engagement with Science.

4.5 Mary

Mary was also a postgraduate Physicist who is continuing her studies for a master degree at Science Education. She doesn't feel very confident with her content knowledge, especially with Chemistry and Biology. She says: "I would grade my knowledge in Physics with five, while I will give only one to Chemistry and Biology". She also describes herself as a person with low self-estimation. She really enjoys teaching Science, as "It has always been a dream for me"; she likes the contact with the children and especially with students at high school. It is important for her students to appreciate her: "I want my students to remember me".

Mary viewed teaching as a means of assisting students to broaden their knowledge: "Teacher's role is to support student to acquire new knowledge that they can use it later in the following school years". At the first years she considered teaching as a rather easy activity, but later on while she continued her studies she started to recognize significant difficulties. She mentions that a successful teacher should plan his actions so that students would move beyond boniness to a deeper formation of knowledge. Experimentation could be a valuable tool at this effort.

Mary described learning as a personal activity that students experience and expands their existing knowledge: "Learning is something that you experience and from now on is belongs to you forever". It links learning with students: "Learning has to do with the students and how they can assimilate new knowledge"; and teaching with the teacher: "Teaching is a matter of the teacher. Teaching is a tool and learning is a path".

5. Conclusions

Results show interesting consistency among each other's beliefs in the areas of teaching and learning that concerns students' engagement with Science. They all demonstrate views which suggest that teaching should be attractive and that teacher's role is to provide a facilitating learning through assisting and guiding the students.

A prominent educational means to achieve that goal are practical activities, so they highly value the act of 'doing' more so than just 'hearing' about the content. They feel rather confident in preparing and performing appropriate experimentation and they all adopt physical experimentation rather than virtual, whereas this is feasible.

They are of the opinion that knowledge should not be static, in the contrary it should be in a dynamic relation with real life, exciting students' curiosity and stimulating their learning in meaningful ways. They don't only want to show that science is relevant in their lives, but they also want to lead students to trust science methods in a variety of circumstances.

Another common belief is that the teacher should have an extended knowledge of content, a prerequisite for them in order to make fruitful links and projections with other disciplines and also to confront students' misconceptions. Content knowledge is acknowledged by the participants as a focal point mentioning it when they are asked to describe teaching difficulties. But they don't all agree at the statement that their teaching approaches were influenced by this knowledge.

When they are asked to describe teaching and learning generally, they repeatedly state views which reveal that their teaching is student oriented. But unfortunately, when they are asked to depict specific actions that they are willing to take at specific circumstances, they often describe educational strategies which elevate the transmissive delivery of content. This could mean that their pedagogical knowledge is not only limited but also fragmented, showing inconsistency between their own views.

Also, it is interesting the fact that although they noted reflection as an important procedure which would help them to evaluate and refine their skills, they hardly mentioned that they would use reflection's conclusions when they would come to prepare their lesson, nor that they take notes after the lesson enactment. This could mean that reflection is an emotional approach for them, that takes place after a lesson and they don't use it as criterion in future instruction.

6. Discussion-Implications

As it has been mentioned previously the investigation of participants' initial perceptions about teaching and learning becomes a focal point within the context of design and implementation of a training program aiming at the development of prospective Physics teachers' PCK.

First of all it would provide the required information about their beliefs and their expectations, which will contribute at the syllabus' formation. It is more likely then that the information that would be presented to them would be more easily accepted.

Secondly, it is a starting point for the effort to portray attitudes that might reveal aspects of PCK. Of course, this documentation could not act as the unique resource for capturing PCK, but it could be used auxiliary with other means, such as lesson preparation tasks, reflection upon videotaped lessons, discussions with experienced teachers.

A concern that might arise according to the followed methodology is its phenomenological nature. This means that researcher is forming careful descriptions from the participants' perspective on the phenomena which they experienced. A danger with interviews is that the interviewee may provide the interviewer with information that they perceive the researcher wants to hear. Another weakness of these studies might be in the researcher's interpretation and analysis of the data. These weaknesses can be limited if other sources of data, like these that are stated previously, would be used in parallel, so that through triangulation would be provided better credibility to the methodological design of the study.

7. References

[1] Bertram, A. R. (2010). Enhancing science teachers' knowledge of practice by explicitly developing pedagogical content knowledge. Ph.D. thesis, Monash University, Clayton, Victoria, Australia.

[2] Brickhouse, N., & Bodner, G.M. (1992). The beginning science teacher: Classroom narratives of convictions and constraints. Journal of Research in Science Teaching, 29 (5), 471-485.

[3] Britzman, D. (1991). Practice makes practice: A critical study of learning to teach. Albany, NY: State University of New York Press.

[4] Chen, C., Taylor, P.C., & Aldridge, J. (1997). Development of a questionnaire for assessing teachers' beliefs about science and science teaching in Taiwan and Australia. Paper presented at the annual meeting of the National Association for Research in Science Teaching, Chicago, March 22-24.

[5] Clermont, C.P., Krajcik, J.S., & Borko, H. (1993). The influence of an intensive in-service workshop on pedagogical content knowledge growth among novice chemical

demonstrators. Journal of Research in Science Teaching, 30, 21–43.

[6] Duschl, R.A., & Wright, E. (1989). A case study of high school teachers' decision making models for planning and teaching science. Journal of Research in Science Teaching, 26(6), 467-501.

[7] Grigoriou V., Kalkanis G., (2009). Training of prospective Greek teachers in the development of simulations for the model of the ideal gas, 8th ESERA conference August 31st – September 4th 2009 Istanbul, Turkey.

[8] Grigoriou V., Vithopoulou E., Kalkanis G., (2010). Educational support to prospective Physics teachers at the field of Green Energy; first assumptions, M. Kalogiannakis, D. Stavrou & P. Michaelidis (Eds.) Proceedings of the 7th International Conference on Hands-on Science. 25-31 July 2010, Rethymno-Crete, pp. 351-354

[9] Grigoriou V., Gikopoulou O., Papageorgiou K., Kalkanis G, (2010). Prospective Physics Teachers design and develop a normative lesson utilizing Hands-on applications of Digital Technologies – Preliminary results., M. Kalogiannakis, D. Stavrou & P. Michaelidis (Eds.) Proceedings of the 7th International Conference on Hands-on Science. 25-31 July 2010, Rethymno-Crete, pp. 347-350

[10] Grigoriou V, Kalkanis G, (2012). The principles of a short time seminar for developing prospective Greek Physics teachers' PCK, In C. Bruguière, A. Tiberghien & P. Clément (Eds.), E-Book Proceedings of the ESERA 2011 Conference: Science learning and Citizenship. Part [12] (co-ed. Dimitris Psillos and Rosa Maria Sperandeo), (pp.62-68) Lyon, France: European Science Education Research Association.

[11] Grossman, P. L. (1990). The making of a teacher: Teacher knowledge and teacher education. New York: Teachers College Press, Columbia University.

[12] Gullberg, Annica , Kellner, Eva , Attorps, Iiris , Thorén, Ingvar and Tärneberg, Roy(2008) 'Prospective teachers' initial conceptions about pupils' understanding of science and mathematics', European Journal of Teacher Education, 31: 3, 257 — 278

[13] Kagan, D. M (1992). Implications of research on teacher belief. Educational Psychologist, 27(1), 65-90.

[14] Korthagen, F.A.J. (2001). The realistic approach: Its tenets, philosophical background, and future. In F. Korthagen, with, J. Kessels, B. Koster, B. Langerwarf, & T. Wubbels (Eds.), Linking theory and practice: The pedagogy of realistic teacher education (pp. 254–274). Mahwah, NJ: Lawrence Erlbaum.

[15] Pajares, M. F. (1992). Teachers' beliefs and educational research: Cleaning up a messy construct. Review of Educational Research, 62(3), 307-332.

[16] Shulman, L.S. "Those Who Understand: Knowledge Growth in Teaching," Educational Researcher (1986). 15 (2), 4-14.

[17] Shulman, L. S. (1987). Knowledge and teaching: Foundations of the New Reform. Harvard Educational Review, 57(1), 1-22.

[18] Thomas, J.A., and J.E. Pedersen. 2003. Reforming elementary teacher preparation: What about extant teaching beliefs? School Science and Mathematics 103, no. 7: 319–30.

[19] Van Driel, J., Verloop, N., & Vos, W. de (1998). Developing science teachers' pedagogical content knowledge. Journal of Research in Science Teaching, 35(6), 673-695.

[20] Van Driel J., De Jong O. & Verloop N. (2002). The Development of Preservice Chemistry Teachers' Pedagogical Content Knowledge, Science Teacher Education, 86.

[21] Wentworth N. M. & Pinnegar S. (1996). Stories of Learning and Schooling: Capturing Preservice Teachers' Beliefs About Teaching and Learning. Brigham Young University. from, http://www.auburn.edu/academic/education/tpi/fall96/wentworth.html

[22] Wideen, M., & Grimmett, P.P. (1995). Changing times in teacher education: Restructuring or reconceptualization. London: Routledge.

[23] Woller, N. (1995). Working for conceptual change in elementary mathematics instruction: Perceptions from researcher, teacher educator, classroom teacher and preservice teacher. Paper presented at the annual meeting of the Northern Rocky Mountain Education Research Association, Jackson Hole, Wyoming.

 ISBN 978-989-98032-0-6

PRI-SCI-NET MINI SYMPOSIUM. INTRODUCING PROJECT PRI-SCI-NET: THE CASE OF PARTNER MUGLA

A. Oguz-Unver[1], K. Yurumezoglu[2]
[1]*Mugla Sitki Kocman University, Faculty of Education, Department of Science Education, 48000, Mugla-Turkey*
[2] *Dokuz Eylul University, Faculty of Educatio, Department of Physics Education, 35000 İzmir-Turkey*
ayseoguz@mu.edu.tr, kemal.yurumezoglu@deu.edu.tr

Abstract. *In today's world involving science learners in their own learning processes are indisputable fact. However, practical approach of this idea through the school system is needed some supports. Pri-Sci-Net which is EU funded FP7 is one of the projects that promotes Inquiry-based learning in science at primary level of education through developing activities for teachers to use as well as setting up a Europe-wide network for professionals and academics in the area of Primary Science Education. The project is coordinated by the Malta Council for Science and Technology (MCST) and has 17 partners from 14 countries. A virtual platform set up at European level will network professionals as well as support the organization of training courses. The project will also recognize teachers' and researchers' achievements in implementing Inquiry-based learning in science at primary level, as well as provide an opportunity for teachers and academics across Europe to share their experiences and successes. The project is relevant to primary teachers interested in science as it will offer downloadable teaching material, training courses, online collaboration and networking, as well as opportunities to attend the international activities being organized by the project [1]. Therefore, the aim of this paper is to introduce the project through the case of partner Mugla, to encourage teachers involving to Europe-wide Pri-Sci-Net project's network for sharing their experiences and successes and to provide examples of inquiry based teaching activities from national training courses. We believe that the promotion of this project for the conference attendees is handy for their professional development.*

Keywords: Pri-Sci-Net, Inquiry-Based Learning Approach, EU Funded FP7 Projects, Science Activities.

1. The Project Pri-Sci-Net

Pri-Sci-Net is an EU funded FP7 supporting and coordinating action (Call SiS-2010-2.2.1.1) on innovative methods in science education: teacher training on inquiry based teaching methods on a large scale in Europe. The project is coordinated by the Malta Council for Science and Technology (MCST) and has 17 partners from 14 countries.

This project is about setting up a Europe-wide network for professionals and academics in the area of Primary Science Education. The aim is to provide training and professional support to teachers to help them use inquiry based learning in science in schools. The platform at European level will network professionals as well as support the organization of training courses. It also recognizes teachers' and researchers' achievements in implementing inquiry-based learning in science, as well as provides an opportunity for teachers and academics to share their experiences and successes. The project will concurrently also take small projects in primary science education, and promote them on a larger scale in order to provide examples of inquiry-based teaching approaches to have an impact at European level. The project includes several previous projects, mainly: using an already developed theoretical pedagogical model for the teaching of science at primary level for developing teaching resources (developed as part of Comenius 1 and 2 projects); utilizing the European network for primary school teachers to provide training and professional development to primary science teacher trainers; as well as providing in-service training opportunities based on experience of partners in implementing ERASMUS intensive courses for primary school teachers on a national and international level. Pri-Sci-Net aims to establish a European community of primary science educators working within the inquiry-based approach.

The project Pri-Sci-Net will produce the following activities:

- Development and publication of 45 science teaching activities using inquiry-based science education (IBSE) in 15 different languages;
- Recognition of Excellence for teachers implementing IBSE at primary;
- Two international conferences to be held in Portugal and in Malta;
- Four 20-hour national training on IBSE at different levels for teachers and teacher-trainers in each of the 13 partner countries;
- Three international teacher-training courses;

- The creation of a virtual European network platform for teachers and researchers in primary science;
- An online newsletter and a research journal on IBSE in primary science;
- The project is relevant to primary teachers interested in science as it will offer downloadable teaching material, training courses, online collaboration and networking, as well as opportunities to attend the international activities being organized by the project. For further information please visit http://prisci.net/ [1].

2. Pri-Sci-Net Vision of IBSE

Inquiry-based science at primary level is a teaching and learning framework with implications about learning science, learning to do science and learning about science.
In this framework:

Children:
- engage actively in the learning process with emphasis on observations and experiences as sources of evidence;
- tackle authentic and problem based learning activities where the correctness of an answer is evaluated only with respect to the available evidence and getting to a correct answer may not be the main priority;
- practice and develop the skills of systematic observation, questioning, planning and recording to obtain evidence;
- participate in collaborative group work, interact in a social context, construct discursive argumentation and communicate with others as the main process of learning;
- develop autonomy and self-regulation through experience.

The teacher scaffolds and guides learning by providing a role model of an inquiring learner. The teacher does not function, in the eyes of the children, as the sole bearer of expert knowledge. Instead, the main role of the teacher is to facilitate negotiation of ideas and to highlight criteria for formulating classroom knowledge.

Assessment: It is mainly formative, providing feedback to the teaching and learning process for all classroom participants.

Investigate: Inquiry-based learning requires that children investigate questions about how the world works. Investigations need to be relevant to the children. In investigations children are actively engaged in gathering evidence which will enable them to understand better the scientific phenomenon being studied and to find possible answers to their initial question. Investigations are most effective when children work in groups. Social interaction helps them share their ideas and interpretations of what they see, and to construct scientific understanding with other children. Working in groups also helps children to develop social skills such as teamwork, tolerance and respect for the opinion of others

Inquire: Young children naturally inquire about how the world works. As teachers, we need to nurture this sense of inquisitiveness; instead of killing children’s curiosity and desire to try things out by telling them what we believe is the correct answer. Science provides the right context to foster the development of inquiry skills. Science activities in primary are to be based on asking questions about nature around us and to go about observing closely what happens, looking for information, and based on the evidence collected to construct possible answers to our own questions.

The teacher needs to provide children with a role model of how to inquire. Rather than being the bearer of knowledge, the primary teacher is one who, together with the children, asks questions, develops ways of investigating and making observations, based on which, it is possible to draw conclusions. Primary science thus involves the teacher and children inquiring together.

Evaluate: Evaluation involves reflection, a process which promotes in-depth learning in science. Inquiry-based learning requires children to reflect on the evidence which they have gathered during their investigation. This evidence needs to be evaluated before reaching agreement on what conclusions can be drawn.

Evaluation of evidence requires the children to consider what patterns they can identify in their observations as well as how sure they are of the conclusions that they have drawn. Children need also to evaluate if more than one explanation can fit their observations and thus the possibility of having more than one possible answer.

Evaluation best takes place in groups as children bring different perspectives and interpretations of the same evidence. Evaluation also helps children to build arguments in favor of their

© 2012 HSci. ISBN 978-989-98032-0-6

conclusion sand when considering alternative possible explanations put forward by others.

Connect: Learning science is about making connections, about natural phenomena, how they work, and the explanations which scientists have developed. When inquiring about scientific phenomena, one needs to make connections between observations made and explanations for these observations.

Children should be encouraged to build connections between their observations and their ideas in order to help them draw conclusions with respect to what they set out to investigate. Connections are best constructed within a social context, as children explore and argue in favor or against possible explanations for their observations with peers. Connecting ideas to observation is an essential process when doing and learning science. Learning to make connections from a very young age will promote a better engagement with science [1]

3. Importance of the Inquiry Based Science Education

The purpose of science courses in schools should be transferring the unique way of thinking of the science field to students. In this point of view, science education should aim that analyzing and synthesizing, thinking analytically, enhancing critical and creative approach skills instead of memorizing the stack knowledge [2]. On the other hand, inquiry based science education, which is inspired from nature of science and approved by pedagogues, is one of the most appropriate methods of teaching science.

Inquiry-based science education, which was started with the name of “hands on science” by Leon Lederman who is Nobel Prized, has become the topic dealt with in the field of education by many countries after the USA. France, which is one of these countries, has undertaken the coordinator of the web site that is set up for improving science education by International Council for Scientific Unions (ICSU) and French Academy of Science in 1993. After George Charpak who is Nobel prized physicist and the member of the French Academy of Science, Pierre Lena and Yves Quéré visited the school of Leon Lederman in 1995, they were impressed by his studies and decided to extend a similar educational implementations in France. For the purpose of this, they started “La Main à la Pâte/Hands on science” project in 1996 [3-4]. Associations that spread three regional networks (Latin America, European Union and Southeast Asia) were set up with more than 30 countries about science education. In 2006, “Seed cities for science” network was created in 12 European cities with “pollen” project that is under the leadership of “Hands on science”. Within this framework, science education was considered from different point of view in many countries [3].

The new teaching programme of Turkey on primary education that renovated as constructivist approach based in 2005 was also impressed by the alteration of science education programme in the world. Although inquiry based science education is not mentioned in national education programmes, it is known clearly by pedagogues that a constructivist system can be carried out with inquiry based.

Inquiry-based science education is easy to adopt by students because of showing parallelism with the nature of science and scientist’s exertion. But teachers are required to go through a training process, since, when teachers are prone to inquiry, children are too [5]. In way of inquiry, children would find answers with posing questions, participating in science activities as playing game and would become willing to learn more with bearing sense of curiosity. Because of teachers’ having the main responsibility about inquiry-based science education in class, teacher education plays a critical role. Concordantly, all activities that carried out within the context of the project and province of Mugla as national scale consist of this framework.

4. Studies Carried Out in Partner MUGLA

One of the most significant milestones of the project is national training courses. These courses are four 20-hour national training on IBSE at different levels for teachers and teacher-trainers in each of the 13 partner countries. For the trainings, three main approval progresses should be followed. First is the formal approval from the director of national education, then the permission from school principals and finally consents from teachers. The main question from the participants was “So what? Will these trainings applicable?” Especially it was difficult to persuade the teachers for attending trainers, since their work intensity they do not want to give extra time. Therefore, as partner MUGLA, we prepared a series of activities for director of national education, principals and teachers.

The world today has come to accept that science education in its new form is being restructured around a foundation of activities based on touching, feeling, discovering, inquiring that are at the same time entertaining. Today, it is easy for us to reach the basic concepts of science and scientific knowledge. However, a significant trouble is how individual would be closer science than now. The truth is that scientific knowledge can be easily learned, yet scientific curiosity and willingness require extra duties and responsibilities. As science communicators, we must ask ourselves the questions of how we design the environments, where everyone could think of creative and innovative, or how we bring up our next generations with the behaviors of responsibility and making decisions in their own right. According to these general ideas, science fair could attract all attentions due to the fact that they are real application area of science. The infrastructure of the fair was ready due to the workshop named Science Kiosk [6] which served as a bridge to provide teachers participant to the project Pri-Sci-Net.

The Science Kiosk workshop is a setting where original experiments and activities are produced with a perspective that acknowledges the integrated nature of science and the potential of an inquiring mind. It is also a science and technology classroom and teaching workshop where activities produced are presented to national and international panels, committees, conferences and symposiums. Born in 2007 in the unused space at the basement and growing with new participants every year, this workshop, which has as one of its goals to be the first in its field and the leader of such endeavors in Turkey, has since last year come to a point where it can share its activities and publications with the public through its own website, www.bilimdukkani.com.

The Science Kiosk is conducted in the following manner: Students each year learn in their science classrooms and laboratories the experiments and activities that were produced at the workshop the year before. They are at the same time encouraged to read about the history and philosophy of science, enhance their scientific thinking skills, and stimulated to use their creativity to produce scientific knowledge so that they can themselves design scientific activities the next year and contribute to the development of the workshop. Some unique studies are presented at the conferences or published in the journals. By the end of each school year, all the activities which were developed at the workshop exhibited at the science fair. Each year the fair has its own theme. In 2012 the theme was astronomy and the slogan was "my eyes are always in high" (see figure 1,2,3). All teachers, students, directors from the schools, parents and the universities were invited.

Figure 1. *Science fair brochure*

One of the main purpose of this year fair was convinced the teachers for national Pri-Sci-Net courses. For that reason a fair booth was established and a poster that describing the project prepared (see figure 4). Thus, the participants had detailed information about the project.

Apart from that two lectures were organized. One was about astronomy and the subject of the speech was "our place in the cosmos". The other was biology and the subject of the speech was "evolution and philosophy of science". The science fair was ended by observing the sky at night (see figure 5,6).

At the end of the day, most of the participants were impressed by the science fair. From their writing to the diary, following outcomes could be summarized:

1. Teachers were convinced to do similar science activities after observing how students were enjoy fair (see figures 7,8,9).
2. Participants realized the importance of activities in science education.

© 2012 HSci. ISBN 978-989-98032-0-6

3. Teachers were aroused interest to attend the Pri-Sci-Net national courses since the similar activities were taken place in.
4. The science fair was mediated the teachers interact each other.
5. The director and the parents were understood the significant of science activities and certain about the continuity of the similar studies.
6. A strong confidence between the schools and the universities was founded.

Figure 2. *A view from science fair 2012*

Figure 3. *A science fair activity*

The aim in the project is to try and reach as many of the key stakeholders as possible, since, engaging teachers in knowledge transfer processes such as international workshops, presentations, literatures and continuing professional development materials delivered via ICT are considerable. Therefore, beyond the science fair partner MUGLA prepared a series of dissemination activities for this year. These are writing a short essay about description of Pri-Sci-Net project in several national and local newspapers and popular science magazines, presentations/meetings with policy makers and directors, and finally translation and disseminate the project brochures to relevant authority and people such as teachers, educators, etc.

Figure 4. *The introducing poster of Pri-Sci-Net project*

Figure 5. *The telescope used at the fair*

Figure 6. *Participants observing the sky*

Figure 7. *High school students observing an activity*

Figure 8. *Elementary school students doing activities*

Figure 9. *Kinder garden students visiting Science Kiosk*

Acknowledgement: The project Pri-Sci-Net has received fund from the European Union Seventh Framework Programme (FP7/2007-2013) under the Grant Agreement No. 266647

References

[1] http://prisci.net/; [08/24/2012].
[2]http://www.bilimegitimi.tv.tr/ogretmenler.html; [08/24/2012].
[3] http://www.lamap.fr/international; [08/24/2012].
[4] http://www.tuba.gov.tr/tr/akademik/akademi-projeleri/bilim-egitimi.html; [08/24/2012].
[5] http://www.bilimegitimi.tv.tr/vizyon-yk.html; [08/24/2012].
[6] www.bilimdukkani.com; [08/24/2012].

EXAMINATION OF PRIMARY SCHOOL STUDENTS' IDEAS ON STSE THROUGH JOURNALS

D. Erduran Avcı, T. Akçay
Mehmet Akif Ersoy University Eucation Faculty Science Education Department, Burdur/Turkey,
derduran@mehmetakif.edu.tr,
akcaytolga@gmail.com

Abstract. *The purpose of this study was to investigate the effect of reflective journals and discussions to primary school students' ideas on Science-Technology-Society-Environment (STSE) acquisitions. In the qualitative research performed for this purpose, case study method was used. Participants of the research were seven students who are at sixth, seventh, or eighth grades. Semi-structured interview form and journals were used as the data collection tools for the study. Content analysis was applied to the data acquired from interviews and journals. Results of the research pointed out that participants have positive sentiments towards writing journals. Participants expressed that writing journals made them think about STSE issues and let them gain information about them. They also stated that they enjoyed the discussions and they learned some information, which was unknown to them, from their friends during the discussions. It was observed that the post-discussion journals were more complicated than the pre-discussion journals which meant that discussions guided the participants while writing journals. As the result, use of student journals together with discussion activity contributed students in gaining STSE acquisitions.*

Keywords: Reflective journals, discussion, STSE acquisitions, student ideas.

1. Introduction

One of the prime targets of science education is growing students who are both able to understand the nature of science and technology together with its relations to society and environment, and able to use their knowledge and ability in finding solutions to the problems [1]. In this context, STSE, one of the seven learning fields of the renewed Turkish Science and Technology Program, gain importance. 2004 Primary School Program, which introduced

 ISBN 978-989-98032-0-6

many new features, is also the first program which covered STSE topic [2]. Although there has been a considerable increase in the domestic studies about the content of the program, studies about STSE acquisitions are not enough to understand the nature of STSE acquisitions. Aydın and Yaşar [3] tried to figure out how exactly STSE acquisitions would be comprehended and how correctly they were comprehended in comparison to the program. Bakar [4] evaluated the STSE subjects in the science and technology book sets which were used in Turkey. Aydın [5] studied on class teacher opinions about the impact of STSE learning field on students' environmental consciousness gain. Doğru and Şeker [6] inspected the opinions of the primary school students about STSE subjects. Afacan [7] tried to figure out the variation of primary school 4th to 8th grade students' perception level and scientific attitudes according to the socio-economic environment of the school. In this study, effect of the use of reflective journals, which focus on the nontraditional writing techniques instead of traditional ones, together with discussions, on the opinions of primary school students about STSE acquisitions was researched. Participants of the study used reflective journals in order to analyze themselves and others [8, 9], where they made discussions in order to comprehend subjects better and interchange opinions [10].

1.1.Purpose

The purpose of this study was to investigate the effect of reflective journals and discussions to primary school students' ideas on Science-Technology-Society-Environment (STSE) acquisitions. Answers to the following two problems were sought:

- What are the opinions of the participants about STSE relations?
- What are the opinions of the participants about the use of journal writing technique and discussion making technique in teaching STSE subjects?

2. Method

2.1.Research design

Case study technique was applied in this study in order to deeply analyze an existing case [11]. Since the study has a qualitative nature parallel to the essence of the research problem, interview technique was used. A semi-structured interview form and the reflective journals formed the data collection tools of the study. Participants wrote journals with three topics: 'Nature of Science and Technology', 'Relation of Science and Technology', and 'STSE Relations'. These topics were chosen because the new Turkish Education Program focuses on these three basic dimensions [1]. Participants wrote two journals per topic. First journals were written without any preparations. They shared their writings by reading them in class and discussed about their writings. They wrote their second journal using the information and results from the discussions.

2.2. Participants

Participants of this research were 7 primary school students who were attendants of a village school in Şanlıurfa city in Turkey. One of the participants was an 8th grade student, one was a 6th grade student, and the remaining five were 5th grade students. The school was in a socio-economically undeveloped region. Therefore the economic conditions of the participants' families were very bad. The participants were willing for the study and researchers had the opportunity to contact them easily. Therefore they were found to be appropriate for the study.

2.3. Data collection tool

A semi-structured interview form, which was prepared by the researchers and included open ended questions to find out the opinions of the participants about the application, was used as the data collection tool of the study. In addition, in order to learn the effect of the application on participants' opinions about STSE acquisitions, reflective journals written by the participants were inspected.

2.4. Data analysis

The interviews were cam-corded with the permission of the participants. Data obtained by camera was transformed into written data by the researchers. Content of this data was widely analysed and categorized into main categories, which were determined during data analysis according to similarities and differences. Then, differences among the data from same category were analyzed in order to find out the subcategories. [11]. Depending on this application, it can be stated that the data analysis method in this study was content analysis [12]. Büyüköztürk et al. [13] defines content analysis as "a systematic and repeatable technique in which some words of a text is summarized by smaller content categories using a code built on specific rules".

As a second data source beside interviews, the reflective journals, written by the students, were used. Data obtained from these journals were also analyzed using content analysis. Çepni and Çil [14] classified the 38 STSE acquisitions, which are determined for 6th, 7th, and 8th grades in Ministry of National Education Primary School Science and Technology Program [1], into several categories. Researchers made use of this categorization in data analysis. Researchers used the acquisitions under three specific categories, which were the journal topics of the research, as a guide for systematic analysis. Çepni and Çil [14] grouped 10 acquisitions into 'Nature of Science and Technology' category and 2 acquisitions into 'Relation of Science and Technology', which were the first and second journal topics respectively. For the third topic, 'STSE Relations', all 38 acquisitions were covered for analysis systematically.

In the findings section of the research, some participant expressions are presented. For the sake of the research ethics, the identities of the participants are hidden. The code names presented here are totally different than their original names.

3. Findings

Findings of the study are presented below in two sections, which are 'Analysis of the Interviews' and 'Analysis of the Journals':

3.1. Analysis of the interviews

Findings from the analysis of the interviews are presented below under sub-sections 'Opinions about writing journals' and 'Opinions on making discussions'.

3.1.1. Opinions about writing journals

After the inspection of participant opinions about journal writing, it can be stated that they considered journal writing as an entertaining activity which improved their writing and reading skills, helped them in gaining new knowledge, and directed them to thinking and writing. Some sample participant statements about writing journals are presented below:

"I learned new information while writing journal. I mean I learned things I did not know." Gözde

"Journal made me think a lot while writing." Ceyda

"I liked wring journal. I was bored before at home. Studying was good for me." Gözde

"My reading and gaining information abilities improved while writing journals." Ceyda

"You know, we write second time in the second journal; we correct our mistakes then." Betül

3.1.2. Opinions about making discussions

As the result of the analysis of the participant opinions about discussion activity with journal writing, it can be stated that they considered it as an activity which they participated willingly and which helped them learn from their peers, let them express themselves and improved their discussion ability. Some sample participant statements supporting this fact are as follows:

"Discussing improved our minds and knowledge." Ramazan

"We taught what we did not know together during discussions. I am very glad because I taught things they did not know and they taught me things I did not know." Gözde

"I liked making discussions." Ramazan

"My speaking and thinking abilities improved and I gained self-confidence. I would not speak comfortably before but now I can do. I can state my opinions." Betül

Table 1. *Acquisitions which are emphasized in the first journals about 'Nature of Science and Technology'.*
** No: Number of STSE acquisition in Ministry of National Education Program [1].*

No*	Acquisition	Sample Participant Expression
1	He conducts experiments in the development of scientific information, gathers evidence, develops relations between events and concepts, proposes possible causes, defines the importance of imagination, and explains it with examples.	"When you say nature of science and technology, it reminds me of science, discovery, and technology. It reminds me of observation, researchers, laboratory, information, events, and imagination." Betül
5	He understands that many technological systems and products may be developed in order to satisfy demands	"If technology did not improve, there would be no transportation vehicles, no computers, it would be

	and needs but technology always cannot develop solutions to every problem and cannot neutralize them all.	very hard for us without technology. Technology makes our job easier." Egemen
6	He understands that none of the technological design is ultimately perfect by security, cost, aesthetic and environmental effect means. He understands that properties of the material used and laws of nature limit technological products.	"Since technology improved a lot, people got used to sitting. And they became too lazy. Then, for example, people may have car accidents and die. These are the harms of technology." Ramazan

Table 2. *Acquisitions which are emphasized in the second journals about 'Nature of Science and Technology'*

No	Acquisition	Sample Participant Expression
1	He conducts experiments in the development of scientific information, gathers evidence, develops relations between events and concepts, proposes possible causes, defines the importance of imagination, and explains it with examples.	"One decides the topics he wonders. Then thanks to science he researches, observes, experiments, and tries to find out the topics this way. If he tries this way, he tries to learn other things and he asks questions himself all the time." Cansu
3	He gives examples about how scientific information changes and develops when new evidence is found.	"Knowledge of science depends." Gözde "It widens as new information is added." Hilal
5	He understands that many technological systems and products may be developed in order to satisfy demands and needs but technology always cannot develop solutions to every problem and cannot neutralize them all.	"Technology makes the life easier for people. There are also problems to which technology cannot find solutions. It could not find answers to some problems. For example people's personal problems, problems which emerge from people's discussions with their ideas." Gözde
6	He understands that none of the technological design is ultimately perfect by security, cost, aesthetic and environmental effect means. He understands that properties of the material used and laws of nature limit technological products.	"Technology too has its defects. Like radiation, like our eyes get uncomfortable when we look at TV or computer monitor, like some motor vehicles explode when they are pushed to their limits, and some light radiating instruments cause eye problems when their light contacts eyes." Cansu
7	He notices that technology differs about the same subject throughout history, changes, and new technologies have footprints of elder technology. He gives examples about this fact.	"Technology always changes. Because always a newer machine replaces the older one doing the same function. So machine change happens. There are differences between new and old technological products.. " Hilal
9	He understands that many resources (imagination, creative thinking, culture and traditions, mathematical information, information about the ways of nature gained through science, any information, concepts, and materials which even looks unrelated at first sight) are used in technology development.	"Technology developed with idea, curiosity, and renewal. It developed by trial. It emerged by thinking.." Hilal

3.2. Analysis of the student journals

Participants wrote two journals per three topics. Difference between two journals about the same topic is that: the first one is written before making the discussion about the topic and the second one is written after making the discussion. Journal topics were determined considering the 38 STSE acquisitions in the science and technology program. Journals before the discussion and after the discussion were inspected and compared according to participants' emphasizes to the STSE acquisitions.

Participants emphasized three acquisitions in the first journal they wrote about 'Nature of Science and Technology'. It was observed that they emphasized six acquisitions after the discussion. The acquisitions emphasized for the first journal topic and sample participant expressions are provided in Table-1 and Table-2.

Second journal topic of the participants was "Relation of Science and Technology". Participants emphasized one acquisition in the first journal they wrote about this topic. It was observed that they emphasized two acquisitions after the discussion. The acquisitions emphasized for the second journal topic and sample participant expressions are provided in Table-3 and Table-4.

© 2012 HSci. ISBN 978-989-98032-0-6

Table 3. *Acquisition which are emphasized in the first journals about 'Relation of Science and Technology'*

No	Acquisition	Sample Participant Expression
17	He gives examples to the fact that scientific developments lead to technological advancement which gives way to new technological inventions and applications.	"Science transferred the research in it to technology then technological products could be developed." Gözde

Table 4. *Acquisitions which are emphasized in the second journals about 'Relation of Science and Technology'*

No	Acquisition	Sample Participant Expression
16	He gives examples of technologies which support, advance, enable, or are used in scientific research.	"Technology makes inventions and science uses them. For example if there were no microscopes, scientists would not see the very tiny things and discover them." Ceyda
17	He gives examples to the fact that scientific developments lead to technological advancement which gives way to new technological inventions and applications.	"Science makes research for technology and tests. Then transfers it to technology. Technology transfers it technological products." Cansu

Third journal topic of the participants was "STSE Relations". Participants emphasized four acquisitions in the first journal they wrote about this topic. It was observed that they emphasized fourteen acquisitions after the discussion. The acquisitions emphasized for the third journal topic and sample participant expressions are provided in Table-5 and Table-6.

Table 5. *Acquisitions which are emphasized in the first journals about 'STSE Relations'*

No	Acquisition	Sample Participant Expression
26	He knows how individuals and society affect the environment.	"Environment benefits or suffers from the inventions society uses." Hilal
28	He understands that science and technology applications may have both positive and negative effects on environment.	"I mean science and technology contributes to the society. But we shall not forget the harms of science and technology. For example smokes from factories affect the environment negatively. In addition, as the technology advances people get lazier. It also affects the human relations negatively. People used to visit each other but now there is telephone. They even phone each other in religious days instead of visiting." Betül
31	He explains how past and present developed technologies changed personal and social life, working style, and their interactions with environment by examples.	"Science researches and it is transmitted to technology and these way new inventions are made and life of the people and societies become easier." Ceyda
32	He explains that a specific scientific or technological development may have foreseen/unforeseen positive/negative effects on individuals, society, and environment by examples.	"For example, since there is telephone, people do not see each other now, I mean, technology effects human relations." Egemen

Table 6. *Acquisitions which are emphasized in the second journals about 'STSE Relations'*

No	**Acquisition**	**Sample Participant Expression**
18	He understands that wastes (domestic, industrial, organizational, medical, etc.) should be recycled or destroyed in order to prevent potential environmental harm and the management of the wastes produced by technological systems (chemicals, plastics, metals, etc.) is an important social problem.	"We should not throw our wastes to the ground to prevent pollution. We must not pollute the water. We must prevent factory smokes. For wastes, first waste bins then waste trucks come and remove them. For example we must stop someone if he throws garbage to the ground. There are waste bins everywhere now." Ramazan
19	He explains how natural resources, living things and their habitats may be protected using technological products and systems and how harmful wastes originate from the use of products and systems can be reduced.	"Now there is no technological advancement therefore people get sick from the factory smokes. In the future, when technology advances, they will find a solution to it. They will make an invention in the chimney cleaning the air." Ramazan
20	He determines the relations between global environmental problems and modern technological	"People use many chemicals when using technological products. These chemicals make harm to atmosphere. They

© 2012 HSci. ISBN 978-989-98032-0-6

	systems and he proposes solutions for environmental problems.	harm atmosphere and cause global warming and acid rains. This affects environment negatively. But these negative effects can be prevented. For example planting trees or not using chemicals etc.” Gözde
21	He knows of local, national, and global environmental problems and discusses possible solutions and their consequences.	“Soil pollution, air pollution, water pollution, etc. are some of the society’s national environmental problems. Solution of these problems is making people conscious.” Gözde
22	He knows and discusses the methods of protecting environment and.	“We should warn people frequently about the environmental harm of the wastes and should have waste bins.” Ceyda
24	He knows that natural resources should be protected and improved.	“There are some natural resources to be protected. We should protect our cultural and touristic assets.” Hilal
25	He understands that not only artificial products but also natural products may have negative effects on environment.	“Natural products may also effect environment. For example earthquake and tsunami.” Gözde
26	He knows how individuals and society affect the environment.	“People use inventions and pass to the society then they both use it. Then its harm passes to environment.” Hilal
28	He understands that science and technology applications may have positive or negative effects on individual, society, and environment.	“If we use technological advancements too much, individuals degrade and it prevents being social as a community. When we come to advantages, when we use it less, it makes communication and meeting events easier. “ Hilal
29	He understands that it is possible to take measures against the negative effects of science technology using science and technology, therefore it is possible to reduce the effect or completely remove it.	“We use technological products and make garbage trucks travel everywhere and make them collect garbage and so we protect environment. There are many relations between technological advancement and environment.“ Egemen
31	He explains how past and currently developed technologies change individual and social life, methods of working, and environmental interaction of people by examples.	“For example, people used to be hard-working but after technology they get lazier and do not pay attention to environment.” Ceyda
32	He explains that a specific scientific or technological development may have foreseen/unforeseen positive/negative effects on individuals, society, and environment by examples.	“When technology improves, it brings environmental problems with it. As an example, nuclear plants prove many uses. But if there is a leak, it kills many people and the remaining who live becomes sick or disabled. In addition it harms environment.”
34	He gives examples from people he knows or from his relatives who has occupations with scientific or technological base.	“Woman or man does not make any difference in science and technology. For example Meri Küri is a woman and Edison is a man.” Ceyda
35	He notices that many men and women contributed to science and technology in the past, they do so in present and they will do so in the future.	“People from different cultures like Mari Curie, Edison, Grahambell, Oktay Sinanoğlu, Gazi Yaşargil, Pastör contributed to science and technology.” Gözde

4. Discussion and Conclusion

Journal writing is an entertaining activity for writers where it makes them think while writing and make them learn. In literature, it is stated that journal writing for learning makes writers think [15, 16] and assists learning [17,18, 19, 20, 21, 22]. It was noticed that student opinions about journal writing, which is one of the writing for learning activities, were parallel to the literature.

Journal improves reading abilities of the writers as well as writing abilities. It is emphasized in several researches that reading has the same importance in writing-for-learning studies [17, 18]. Hand, Hohenshell and Prain [18] stressed that writers should clarify their ideas before they explain them to an audience, whether oral or written, in writing activities. In this context, reading personal journal to an audience after a journal activity was considered very important.

Discussion is regarded as an entertaining activity, which helps students learn, makes them learn from their friends, allows them express their ideas, and creates opportunities that enhance their discussion abilities, by the students. In the literature it is stressed that discussion method allow them join to the process actively [23, 24, 25], structure the knowledge [23, 24] and learn from their friends [24, 26]. In this context, findings of this study were parallel to the literature. Second journals of the students, which were written after the discussion activity, were more successful than the first ones. Discussion is a method which makes students learn actively and enhance the retention of

© 2012 HSci. ISBN 978-989-98032-0-6

knowledge [27]. This fact might be the cause of those second journals was more successful than the first ones.

Inspection of student journals before and after the discussion from the perspective of STSE acquisition emphasizing revealed that discussion activities have an important effect on reflecting STSE acquisitions. Students especially stressed on STSE acquisitions in great numbers

in the journals about 'STSE Relations'. Kırıkkaya [28] stated that teachers can realize STSE acquisitions even slowly but realizing them all is quite difficult. In this research, a considerable improvement was observed in all participants during four weeks of study but not all acquisitions were realized. Yangın and Dindar [29] stressed that discussion and similar activities have a great importance in STSE acquisition learning as well as integrating STSE acquisitions to the program. In this context, it can be stated that using student journals together with discussion activities contributes to revealing student ideas.

It can be observed in this study that ideas of the students, who wrote journals and made discussions, about STSE acquisitions improved. Performing similar studies at high school and university levels might provide us additional information about the impact of writing journals and making discussions on STSE learning. In addition, performing a similar study with the participants on same topics after several months might prove useful to get information about the retention of acquisitions.

References

[1] İlköğretim Fen ve Teknoloji Dersi Öğretim Programı ve Kılavuzu. MEB Ankara, Türkiye: Devlet Kitapları Müdürlüğü; 2006.

[2] Dindar H, Taneri A. MEB'in 1968, 2000 ve 2004 Yıllarında Geliştirdiği Fen Programlarının Amaç, Kavram ve Etkinlik Yönünden Karşılaştırılması. Kastamonu Eğitim Dergisi 2011; 19(2): 363-378.

[3] Aydın F, Yaşar A. Fen ve Teknoloji Öğretim Programında Yer Alan FTTÇ Öğrenme Alanına İlişkin Kazanımlar Nasıl Algılanıyor ve Nasıl Algılanması Gerekiyor? 2nd International Conference on New Trends in Education and Their Implications; 2011 27-29 April; Antalya-Turkey; 2011. p. 462-466.

[4] Bakar E. Türkiye'de Okutulan Fen ve Teknoloji Kitap Setlerindeki FTTÇ Konularının Değerlendirilmesi. International Conference on New Trends in Education and Their Implications; 11-13 November; Antalya-Turkey; 2010. p. 510-514.

[5] Aydın G. Fen-Teknoloji-Toplum Çevre Öğrenme Alanının Çevre Bilinci Kazandırmasına İlişkin Sınıf Öğretmenlerinin Görüşleri. Yayınlanmamış Yüksek Lisans Tezi, Anadolu Üniversitesi, Eskişehir; 2010.

[6] Doğru M, Şeker F. İlköğretim Altıncı, Yedinci ve Sekizinci Sınıf Öğrencilerinin Fen - Teknoloji - Toplum - Çevre Konularına İlişkin Görüşleri. Uluslararası İnsan Bilimleri Dergisi 2012, 9(1): 61-81.

[7] Afacan Ö. İlköğretim Öğrencilerinin FTTÇ İlişkisini Algılama Düzeyleri ve Bilimsel Tutumlarının Tespiti (Kırşehir İli Örneği). Yayınlanmamış Doktora Tezi, Gazi Üniversitesi, Ankara; 2008.

[8] Yiğit N, Alev N, Ekiz D. Öğretmenlik Uygulaması Sırasında Yansıtma Temelli Rehberlik Çalışmalarının Öğretmen Adaylarının Mesleki Gelişimlerine Katkısı. İnönü Üniversitesi Eğitim Fakültesi Dergisi 2010; 11(3); 75-100.

[9] Kazu H, Demiralp D. İlköğretim Birinci Kademe Programlarında Yansıtıcı Düşünmeyi Geliştiren Yöntemlerin Kullanılma Durumu. International Online Journal of Educational Sciences 2012; 4(1); 131-145.

[10] Aydoğdu M, Kesercioğlu T. Editors. İlköğretimde Fen ve Teknoloji Öğretimi. Ankara: Anı Yayıncılık; 2005.

[11] Yıldırım A, Şimşek H. Sosyal Bilimlerde Nitel Araştırma Yöntemleri. Ankara: Seçkin Kitapevi; 2011.

[12] Weber RP. Basic Content Analysis. Newbury Park, California: Sage Publications; 1990.

[13] Büyüköztürk Ş, Çakmak KE, Akgün ÖE, Karadeniz Ş, Demirel F. Bilimsel Araştırma Yöntemleri. Ankara: Pegem Akademi; 2008.

[14] Çepni S, Çil E. Fen ve Teknoloji Programı İlköğretim 1. ve 2. Kademe Öğretmen El Kitabı. Ankara: Pegem Akademi; 2010.

[15] Mason L., Boscolo P. Writing and Conceptual Change. What Changes? Instructional Science 2000; 28: 199-226.

[16] Akar, M. S. (2007). Laboratuvar Dersinde Yazma Metinleri Oluşturmanın ve Analog Kullanımının Akademik Başarıya Etkisi. Yayınlanmamış Yüksek Lisans Tezi, Atatürk Üniversitesi, Erzurum; 2007.

[17] Hand B, Prain V. Teachers İmplementing Writing To Learn Strategies İn Junior

© 2012 HSci. ISBN 978-989-98032-0-6

Secondary Science: A Case Study. Science Education 2002; 86(6): 737-755.

[18] Hand B, Hohenshell L, Prain V. Exploring Students' Responses To Conceptual Question When Engaged With Planned Writing Experiences: A Study With Year 10 Science Students. Journal of Research in Science Teaching 2004; 41(2): 186-210.

[19] Günel M, Uzoğlu M, Büyükkasap E. Öğrenme Amaçlı Yazma Aktivitelerinin Kullanımının İlköğretim Seviyesinde Kuvvet Konusunu Öğrenmeye Etkisi. Gazi Eğitim Fakültesi Dergisi 2009; 29(1): 379-399.

[20] Günel M, Kabataş-Memiş E, Büyükkasap E. Öğrenme Amaçlı Yazma Aktivitelerinin ve Analoji Kurmanın Üniversite Düzeyinde Mekanik Konularını Öğrenmeye Etkisinin İncelenmesi. Gazi Eğitim Fakültesi Dergisi 2009; 29(2): 401-419.

[21] Atila ME, Günel M, Büyükkasap E. Betimleme Modlarının Öğrenme Amaçlı Yazma Aktiviteleri İçerisindeki Kullanım Varyasyonlarının İlköğretim Kuvvet ve Hareket Konularının Öğrenimi Üzerine Etkisi. Türk Fen Eğitimi Dergisi 2010; 7(4): 113-127.

[22] Yıldız A, Büyükkasap E. Öğretmen Adaylarının Compton Olayını Anlama Düzeyleri ve Öğrenme Amaçlı Yazma Aktivitelerinin Akademik Başarıya Etkisi. Uluslararası İnsan Bilimleri Dergisi 2011; 8(1): 1643-1664.

[23] Aykaç N. Hayat Bilgisi Dersi Öğretim Programında Kullanılan Yöntem ve Tekniklerin Öğretmen Görüşlerine Göre Değerlendirilmesi. Kastamonu Eğitim Dergisi 2011; 19(1): 113-126.

[24] Çeken R, Tezcan R. Fiziksel ve Kimyasal Değişmelerin Video Gösterimi ve Tartışma Yöntemi İle Öğretilmesinin Yedinci Sınıf Öğrencilerinin Başarı Düzeyine Etkisi. Kastamonu Eğitim Dergisi 2011; 19(1): 221-228.

[25] Çepni S, Ayas A, Johnson D, Turgut F. Fizik Öğretimi. Yök/Dünya Bankası Milli Eğitimi Geliştirme Projesi Hizmet Öncesi Öğretmen Eğitimi. Ankara; 1997.

[26] Ünal Ç, Çelikkaya T. İlköğretim I. Kademe Sosyal Bilgiler Dersi Coğrafya Konularının Öğretiminde Kullanılan Yöntem Ve Teknikler İle Bunların Uygulanma Sıklığı. Doğu Coğrafya Dergisi 2011; 151-166.

[27] Doğanay A. Öğretim İlke ve Yöntemleri. Ankara: Pegem A Yayıncılık; 2007.

[28] Kırıkkaya, E. İlköğretim Okullarındaki Fen Öğretmenlerinin Fen ve Teknoloji Programına İlişkin Görüşleri. Türk Fen Eğitimi Dergisi 2009; 6(1): 133-148.

[29] Yangın, S. & Dindar, H. İlköğretim Fen ve Teknoloji Programındaki Değişimin Öğretmenlere Yansıması. Hacettepe Üniversitesi Eğitim Fakültesi Dergisi 2007; 33:240-252.

ATOM IN ANCIENT TIMES. EVOLUTION PROCESS OF ATOMIC IDEA IN ANTIQUITY

A. Oguz-Unver[1], S. Arabacioglu[2], G. Unver[3]

[1,2]Faculty of Education, Department of Science Education, Mugla Sitki Kocman Univ., Turkey
[3]Faculty of Letters, Department of Archaeology, Mugla Sitki Kocman University, Turkey
ayseoguz@mu.edu.tr, sertacarabacioglu@mu.edu.tr, gunver@mu.edu.tr

Abstract. *Although many science curricula have started modern atomic theory from Daltons' ideas, the basic idea of atom is mainly have its root from Democritus (ca. 460-370 BC) who was a philosopher and a student of Leucippus. Learning science through historically developmental processes makes students to internalize the concepts. For instance, the argument of the Lavoisier related to the conservation of the mass has firstly mentioned with examples by Lucretius in antiquity as nothing is exactly disappointed. Initially, the first basic observations and philosophical inquiries regarding the idea of the matter and the atom has initially stated with examples and arguments in "De Rerum Natura" (On the Nature of Things) written by Titus Lucretius Carus, a Roman philosopher effected from Epicurean philosophy and believed to have lived between ca. 98-55 BC. Examining the research on the instruction of atom idea, the studies mainly lay on the determination of alternative conceptions or misconceptions of the educators and learners. The instruction on how to teach atom is limited and the recommended instructions mostly based on teaching atoms through models. The complexity of the atom idea has made it hard for students. But as Yves Quéré stated starting from the basic instead of complexity may make science enjoyable. Therefore, doing basic observation of atom like in ancient times may attract students to learn. In this context, the current study is inspired by the masterpiece work of Lucretius, named De Rerum*

Natura (On the Nature of Things). The study aims to design activities about matter and atom and additionally determine the views of students about the functioning of these activities in the classroom. The activities are "Space and Motion", "Eternal Non-Divisibility", "The nature of corrosion". Dissemination of the activities will be through the web-side www.bilimdukkani.com.

Keywords: Lucretius, De Rerum Natura, Atom, Antiquity, Science Activities, Observation.

1. Introduction

1.1. A brief story of atom

A large majority of science programs today point to the views of Dalton as the beginning of modern atomic theory. The origin of the idea of the atom, however, goes back to the 5th century BC, to school of Abdera (Avdira, Greece) and its founder Leucippus who possibly was born in Miletus. He was mentor of well-known philosopher Democritus of Abdera. Natural sciences were an integral part of philosophy in Antiquity, The history of philosophy includes pioneering thoughts that provided resources and inspiration for Leucippus. These thoughts were shaped over a process that took approximately 150 years. Actually, everything began with Thales of Miletus (Balat, Turkey) in the 6th century BC. It was Thales who first speculated that there had to be a substance that was there in the beginning at the origin of the universe. Additionally Thales tried to explain universal order in rational terms instead of mythological, which signified a transition from *mythos* into *logos*. Thales suggested that *arche* (the original basic principle) was water. While Thales and Anaximenes were attempting to explain the origin of the universe (*arche*) in terms of a substance, a contemporary of Thales, Anaximander of Miletus, introduced a brand new idea. Anaximander postulated that *arche* could not be one of the substances known by man but that it was rather the *apeiron*, or infinite source that generated opposites which acted on the creation of the world. This was an important first step toward the school of thought that would eventually create the idea of the atom [1]. Later in the middle of the 5th century BC, Anaxagoras of Clazomenae (Urla, Turkey) explained all generation and disappearance as mixture and separation, introducing the concept of *nous* (the mind) as a controlling force. Generation and disappearance occurred from the motion controlled by this "mind". Thus, matter was created and destroyed under a controlled system. The last step in the process of this early development was the mentor of Leucippus, Zeno of Elea, who set forth the idea that a segment of matter could be divided into an infinite number of pieces. This was the final and most important step that led Leucippus to the theory of atomism. Leucippus, however, significantly expanded upon the teachings of Zeno, drawing from Anaxagoras as well, to form his own atomic theory. Leucippus' most important contribution was his premise that matter cannot be divided infinitely and that there exists an indivisible entity or *arche* (*arche atomos*). Leucippus brought forward the principle that there is no void in the elementary bits of matter that make up the mass of an object, and that the mass instead is completely solid with *arche*, defending the view that division of matter takes place until this *arche* is reached [2]. The fact that the idea of atom emerged as early as the 5th century BC in the Antiquity also resulted in the inclusion of this concept in the language of the culture in which it was born. It is without doubt that the word *atomos* is an ancient Greek adjective with two endings. Its etymology derives from the verb *temnein*, meaning "to cut, divide". Today, the same verb is at the root of the term "anatomy" as well. The bits of matter that we speak of today when we refer to the concept of particles, then, refer to the same, completely solid particles that have reached an ultimately indivisible form. From this perspective, an "atom" represents the first and smallest entity in a substance, which is the last indivisible particle that is reached after continuous division. Leucippus believed that atoms differentiated from each other only in shape, position and arrangement and that differentiation of matter was caused by the changes occurring in these qualities. Inevitably, this train of thought continued to be expanded upon after Leucippus. Leucippus' pupil, Democritus of Abdera, adopted this theory of the atom, perceived with the senses from a mechanical and materialistic perspective, further developing and completing the reasoning to a great extent. Approximately 120 years after Leucippus, Epicurus made the idea of the atom the foundation of his philosophy of matter. His teachings were passed down to younger generations by such Roman philosophers as Lucretius, Cicero and Seneca, creating a foundation for the Renaissance and making a

© 2012 HSci. ISBN 978-989-98032-0-6

deep impact on even the philosophers of the contemporary world.

1.2. Approaching the atom through observation

Although millions of dollars are spent on projects that have been initiated in the name of understanding the atom, the idea is still a huge mystery to us. Under the circumstances, teaching a concept like this, which is so difficult to understand, is an important issue. A look into the literature shows that teaching the idea of the atom is for the large part based on modeling techniques [3, 4]. The complexity of the idea of the atom has provided incentive for researchers to review and understand the misconceptions that exist in this context [5, 6, 7, 8, 9, 10]. The first emergence of the idea of the atom, however, was actually founded on scientific observation. In the historical and epistemic development process, it was Leucippus and Democritus' focus on scientific observation through the world of the senses that brought the atom to the degree to which it is understood today. In terms of the times in which they lived, the ancient philosophers who explored the atom had only the tools of observation and the vast opportunities provided by the sensory world to analyze and conceive the presence of a void between atoms and the structure of the atom itself. It was for this reason that the process of searching for the atom took place with the harmonious and systematic use of sensory perception and logical coherence. The conscious and coordinated observations organized by an individual in the sensory world in order to give meaning to surrounding objects create a coherent whole from the scattered data that reaches us from the external world and are also important in terms of our being able to make more productive use out of our interaction with that external world [11]. The atom continues to be explored today in the phenomena that we observe daily [12].
"How better can we understand the dissolving of a piece of salt in a pot of water than by supposing that the atoms of which the salt is composed spread into the empty spaces between the atoms of the water? How better can we understand the spread of a drop of oil on the surface of water, out to a definite area and no farther, than by supposing that the film of oil spreads until it is a few atoms thick?" [13, p.2]

2. Method

In this context, the present study has focused on preparing activities and classroom demonstrations where, in line with the observations and questions posed by the ancient atomists, the subjects of "the nature of the empty void between atoms," "infinite indivisibility," and the "nature of obliteration" are treated. The poem by Titus Lucretius Carus, *"De Rerum Natura"* was the main source used for these activities [14]. The observations about atoms obtained through the world of senses that have been set forth in the poem were employed for the purpose of creating the idea of the atom for students by using the resources of the observable world. The sample for the study constituted a group of pre-service teachers at a State university who had received training in observation through various activities prior to making the sensory observations for this study.
According to Yves Quéré (The approach of "La main å la pâte"), to instill in students a love for science, it is important to implement an educational program than relies on direct observation and experimentation rather than on the exposition of complex and comprehensive topics. In "La main å la pâte", children discover natural objects and phenomena directly through their observations and experiments, stimulating their imagination, expanding upon their ideas, and developing a mastery of language. The present study has approached the idea of the atom, which students find so difficult to understand, in the vein of the "La main å la pâte" program. The students were first shown a presentation about how the idea of the atom developed from the time of Thales down to the present day. Then the students carried out a series of observational activities that allowed them to follow in the footsteps of Lucretius to search for the atom within their own world of sensory perception.

3. Conclusion

The observations, arguments and inquiries about the natural phenomena related to the atom in the poem were presented in the form of a typical "La main å la pâte" lesson. The students, for example, were asked to make observations about the obliterations they saw in nature and how these phenomena came about or to inquire with their senses into the empty void between atoms and seek answers to why they could easily put their hands in water, dance around in the air, but yet were unable to pass through a rock. The students tested their hypotheses in this process. When they analyzed their reflections at the end of the exercise, it was found that the elements that had an impact on the students were the following:

i. The idea that all matter could be traced to its smallest indivisible structure

ii. The information that the philosophy which includes natural sciences had flourished in their own native land, Anatolia. Additionally the philosophers of western Anatolia were important steps of the evolution process of atomic idea.

iii. In today's modern educational practices, the idea that the atom could be discovered through observation as it could be 2500 years ago.

iv. The fact that the idea of the atom can be traced back to the 5th century BC

From another perspective, it was seen that the pre-service teachers were positively motivated when they found that they were able to learn the idea of the atom from observation without making use of a teaching model. In this process, the students also learned evidence-based reasoning and how to inquire into phenomena without being influenced by the preconceived notions of others.

In the last part of the study, the idea of the atom will be presented, beginning with Lavoisier and continuing through the experiments of Dalton, Thomson, Rutherford, finally ending with Bohr and modern atomic theories.

4. References

[1] Sokrates'ten once felsefe I: (Fragmanlar - Doksograflar) = Eine die vorsokratiker. (tr. Özügül, O.). Capelle W. Kabalci Yayınevi; 1994.

[2] Sokrates'ten once felsefe II: (Fragmanlar - Doksograflar) = Eine die vorsokratiker. (tr. Özügül, O.). Capelle W. Kabalci Yayınevi; 1995.

[3] Davies P. Threshold concepts: how can we recognize them? Paper presented at the EARLI Conference; 2003 August 26–30; Padova, Italy.

[4] Hawkes S.J.. Why should they know that? Journal of Chemical Education 1992, 69(3): 178–181.

[5] Clement J. Students' alternative conceptions in mechanics: A coherent system of preconceptions. Proceedings of the First International Seminar; Misconceptions and educational strategies in science and mathematics 1983 June 20–22; Ithaca, NY: Cornell University; 1983. p. 310–315.

[6] Gilbert J.K., & Watts M. Concepts, misconceptions, and alternative conceptions: Changing perspectives in science education. Studies in Science Education 1983, 10: 61–98.

[7] Griffiths A.K. A critical analysis and synthesis of research on chemistry misconceptions. In H.-J. Schmidt (Ed.), Proceedings of the International Symposium Problem Solving and Misconceptions in Chemistry and Physics, International Council of Associations for Science Education Publications 1994, 70–99.

[8] Harrison A.G., & Treagust D.F. Secondary students mental models of atoms and molecules: Implications for teaching science. Science Education 1996, 80: 509–534.

[9] Wandersee J.H., Mintzes J.J., & Novak J.D. Research on alternative conceptions in science. In Gabel, D. L. (Ed.), Handbook of research on science teaching and learning 1994. New York: Macmillan. p. 177–210.

[10] Yezierski E.J. & Birk J.P. Misconceptions about the particular nature of matter: Using animations to close the gender gap. Journal of Chemical Education 2006, 83(6): 954–960.

[11] Yurumezoglu K., & Oguz A. Bilim Egitiminde Gozlemin Onceligi: Duyularimla Gozlemliyorum. 1. Ulusal Ilkogretim Kongresi 2007. Ankara: Hacettepe Universitesi; p. 1-9.

[12] Silverman M. P. A Universe of Atoms, An Atom in the Universe 2002. New York: Springer-Verlag.

[13] Weinberg S. The discovery of subatomic particles 2003. Cambridge University Press

[14] Lucr. I, 270-634. Works used: Titus Lucretius Carus, de rerum natura. Lucretius, de rerum natura Paratore, E., & Rouse, W. H. D. (tr.) Cambridge, Mass: Harvard University Press, 1959; Lucretius Carus, Varlığın yapısı I: De rerum natura. Eyüboğlu, I. Z. (tr.) Turkey: Cumhuriyet. 2001.

© 2012 HSci. ISBN 978-989-98032-0-6

DEFINITION AND SCOPE OF DISASTER

A. Oguz-Unver, F. Ozturk
Mugla Sitki Kocman University, Faculty of Education, Department of Science Education, 48000, Mugla -Turkey
ayseoguz@mu.edu.tr, fulyaozturk48@gmail.com

Abstract. *There have been many natural events on the Earth since the beginning of the first human. People are still trying to name these events which affect them, sometimes give harm to them and even make their vital functions difficult. Generally, the term that we define as disaster is expressed in different ways by public corporations so there is a need of reconciliation on this term. As it wouldn't be right to associate disaster with just earthquake, what disaster consists of is a matter of concern. So with this study, the term disaster is defined in the light of the following questions; "What is disaster?", "Is disaster a natural event?", "What is the scope of disaster?" In this context, the interviews held with science teacher candidates (N=35) are compared with literature reviews and the experts' opinions on this term and discussed over and the results for the definition and scope of disaster is reached at.*

Keywords: Disaster, Natural Disaster, Natural Events.

1. Introduction

Many natural events that caused the actual form of the earth have occurred up to date. Several natural events were stuck to human mind. For example: 1815 volcano eruption of Tambora in Indonesia, 1900 tornado in Texas, 1906 earthquake in San Francisco, 1960 earthquake in Chillie, 1970 landslip in Yungay, Peru, 1999 earthquake in Kocaeli, 2010 torrent in Pakistan, 2011 earthquake in Japan, then tsunami as consequence and 2011 earthquake in Van [1]. The reason, why they were not forgotten is destruction. So the natural events have always been a phenomenon [2].

On the other hand they are necessary and important due to changing earth's surface and making earth's energy appear. But people trying to define natural events have had different beliefs. Combining their beliefs with science and technology, humankind has always been stepping up to reality. This reflects, the path to reality is only possible with interrogation of the information we have.

Understanding of disaster brings us realization and measures against it. So conscious perspective is provided by defining disaster. Education about disaster must be on this ground activated.

1.1 What Is Disaster?

As definition of the term disaster, views of Institution of Turkish Language and other institutions will be taken into consideration. They are given in Table.1.1.

Table.1.1. *Definitions of disaster*

Institution of Turkish Language
As lexical meaning afet (a:fet) 1. Destruction of some natural events: Floods were like disaster that year. 2. Destroyer 3. Too bad 4. I have just seen, fame is a disaster like wealth. –R. N. Güntekin 4. Rhetoric The woman, with whose beauty surprise and charm people: She was a disaster with beautiful face and kiss like tulip. – Y. K. Beyatli. 5. Medical Complication on tissues as a result of diseases. natural events
Republic of Turkey The Ministry Of Public Works And Settlement General Management of Disastrous Affairs – National Disaster Management and General Management of Disastrous Affairs
Disaster happens because of the natural or man-made reasons, gives harm to social functions and causes social, economic and natural losses. (April 2009, p.3)
Republic of Turkey Ministry of Health General Management of Main Health Services
ACEP* The situations, that medical services of a society or an area –people faced with natural or man-made disasters- are not enough and over capability.

© 2012 HSci. ISBN 978-989-98032-0-6

WHO*   Ecological phenomenon that is sudden and happens in grand scope, external supply is needed.   An urgent condition, in which is available resources, ordinary measures are insufficient, causes serious problems about management and triage.   **UNHA***   Results of natural, technological or human origin events cause physical, economic and social losses, stop or interrupt daily life, activities.   **PAHO***.   Events or situations generally happen suddenly and unexpected, their scope can't be predicted, is variable.
College of Civilian Defense (Instructor)
Natural, technological or human origin events, which cause physical, economic and social losses for human, affect societies by stopping daily life and activities or interrupting, can't be overcome with their own opportunities and resources.   In other respects; disaster is not the event itself, it is the result. (April 2009, p.3)

*ACEP: American College of Emergency Physicians
WHO: World Health Organization,
UNHA: United Nations Humanitarian Affairs
PAHO: Pan American Health Organization

In aspect of the different definitions of institutions, disaster is not defined with strict lines. According to definitions, disasters can be separated in 3 groups as natural, technological and human origin [3].

1.2 Scope of Disaster

If the scope of disaster is taken in hand, formations such as earthquake, torrent, landslide, avalanche, volcano eruption are natural formation. If the natural events mentioned result destructions, it is possible to think about scope of disaster. Meanwhile irregular increase of population, which leads to decrease of energy resources, insensible consumption of energy resources, wars, epidemics, starvation, global warming, effect of hothouse, harm on ozone layer, nuclear eruption, aridity are handled with scope of disaster [4]. That means, disaster can occur as a result of natural, human origin and technology made by human, also it mentions structure depredation, harm on living creatures, lack of energy resources, no possibility for maintaining life standards and vital functions.

1.3. Education about Disaster

Education about disaster is generally understood as education of earthquake in literature, therefore we see studies only about it [5]. There are few studies about education about disaster realised with instructors and students. (for example Bulus Kirikkaya, Oguz-Unver & Cakin, 2011). According to conclusions in International Workshop for Education about disaster (2009), performance of institutions for convincing common sense about consciousness of disaster and importance of being protected from disaster is not sufficient, although it is not underestimated. Because the society is aimed to be educated after a disaster and the efforts can't be maintained. Education involving all the borders of disaster is approved to be applied in formal education system to make it ordinary, permanent and possible to maintain [6]. In the educational programme of ministry, positive feedbacks are detected, however discussion about their adequacy and effectiveness seems to be necessary. Recent studies indicate inefficiency of programme because of the fact that science and technology teachers have no satisfying information about science of earth and education about nature [7].

1.4. Purpose of Study

With this study, the term disaster is defined in the light of the following questions; "What is disaster?", "Is disaster a natural event?", "What is the scope of disaster?" In this context, the interviews held with science teacher candidates are compared with literature reviews and the experts' opinions on this term and discussed over and the results for the definition and scope of disaster is reached at.

2. Method

The study realized is a kind of survey. This method is advantageous in respects of getting information from sampling, which involves quite many individuals [8]. 3 open-answered questions

© 2012 HSci. ISBN 978-989-98032-0-6

in test form were used in the research with method quantitative analysis as an instrument of gathering information.

2.1. Sample

Survey was applied with 3rd grade students (N=35), who study science teacher´s training for primary schools in one of the western universities.

2.2. Instrument of Gathering Data

Our instrument for gathering data in the research consists of 3 open-answered questions in test form, which were prepared taking experts´ views into account, carries the aim of examining candidates of science teachers´ views on the scope and definition of disaster utilizing knowledge learnt during school life. These 3 questions are: "What is disaster?", "Is a disaster a natural event?", "What are the disasters taking place on the Earth?"

2.3. Data Analysis Procedure

In this research participants´ answers were coded in the light of themes. Afterwards qualitative data and computational analysis were applied so as to relate, give a meaning to themes and make predictions for the future [9].

3. Findings

When students´ views gathered about term disaster was annualized in details, we see, their views stroke as destruction, harm, earthquake, death and their views on scope of disaster appealed as earthquake (32 individuals), torrent (30 individuals), avalanche (23 individuals), landslide (11 individuals), tsunami (24 individuals). Considering that, detecting diversities between natural events and disasters is so important. Understanding of disaster will bring us awareness and knowledge that directs how to be protected from disaster. Also awareness of disaster is only in sight by defining disaster. Instrument applied for gathering data and studies of students´ views are represented in graphs.
When students´ answers about the definition of disaster (See Table 1.2) is taken into account, variable thoughts are noticed. 11 students think disaster is just natural, while 12 of them think; disasters are both natural and man-made events. That reflects complication of expression disaster like in scientific literature.

In the frame of awareness, % 94,28 of students said "Yes" to the question "Is disaster a natural event?" (See Table.1.3. below) As consequence, the expression disaster and natural event are confused. So transparency of the term disaster should be cleared by scientific approach to the education about disaster.

Table.1.3. *Frequency of the responses deal with "is disaster a natural event?"*

Answers	f
Yes	33
No	2

Table.1.4. *Frequency of the responses about given examples on natural disaster Owing to the fact that students moved more than one overture, number of frequency of answers and total sampling should not be compared.*

Answers	f
- Earthquake	32
- Torrent	30
- Tsunami	24
- Avalanche	23
- Erosion	18
- Conflagration	11
- Landslide	11
- Windstorm	10
- Hurricane	9
- Volcano eruption	8
- Tornado	7
- Landslip	6
- Nuclear eruption	5
- Aridity	5
- Battle	4
- Radiation accidents	4
- Harm on Ozone Layer	2
- Epidemics	2
- Lightning	2
- Tide	1
- Acid rains	1
-Earthquake, torrent, conflagration disaster	1
- Environment pollution	1
- Global warming	1
- Biologic battles	1
- Tsunami after the earthquake in Indonesia, Van 7.4. degree, Chillie 9.0 degree, El Nino Tornado etc.	1

To the question "What is the scope of disaster?" nearly all the students said "Earthquake". It shows the reality of inaccurate combination between disaster and earthquake. As seen in Table 1.4., students give examples of natural events to this question. The obligation of separation between disaster and natural event has great importance.

4. Result and Discussion

Disaster doesn't indicate diversity according to person, civilization's development level and geographic situation. What makes difference is the effect's degree. Thus, this question comes to our mind. 'If disaster were a natural event why aren't their effects the same?' Taking into consideration all these explanations we see that in fact, the term of disaster and natural event involve different meanings. While natural events are the changes on the Earth, disaster is a harm and result. In other words, disaster is a harm caused by human effects and it gives harm to humanity and aliveness. So, can the term of 'natural disaster' which is used heavily be true as the meaning it involves? When we asked to the experts this question together with the definition of disaster and we got similar but different answers. To gather experts' views on the subject Prof. Mikdat Kadioglu and Asst. Prof. Dr. Esma Bulusw Kirikkaya were asked about the subject. Their views were given a place below.

> *It's a common name given to the results of the man-made event or events which bring about physical, economic, social, cultural, natural and environmental loses, affect communities stopping or cutting people's activities which the affected society can't handle with utilizing local opportunities and supplies necessitating crisis management. (Kadioglu M.),*

> *The results of natural, technological and man-made events which bring about physical economic and social loses, affect societies stopping or cutting people's activities and the affected society can't handle with utilizing their own opportunities and sources, are called as disaster. (Bulus Kirikkaya E.)*

Like we investigated the definition of disaster it has been examined that how it can be true to separate the disaster according to its sources. In a study of Cannon (1994), we see that he separated the word of hazard which is English and means danger and risk from disaster meaning catastrophe [10]. To the definition of disaster has been reached after examining the literature and grapping the awareness of the variances between the hazard and disaster. Disaster which mainly has natural, technological and man-made resources without neccesitating any natural event and sudden happening is a disaster which can be turned into destructions and harm just by human's hands.

5. References

[1] EM-DAT, The International Disaster Database; 2012. *University of Louvain,* http://www.emdat.be/disaster-list [08.25.2012]
[2] Alkan N, Elmas I, Karakus M, Akkay E. Dogal Afetler Sırasında Karsılasılan Sorunlar: Bir Anket Calısması. Ulusal Travma Dergisi 2001; 7(3): 195-200.
[3] Afet Yonetimi Beklenilmeyeni Beklemek En Kotusunu Yonetmek. Kadıoglu M. Marmara Belediyeler Birligi; 2011.
[4] Disaster Education. National Graduate Institution for Policy Studies (GRIPS). Building Research Institution (BRI); 2007.
[5] Ergunay O. Afet yonetimi nedir? Nasil olmalidir? Erzincan ve Dinar Depremleri Isıgında Turkiye'nin Deprem Sorunlarina Cozum Yollari Arayısları. TUBITAK Deprem sempozyumu Bildiriler Kitabi 1996. Ankara: TUBITAK; 1996. p 263-272.
[6] Disasters, development and environment Cannon T. John Wiley & Sons; 1994.
[7] Dal, B. An Investigation into the Understanding of Earth Sciences Among Students Teachers. Educational Sciences Theory & Practice 2009; 9(2): 597-606.
[8] Bilimsel Arastirma Yontemleri. Buyukozturk S, Akgun O, Karadeniz S, Demirel F, Kılıc E. Pegem Akademi Yayincilik; 2012.
[9] Sosyal Bilimlerde Nitel Arastirma Yontemleri. Yildirim A, Simsek H. Seckin Yayincilik; 2006.
[10] Bulus Kirikkaya E, Oguz-Unver A, Cakın O. Ilkogretim Fen ve Teknoloji Programinda Yer Alan Afet Egitimi Konularina Iliskin Ogretmen Gorusleri. Necatibey Egitim Fakultesi Elektronik Fen ve Matematik Egitimi Dergisi 2011; 5(1): 24-42.

© 2012 HSci. ISBN 978-989-98032-0-6

RAISING PALESTINIAN WOMEN'S INTEREST IN SCIENCE THROUGH INFORMAL LEARNING ACTIVITIES: A CASE STUDY OF "THE TRANSIT OF VENUS"

B. Battrawi
Walid & Helen Kattan Science Education Project – Qattan Centre for Educational Research and Development – A.M. Qattan Foundation, Ramllah-Palestine
bisan@science.qattanfoundation.org

Abstract. *This paper came as a result of an informal science learning activity that aims at raising a group of Palestinian female students' interest in science. The activity was comprised of various events leading to the observation of the astronomical phenomenon; the transit of Venus. The main goal of this informal learning activity was for the participants to observe and learn about a once in a life time phenomenon in an informal setting outside the school context. Data collected show evidence of students working as "nascent scientists". The paper reviews international research on women in science and informal learning activities, and relates them to one another and to the Palestinian context.*

Keywords: Informal Science, Science Education in Palestine, Women in Science.

1. Introduction

An essential component of development; science education, literacy and application, has been a field of tremendous research especially with the rapid advances in technology and globalization (Liu, 2009). In Palestine, science education remains to be traditional where the students' role is limited by the text-based lectures of the teachers, and their performance is evaluated based on how well they know the text. (A.M. Qattan Foundation, 2011; Wahbeh, 2003) Thus, the students' interests in science are inhibited and a culture of fear of sciences is carried on due to its rigidity in schools. Moreover, the Palestinian culture of education does not necessarily encourage informal science learning due to many reasons, one of which is the lack of informal learning settings. Science literacy is very important for Palestine's development which is according to Laetsch (1987) an essential indicator of development since it enables better political decisions and economic returns; helps reduce superstition, improves individual behaviors, and helps create a more ethical world (Liu, 2009). Achieving science literacy is definitely a challenge, yet it is important to understand that science could be learned in many places; in and outside the schools, within and outside work, and both formally and informally (Liu, 2009; Fenichel & Schweingruber, 2010; National Research Council, 2009; Hofstein & Rosenfield, 1996). Hence, developing informal science learning environment is a crucial step towards achieving science literacy in Palestine.

Informal science education is becoming increasingly popular worldwide, as it allows for a better understanding of scientific and natural phenomena as well as a better retention since it engages the learner in a personal experience. Informal science, as Crane, Nicholson, Chen and Bitgood (1994) define it, refers to the "activities that occur outside the school setting, are not developed primarily for school use, are not developed to be part of an ongoing school curriculum, and are characterized as voluntary as opposed to mandatory participation as part of a credited school experience. Informal learning experiences may be structured to meet a stated set of objectives and may influence attitudes, convey information, and/or change behavior" (Stocklmayer, Rennie & Gilbert, 2010; Hofstein & Rosenfield, 1996). Informal learning experiences are unique in the sense that they provide a fun learning atmosphere devoid of the stress of being tested for the developed knowledge (National Research Council, 2009; Stocklmayer, Rennie & Gilbert, 2010; Hofstein & Rosenfield, 1996; Fenichel & Schweingruber, 2010). Therefore, informal science learning could be utilized as a means to tackle the more difficult topics in science such as physics and astronomy.

Astronomy is a field of interest for many people as it allows one to touch on the fascinating wonders of the outside world. This field, in addition to other scientific fields was a field of tremendous interest and research for the Arab and Muslim scientists during the Islamic Golden Age, when Arab and Muslim scientists have contributed immensely to astronomy and science (Hassan, 2000; Maziak, 2005; Morelon, 1994). Despite that fact, Arabs' current contribution to the science is disproportionate to their human and economic capacities (Maziak, 2005). This is also relevant to Palestine, where the scientific contributions are insignificant. It could be argued that the interest in the field of astronomy in Palestine is not towards the scientific explanations of the cosmos but rather the pseudoscientific matters and the purely aesthetic value of the cosmos. This could be reflected in the increasing number of people believing in astrology which is seen through newspaper daily columns on horoscopes; tens of horoscope-related books on book stands; and the increasing number of Arab World television shows on astrology and horoscopes. This matter is of a tremendous importance as superstition and belief in supernatural phenomena are seen as factors that hinder the development of societies (A.M. Qattan Foundation, 2011; Liu, 2009). Thus it is important that the public's knowledge of astronomy is scientifically directed as astronomy is a very important field in science for it provides the fundamental explanations of the life known on Earth and Earth's perspective in the extremely vast universe.

This paper explores an informal learning activity intended to raise interest in science and astronomy among a group of female students. The activity, organized by the Walid and Helen Kattan Science Education Project – A.M. Qattan Foundation, Palestine, was comprised of various events leading to the observation of the astronomical phenomenon; the transit of Venus. The paper reviews the causes for the limited interest in science and scientific research among women and connects some of the internationally recognized causal factors to the Palestinian context. The transit of Venus activity is examined where four main themes are considered in assessing the level of effectiveness of this activity;

- Theme 1: Students' interest in astronomy
- Theme 2: The strength of informal / extracurricular activities
- Theme 3: Challenging the traditions of the community by participating in science
- Theme 4: Students' interest in a science career

2. The Case of Palestine

2.1. Science Education in Palestine

As mentioned previously, science is a very important field as it is an indicator of development. However, many students are still repelled by it as they fear its complexity. Female students in particular are more likely to stay away from science for many reasons which will be discussed later in this paper. Not much research or data is available on this issue in Palestine, but research from the Arab and the Islamic World suggests that there is a serious issue regarding the interest, involvement in and participation in science and scientific research for both sexes, male and female (e.g.: Hassan, 2000; Maziak, 2005). Data presented by the UNDP Arab Human Development Report, 2005, suggest that the percentage of female students in Palestinian universities in the science field in 2003 is 49%, a percentage higher than that of many other adjacent Arab countries. However, Palestine's contribution to science and scientific research is still poor and minimal which indicates that there is a problem with both the education itself and the capabilities. Therefore, there is definitely a need to reform science education and stimulate scientific research and interest in science. The Walid and Helen Kattan Science Education Project - a project running under the umbrella of the Qattan Centre for Educational Research and Development (QCERD) – A.M. Qattan Foundation; is a Palestinian project which aims at "improving the quality of science education in Palestine's schools and effectively transmitting its value into the wider society" - is making many efforts to improve science education both on an educational and societal levels; this involves its informal science program. The informal science program aims to contribute immensely to an enhanced science culture and literacy in the Palestinian society, both inside and outside the schools.

2.2. Women's Underrepresentation in Science

Despite the fact that women's enrolment in science courses in Palestinian universities is relatively high; the majority of women enrolled in science are not actively involved in significant scientific research, where most of those who study sciences end up working in medical laboratories, drug companies, or as teacher assistants in universities. Some end up as housewives, especially once they get married. This lack of interest in significant scientific research could be attributed to many reasons, many of which, related to the still prevalent patriarchy of the Palestinian society. This is especially seen in the more rural areas in Palestine where gender roles are highly apparent. The factors suggested by the tremendous research done on the topic of women and science could also be applied to Palestine when analyzing Palestinian women's role in science. Some of the more general factors that apply to both genders include; a general decline in the interest of young people in scientific careers, a general lack of scientific literacy among the public, a lack of connection between science and scientific research and the everyday lives of people, as well as many other factors (Osborne, Simon & Collins,2003).

International research on the women in science topic has been going on since the 1960s (Fadigan & Hammrich, 2004; Leta & Lewison, 2003). Research suggestions and recommendations also apply to the Palestinian case as women are still underrepresented in sciences not only in Palestine, but also in the international arena. Fadigan & Hammrich (2004) imply in their study of an urban informal science education program directed at female participants in the United States that women and men are not treated equally from a very early age in most societies where men are often encouraged to have a scientific orientation and women are not; "science textbooks and curricula often fail to equally represent females in photos, illustrations, and texts. Science content when traditionally presented in schools, especially in the physical sciences, does not have as great relevancy to real-life experiences for girls as it does for boys." Research on the Palestinian civics education curriculum's representation of females suggests that women's images are not presented in a fair way especially when it comes to careers, as women are depicted to be limited to careers that do not have leadership positions (IDSC, 1999). Another study which analyzes the representation of women in the Palestinian curricula including the science curriculum suggests that women are often represented as housewives or caregivers which reinforces the societal limitation for women and this may hinder interest in careers that require leadership such as science careers (Jarbawi, 2002).

Many studies also suggest that school science teachers also tend to give more attention to boys than girls thus hindering girls' interest in science (Fadigan & Hammrich, 2004; Osborne, Simon & Collins, 2003; Steinke, 1997; Seymour, 1995; Kenway & Gough, 1998). This factor, however, may not be too relevant in the case of Palestine as most of the public schools are single sex schools thus the issue of more attention given to boys than to girls is not likely to occur, but it could be relevant to the families of the students where sons may be given more attention and encouragement than daughters by their parents when studying sciences. Moreover, Seymour (1995) suggests that "the learning experiences of girls are more passive, less demanding, and less experiential – even in all-girls' schools." There are not many published studies on this matter specific to Palestine but much of the international research suggests that there is a relationship between students' attitudes to science and their parents' support where parents usually have a stereotypical view of their children's abilities in math and sciences due to the conventional gender roles of the societies (Osborne, Simon & Collins, 2003; Steinke, 1997).

Other factors relevant to the Palestinian case include women scientists in the media. Steinke (1997; 1999; 2005) analyzes the portraits of female scientists in the media, mainly in the United States media, and suggests that media images have portrayed women as "low-power, sexually unappealing, bespectacled lab drones" (Morse, 1995). This in turn, will more likely turn girls away from sciences as they see it as a masculine domain (Seymour, 1995). This is of relevance when analyzing the Palestinian case. The Palestinian media, to begin with, does not have any portraits of Palestinian persons in science; however, Western media is highly prevalent among the Palestinian society, thus people may be exposed to images of female scientists from a Western perspective. Those images which portray women scientists as masculine persons may have a significant effect on Palestinian females' interest in science as the Palestinian society gives a tremendous importance to the physical appearance of a woman, sometimes more than the personality and the level of intellect. Therefore females may be repelled from sciences by such images. Moreover, the actual lack or absence of Arab and Palestinian women scientists from the media makes being a significant scientist a farfetched dream intrinsic to the Western society. It is very important that role models are present for females in the field of science as science is already seen as a hard topic, but the presence of women scientist role models could "play an important role in promoting greater interest in science among young females" (Steinke, 1997).

3. The Transit of Venus Activity

The transit of Venus is one of the rare astronomical phenomena where the planet Venus transits its parent star, the sun, in a position where it comes between the sun and the Earth thus it becomes visible to Earth as a small black dot on the sun disc. The phenomenon is unique for it only occurs in pairs eight years apart, with the gap between the second transit of one pair and the first transit of the next alternating between 105.5 and 121.5 years. The most recent pair of transits took place in 2004 and 2012 (Pasachoff, 2012). The 2012 transit took place through the 5th and 6th of June, and it was visible in Palestine on the 6th of June. Since the next transit will not take place until December, 2117, the Walid and Helen Kattan Science Education Project, A.M. Qattan Foundation came up with the idea of observing this unique phenomenon with members of the Palestinian community and spark a sense of involvement with the international scientific community.

The "Transit of Venus" activity was comprised of various events leading to the observation of the astronomical phenomenon. The main goal of this informal learning activity was for the participants to observe and learn about a once in a life time phenomenon in an informal setting outside the school context. The main supervisor, a female science teacher took the initiative of leading the event and gathered a group of female students from grades 7 (n = 14), 8 (n = 7) and 11 (n = 22) from Silwad Secondary School and worked with them, from May 20th until June 6th, 2012 – while they were on their summer break - on developing conceptual knowledge about the phenomena, and building observation tools to watch the transit of Venus. The activity took place in Silwad and Al-Taybeh villages near Ramallah city, Palestine. A total of 4 meetings between the group were held during which, participant students researched about the phenomenon and its scientific and historical significance, worked on hands-on activities related to astronomy, and built their own tools from local materials to watch the phenomenon. The observation tools included binoculars and pinhole cameras.

Besides the mere observation and knowledge of this unique phenomenon, the transit of Venus activity also aimed to spark an interest in science and astronomy among the participant students especially that they come from a rural society, and a public school where less facilities and equipment are present, and where the teachers have less flexibility in time to introduce science in a nontraditional way.

The day of the observation was marked by an exceptional support from the participants' parents who encouraged their children to leave their houses by sunrise and take part of the scientific community. Some of the parents were even interested in the activity and joined the day. On that day, the students, their parents, teacher, and some of the QCERD staff arrived in Taybeh village, Ramallah around 4:30 AM, where the transit of Venus was observed using the tools developed by the students. The students then gave presentations on the knowledge they developed through this activity to their parents and the QCERD staff. The event caught a lot of attention from the Palestinian media as such events are rarely considered by the Palestinian society.

The transit of Venus activity was followed by another astronomy-related activity with the same group of students called the "Landing of Curiosity Rover on Mars" activity; which took place about two months after. The activity was a three-day workshop in which students (n = 25) worked in groups on developing knowledge in different topics related to the planet Mars during the first two days. Their outcomes included PowerPoint presentations as well as short informative videos. The third day was marked by a live streaming event of NASA TV's coverage of the landing of the Curiosity Rover on Mars. The students also presented their work to members of the local community. The students again took part of the international scientific community by anticipating the landing of the Curiosity Rover on Mars which is considered another incredible accomplishment in the human history.

4. Method

4.1. Participants

The transit of Venus activity involved a female science teacher with a group of her students who are involved in their school's science club from Silwad Secondary School. The students were all females from grades 7 (n = 14), 8 (n = 7) and 11 (n = 22). The participants all attended Silwad Secondary School but they came from different villages in the Eastern part of Ramallah, Palestine. All of the participants came from a

© 2012 HSci. ISBN 978-989-98032-0-6

rural Palestinian background. It is noted that the villages of Eastern Ramallah have a good living situation due to the fact that most of the families of those villages have business in the United States, thus, the students have access to the technologically advanced utilities such as smart phones, laptop computers, etc.
The students' participation was driven by their own interest although the activity started just as they were starting their summer break; they were all enthusiastic about a new experience with one of their favorite teachers. It is also noted that the students felt excited and special to be watching a once in a life time phenomenon.

4.2. Procedures

The main data collection tools used in this study include a post-activity questionnaire, semi-structured interviews, and reflection papers. All of the Data were collected after the transit of Venus activity. The reflection papers were collected within the same month of the activity, whereas data from the semi-structured interviews and the questionnaires w were collected during the "Landing of Curiosity Rover on Mars" activity which took place two months after.

4.3. Research Instruments

4.3.1. Post-Activity Questionnaires

The questionnaire which was distributed to a total of 20 students two months after the transit of Venus event and prior to the "the Landing of Curiosity Rover on Mars" activity was developed to assess the effect of an informal learning activity on the students' interest in science. The questionnaire consisted of 15 statements to which students could respond on a uniform five-point Likert Scale ranging from "Strongly agree" to "Strongly Disagree." The themes under which the statement came include;

- Theme 1: Students' interest in astronomy
- Theme 2: The strength of informal / extracurricular activities
- Theme 3: Challenging the traditions of the community by participating in science
- Theme 4: Students' interest in a science career

4.3.2. Semi-structured Interviews
The semi-structured interviews were recorded while the students were working in their groups during "the Landing of Curiosity Rover on Mars" activity. The interviews aimed to get a more personalized reflection on the themes mentioned previously. The students found in the interviews a venue to express their opinions and thoughts about the activity and they all were very excited to talk.

4.3.3. Reflection papers
The reflection papers were collected by the end of June by the science teacher. The students were given the freedom to reflect on their experience during the transit of Venus through those reflection papers. Due to the fact that the students were on their summer break, only a total of 4 reflection papers were collected all from the 11 graders.

5. Data Analysis

5.1. Post-activity Questionnaires

Answers to the statements from the post-activity questionnaires were averaged on a scale of 1 to 5 where 1 equals "strongly disagree," 2 equals "disagree," 3 equals "neutral," 4 equals "agree," and 5 equals "strongly agree" (Finley, 2012). Six of the 15 questions were picked for this study as they correspond with the highlighted themes mentioned previously. The 6 questions are;
Question 1: I am very interested in astronomical sciences (Theme 1)
Question 2: My experience in the transit of Venus activity sparked / increased my interest in astronomy (Theme 1)
Question 3: I enjoyed learning through the transit of Venus activity more than I do in the classroom (Theme 2)
Question 4: I found my experience in the transit of Venus activity challenging to the rural community around me especially since I left my house around sunrise (Theme 3)
Question 5: I felt kind of happy and strong to leave my house in an early hour to observe a very rare and important phenomenon (Theme 3)
Question 6: I want to choose a career in the science field in the future (Theme 4)

5.2. Semi-structured Interviews

As mentioned previously, the interviews were held with the students as they were working in groups during the "Landing of Curiosity Rover on Mars." The interviews were tape-recorded, and then transcribed. Excerpts were selected to support evidence of interest, knowledge and skill development, and peer cooperation.

© 2012 HSci. ISBN 978-989-98032-0-6

5.3. Reflection Papers

Reflection papers were also analyzed by selecting evidence of changed interest, knowledge and skill, and peer cooperation, and were corroborated with the questionnaire and interview data.

6. Results

6.1. Theme 1: Students' interest in astronomy

Results from the post-activity questionnaires show evidence of students' high interest in astronomy. The averages of students' responses to questions 1 and 2 are equal to 4.20 ± 0.69 and 4.65 ± 0.48 out of 5, respectively (figure 1) which indicates that the student's interest in astronomy is high and is also influenced by their participation in the transit of Venus activity.

Moreover, the reflection papers have also revealed that the students' interest in astronomy specifically was sparked through this activity. The following excerpt indicates that this student's interest in planets was encouraged by the activity:

Student A: "That day was full of beauty and fun for me where we went to a nearby village (Taybeh) to watch this phenomenon which I never heard of prior to this activity. I learned a lot from this activity and I was exposed to very new information which I would not normally know. To be honest, this was the first time for me to go on the internet and search on planets and especially the planet Venus."

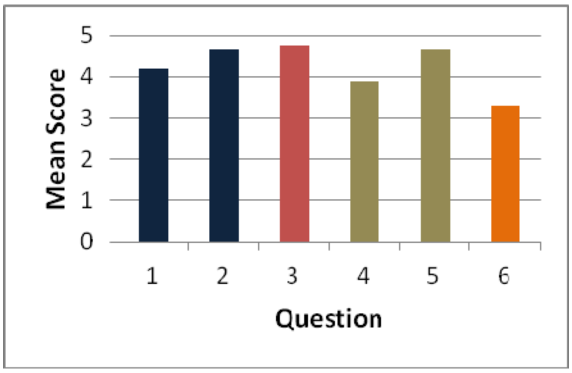


Figure 1. *Average scores of answers to selected questions from the post-activity questionnaire*

6.2. Theme 2: The Strength of Informal / Extracurricular Activities

The mean score of students' responses to question 3 is equal to 4.75 ± 0.44 (figure 1). This indicates that most of the students agreed that this informal learning activity was much more valuable to them than in-class activities. This is also elaborated through the students' opinions in the semi-structured interviews. A sample of the responses to the question of an evaluation of such learning activities as opposed to formal in-class activities where;

Student 1: "In school we are more stressed - we need to get a good grade but here we want to take the information because we want to."

Student 2: "Here we are not tied to a certain thing; we meet new people, we feel important."

Student 3: "Those activities are better than the ones we have in school. They affect us a lot, because we are not restricted by the text book and we have the freedom to learn so the information sticks in our mind for a long time... We are not forced to learn; we want to learn and we encourage ourselves to learn, so we research more and we feel more motivated to learn more."

Student 5: "We feel encouraged to do effective and useful research."

Most of the students indicated in their interviews that those informal learning activities are fun, less stressful when compared to school-based activities, and not tied to grades or tests. They also talked about how meeting new people and working with students older / younger is unique in those activities.

6.3. Theme 3: Challenging the Traditions of the Community by Participating in Science

Responses to questions 4 and 5 are averaged as 3.9 ± 1.02 and 4.67 ± 0.49 respectively. Responses to question 4 suggest that most students had a slightly positive attitude, in terms of agreement, towards the statement "I found my experience in the transit of Venus activity challenging to the rural community around me especially since I left my house around sunrise." The students' agreement to question 5 also indicated that most of them felt strong as participants in an important scientific event.

This is also elaborated through the students' opinions in the semi-structured interviews as well as the reflection papers. Many students express, through the semi-structured interviews, that they challenged their rural conservative community by leaving their houses early in the morning, as in the following excerpts:

 ISBN 978-989-98032-0-6

> Student 3: "It's really nice when a girl leaves the house and does research even though she does not have to (she can stay home and the man could take care of her). And the nice thing is that she is doing it because she wants to, not because someone told her to do it."
>
> Student 4: "… We feel motivated and encouraged. We feel empowered. Our confidence increases."
>
> Student 6: "Our society is an Arab society and it is very conservative, the woman's role is very restricted, even the men do not participate in science so imagine what the case of women would be. But through this experience and the transit of Venus experience we feel that we can empower and develop ourselves. The experience of the transit of Venus has changed so many things for us especially that we left our house very early, around 4:00 AM, and this was a step that broke the rules and the barriers which the society has. And now our parents are ok with it. After they saw that our experience in the transit of Venus was fruitful, they now trust us to participate in more activities and they care that we learn."

All of the students emphasized the challenge they felt when leaving their houses early through their reflection papers which describes how excited they were about challenging the societal rules as in the following sample:

> Student A: "There was a big risk in this event since we left our homes at 4:30 in the morning despite our parents' refusal in the beginning, but we managed to convince them by telling them that we are researching about this important topic and this will have a significant effect on shaping our academic careers."

6.4. Theme 4: Students' Interest in a Science Career

The mean score of students' responses to question 6 is equal to 3.3 ± 1.38. None of the students indicated an interest in a science career in the reflection papers and the semi-structured interviews. However, during "the Landing of Curiosity Rover on Mars" activity some of the 11th grade students asked questions regarding the requirements they need to fulfill to have a career like that of the scientists they have seen through the documentaries they watched.

7. Discussion and Conclusion

The activity in general presents an example of the strength of informal learning activities and the extent to which such activities may reach especially in raising females' active participation in science. The activity presented in this study showed that hands on and informal science are important and effective settings for raising interest in science as they allow one to experience science in an interactive unique way without the stress of being graded.

Data from the post-activity questionnaires, transcribed semi-structured interviews and reflection papers show evidence of students working as "nascent scientists" by developing knowledge through research, anticipating event, developing tools and working in groups. Moreover, results indicate that students became highly motivated to learn more about the similar coming events to take part in them. As the second activity was announced, the student showed an immediate interest in participating without having prior knowledge on the details of the activity. This is especially important since the Palestinian curriculum lacks astronomical content.

The success of the students' learning experiences could be attributed to the fact that this informal learning activity was stress free, ungraded, and marked by a collaborative and friendly atmosphere. The students also felt important as they took part in an international scientific activity simultaneously with challenging the societal restrictions for a very important cause.

The absence of pre-activity questionnaires as well as the lack of research relevant to the Palestinian case presented a limit for this study.

It is important to consider pre-activity questionnaires for research on future activities in order to track changes in attitude and interest in science more accurately. Further research will allow a better understanding of the Palestinian context and the changes necessary to achieve an increased interest in science especially among women. It is important to study the specific factors relevant to the Palestinian case as well as the international factors in relation to the Palestinian context.

8. Acknowledgements

The author would like to thank Nader Wahbeh for his generous support and encouragement to write this paper, and Kareema Awadallah, the

© 2012 HSci. ISBN 978-989-98032-0-6

teacher involved in this study. Many thanks to Nasser Halaweh and the Walid & Helen Kattan Science Education Project – A.M. Qattan Foundation staff.

9. References

1. A.M. Qattan Foundation. *The Walid and Helen Kattan Science Education Project Document 2011*. Ramallah, Palestine: A.M. Qattan Foundation.
2. Assali, A. RCHRS. The Woman's Image in the Civics Education Curriculum from Grades 1 – 6 (in Arabic). http://www.idsc.gov.ps/arabic/edu/derasat/derasat-13.html [08/25/2012]
3. Aswad, N., Vidican, G., & Samulewics, D. Creating a knowledge-based economy in the United Arab Emirates: realising the unfulfilled potential of women in the science, technology and engineering fields. European Journal of Engineering Education 2011, 36 (6), 559 – 570.
4. Bishop, J. Astronomy Learning and Student Thinking. Journal of the Astronomical Society of the Pacific 1996, 25 (2).
5. Etzkowitz, H., Kemelgor, C., Neuschatz, B., Uzzi, B., & Alonzo, J. The Paradox of Critical Mass for Women in Science. Science, New *Series* 1994, 266 (5182), 51 – 54.
6. Fadigan, K., & Hammrich, P. A Longitudinal Study of the Educational and Career Trajectories of Female Participants of an Urban Informal Science Education Program. Journal of Research in Science Teaching 2004, 41 (8), 835 – 860.
7. Finley, L. The Effects of an Informal Science Education Setting on Students' Attitudes towards Learning Sciences. Honors Thesis 2012. Paper 27.
8. Friedman, A. Creating an Academic Home for Informal Education. Public Institutions of Personal Learning (1995).
9. Gupte, N., Gyanchandani, J., Nair, S., & Rao, S. Women in Physics: An Indian Perspective. The IUPAP International Conference on Women in Physics 2002.
10. Hassan, F. Islamic Women in Science. Science 2000, 290 (5489), 55 – 56.
11. Hofstein, A., & Rosenfield, S. Bridging the Gap Between Formal and Informal Science Learning. Studies in Science Education 1996, 28, 87 – 112.
12. Hurd, P. Scientific Literacy: New Minds for a Changing World. Science Education 1998, 82, 407–416.
13. Jarbawi, T. Women in the Palestinian Curriculum. Unpublished paper 2002. (in Arabic).
14. Jones, L. Opening Doors with Informal Science: Exposure and Access for Our Underserved Students. Science Education 1997, 81, 663-677.
15. Kenway, J., & Gough, A. Gender and Science Education in Schools: A Review 'with Attitude.' Studies in Science Education 1998, 31.
16. Leta, L., & Lewison, G. The contribution of women in Brazilian science: A case study in astronomy, immunology and oceanography. Scientometrics 2003, 57 (3), 339 – 353.
17. Liu, X. Beyond Scientific Literacy: Science and the Public. International Journal of Environmental and Science Education 2009, 4 (3), 301 – 311.
18. Lorenzo, M., Crouch, C., & Mazur, E. Reducing the gender gap in the physics classroom. American Journal of Physics 2006, 74 (2).
19. Maziak, W. Science in the Arab World: Vision of Glories Beyond. Science 2005, 308.
20. Morelon, R. Arab Sciences and Philosophy. 1994, 4 (1), 111 – 139.
21. National Research Council. Learning Science in Informal Environments: People, Places and Pursuits. Washington, DC: The National Academies Press; 2009.
22. Osborne, J., Simon, S., & Collins, S. Attitudes towards Science: A Review of the Literature and its Implications. International Journal of Science Education 2003, 25 (9), 1049 – 1079.
23. Pasachoff, J. Venus: it's now or never. *Physics World 2012*, 25, 5
24. Samulewicz, D., Vidican, G., & Aswad, N. Barriers to Pursuing Careers in Science, Technology, and Engineering for Women in the United Arab Emirates. Journal of Gender, Technology and Development 2010, 16, 125 – 152.
25. Seymour, E. The Loss of Women from Science, Mathematics, and Engineering Undergraduate Majors: An Explanatory Account. Science Education 1995, 79 (4), 437 – 473.

26. Steinke, J. A portrait of a woman as a scientist: breaking down barriers created by gender-role stereotypes. Public Underst. of Science 1997, 6, 409 – 428.
27. Steinke, J. Women Scientist Role Models on Screen: A Case Study of Contact. Science Communication 1999, 21 (1), 38 – 64.
28. Steinke, J. Cultural Representations of Gender and Science: Portrayals of Female Scientists and Engineers in Popular Films. Science Communication 2005, 27 (1), 27 – 63.
29. Stocklmayer, S., Rennie, L., & Gilbert, J. The roles of formal and informal sectors in the provision of effective science education. Studies in Science Education 2010, 46 (1), 1 – 44.
30. Surrounded by Science: Learning Science in Informal Environments. Fenichel, M., & Shweingruber, H. The National Academic Press; 2010.
31. Tuan, H., Chin, C., & Shieh, S. The development of a questionnaire to measure students' motivation towards science learning. International Journal of Science Education 2005, 27 (6), 639 – 654.
32. UNDP. Arab Human Development Report: Towards the Rise of Women in the Arab World. New York: United Nations Publications; 2005.
33. UNESCO. Science, technology and gender: An international report. Paris: UNESCO; 2007.
34. UNU-IAS. Revisiting Women's Participation in Science and Technology: Emerging Challenges and Agenda for Reform. Yokohama: UNU-IAS; 2005.
35. Wahbeh, N. Teaching and Learning Science in Palestine: Dealing with the New Palestinian Curriculum. Mediterranean Journal of Educational Studies 2003, 8 (1), 135 – 159.
36. Wolff-Michael, R., & Lee, S. Science Education as/for Participation in the Community. Science Education 2004, 88, 263-291.
37. Wulf, R., Mayhew, L., & Finkelstein, N. Impact of Informal Science Education on Children's Attitudes About Science. 2010 Physics Education Research Conference;2010.

FINNISH EDUCATION SYSTEM AND SOME FEATURES OF PRIMARY SCIENCE EDUCATION IN FINLAND

T. Asunta
University of Jyväskylä,
Department of Teacher Education, P.O.Box 35,
400014 University of Jyväskylä
Finland
tuula.a.asunta@jyu.fi

Abstract. *Finnish education system has interested policy makers and teachers all over the world since the good PISA results. The education system is described shortly to make it easier for the readers to understand the innovative features of our schooling. The basis of good education is in teacher training. Therefore the primary science teacher training program as well as some special features of it will be revealed more detailed as well as some features of science teacher training. As an example the project based learning that is very essential part in training primary science teachers will be shortly introduced.*
There is always something to develop when it comes to the education systems of each country and we can definitely learn from each other. Free education for all as well as the free public library system that has offered opportunities for all people to develop themselves by reading have always been striving forces for all-around education in Finland.

Keywords: education, science education, project based learning.

1. Introduction

Jyväskylä has a significant role in Finnish cultural history. The first training college for Finnish-language teachers was founded in Jyväskylä in 1863 (Viljanen 1992) Since then there have been many stages in the development of teacher training and school education as well. The demands of teacher's qualifications have altered many times, mostly due to changes in society in school organizations. Throughout its existence Finnish teacher education has been paid for by state, while the school system has also been governed by the National Board of Education.
Twenty years after the comprehensive schools reform the structures of the comprehensive school were ready, yet there was the feeling among teachers in schools and universities as well as at the National Board of Education that it was time for an internal reform of the school. The central school governmental power was breaking down and being delegated to local

© 2012 HSci. ISBN 978-989-98032-0-6

authorities and schools. This was the time of developing for example the school curriculum, teaching methods at schools as well as assessment of pupils. This opened up the situation, when those teachers willing to develop their own work were asking and looking for the possibilities to get together (Asunta et al. 2005)

2. Finnish Educational System

To be able to understand Finnish Education you need to be aware of the education system in Finland:

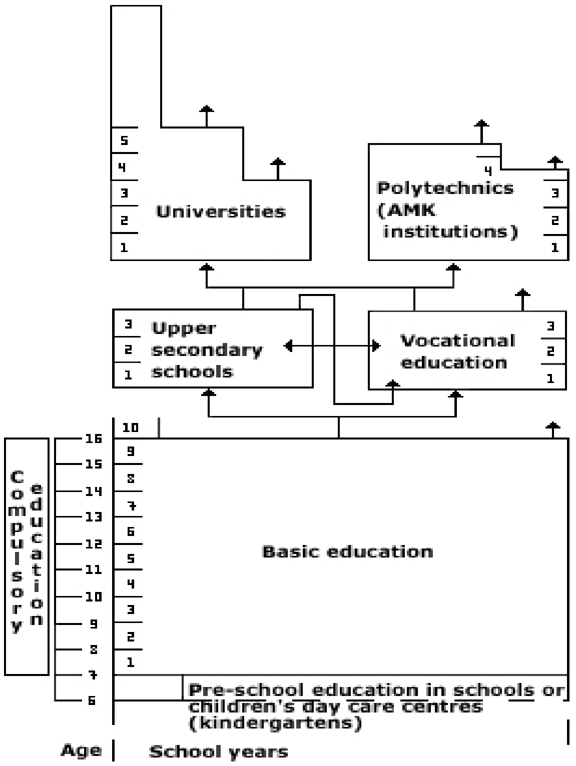


Figure 1. *Finnish Education system*

All 6-year-old children have the right to pre-school education which is free of charge. It is voluntary one year school where approximately 96% of Finnish children attend. The objective for children is to experience joy through learning by doing. Pre-school education is usually provided by day-care centers and a few primary schools. All pre-school groups follow the same curriculum. Pre-school education supports children's learning to learn, developing social skills as well as life management- and teamwork skills.

Basic school is a comprehensive school which is compulsory for nine years starting at the age of seven. The school year lasts 190 working days from mid-August to the beginning of June. In Finland everyone has the right to free basic education, including: necessary equipment and text books as well as school transportation (where needed) and free meals during school days.

For children aged 7-12 years: there is mainly one class teacher and one classroom but in some cases a specialized teacher is teaching English, gymnastic, music, etc. For ages 13-15 there are several teachers -subject teachers and classrooms. And there is an optional 10th class (2-3% of pupils attend). The purpose of this optional class is to offer pupils the possibility to improve their grades. This is very important for some pupils to improve opportunities for further studies.

Lower secondary level education is also free. There are no tuition fees in general and vocational upper secondary education. At the upper secondary levels of education, students pay for their text books and travel expenses.

It is notable that 40% of the school-leavers after finishing comprehensive education go to vocational training. It takes three years of full-time study

Vocational qualification provides extensive basic skills for different occupations such as for example baker, hairdresser, carpenter, bricklayer, truck driver, etc. It is also notable that every pupil have right to take part in special education if needed. Parents and teachers will decide together on that.

Upper secondary school (high school) is course based so there are no year- classes. It consists of general studies, minimum of 75 courses and in the end of that schooling there is the graded national matriculation examination. A student has to pass exams of at least four subjects to pass the matriculation examination, of these only Finnish language is compulsory and a student can choose the other three from four options: mathematics, a foreign language, Swedish language or general studies These subjects have to be chosen by the examinee well in advance prior to the exam. Exams consist of questions which require answers in the form of an essay. The subjects of general studies category are: religion, philosophy, psychology, history, civics, physics, chemistry, biology, geography and health education.

The variety of subjects of these general studies at secondary school guarantees a good start for an education producing balanced and multiply-

© 2012 HSci. ISBN 978-989-98032-0-6

talented individuals, who can integrate well into the society.

3. Citizenship education- is it important at school?

Orlenius (2001) found that young people are not uninterested in the adult world. By encouraging young people to express their inner thoughts and feelings and facilitate dialogue, their competences and interest in the world are stimulated. A school where teachers are genuinely interested in the views of the pupils is equally enriching for pupils and teachers. In contrast: if teachers in their everyday practice do not respect or listen to the ideas and opinions of their pupils but instrumentally superimpose values onto them, the prospect of – via education – developing morally aware, politically active and democratic citizens seems more difficult, if not utopian (Sandström- Kjellin & al. 2010).

4. Assessing at schools

During the past few decades a lot of effort has been put on developing assessing in schools as well as at the Universities (Koppinen, Korpinen & Pollari 1994). The tasks of assessment during the course of studies should guide and encourage studying and to depict how well the pupil has met the objectives established for growth and learning. Previously a teacher was usually only assessing pupils' learning at school numerically but nowadays subjects and behavior are evaluated also by verbal summaries and teachers can also use combination of both numerical and verbal assessing. Today's teachers put more effort also on assessing pupils' learning process. That is much more demanding than traditional assessing and teachers in many schools have a lot of meetings where they are discussing assessing and learning it together. Especially primary teachers also assess the holistic developing of pupils together with parents. They arrange meetings with parents usually twice a year and they can also invite pupils attend this for a while. It is really important to know what pupils really understand and learn without comparing the pupils with each other. Therefore in most primary schools teachers do not give grades on first levels at all but only give pupils supporting written feedback twice a year and tell the pupils which knowledge or skills they need to develop.

5. Teacher training helping student teachers in their way to become competent teachers as well as independent developers

In Finland teacher as a profession has a high status. There are a lot of appliers especially in primary teacher training. The entrance exams for those applying to primary teacher education are demanding. These exams usually include an exam of one book, a group interview and an individual interview (two interviewers together). The entrance exams for secondary student teachers include also an individual interview as well as a small group discussion on a given up to date topic (two interviewers together). However these entrance exams vary a little from year to year and can be different in different universities. In Finland teachers need to have a Master's degree to be deemed qualified and occupy a permanent post at school.

The University of Jyväskylä has always played an important role in the development of Finnish teacher education. The aim of the Teacher Education program is to support students' professional development with the goal of forming a strong professional identity and providing the basis for teachers to contribute to scientific and professional development in their own field. The dialogue between theory and practice should always be present in all teaching and learning. Students are provided the skills for undertaking scientific research and for critically following scientific literature throughout their studies.

Teacher education program in Jyväskylä includes integrated study modules which have both a pedagogical focus and a subject area focus The aim of the Teacher Education programs is to develop

A. Knowledge (subject knowledge and pedagogical content knowledge).

B. Skills, which means that the student is aware of his or her own conceptions of teaching and learning, has the preliminary skills for planning, implementing and evaluating teaching and learning situations and for assessing group processes.

C. Competences, which means that the student has adequate language and communication skills, including knowledge of the key concepts in his/her own field in a foreign language, and the capacity for the critical reading of research literature.

© 2012 HSci. ISBN 978-989-98032-0-6

6. The aim is to develop the following competences:

1. Ethical competence: The student is able to identify and analyze his or her actions from an ethical viewpoint and act in accordance with ethical principles in conflict situations.
2. Intellectual competence: The student bases his or her actions and professional development on scientific thinking.
3. Communicative and interactional competence: The student is willing and able to act collaboratively in interactional situations and groups. The student is capable of and interested in listening to another person and capable of communicating in various interactional relationships.
4. Cultural, community and social competence: The student is able to assess the values and practices of the community and participate in their development, e.g., able to see things differently, assess and change them. The student identifies practices that apply to school and education and the manifestations of multiculturalism.
5. Pedagogical competence: The student is able to plan, implement, evaluate and develop different learning processes.

The training should also provide student teachers with a basis for lifelong learning and for the scientifically-based development of their future work. It should also make them aware of the school community as well as to become familiar with school-commercial enterprise models (Asunta 2005)

One of the central aims of the research strategy in teacher education is to develop the quality of teacher education and teaching, and to strengthen the underlying research base. (Asunta & Viiri, 2006). In their Master's thesis students usually complete an empirical study and combine it with the relevant theoretical basis. They have to attend research seminars during two years (24 + 24 hours) and plan and carry out empirical research in their own or the supervisor's area of interest. While completing their Master's thesis, students will demonstrate their ability to carry out, individually or as pair work, independent but supervised scientific work, which is theoretical, empirical and/or based on archival material. This involves systematic analysis using appropriate methods and theories and a written report of the results. During this research process students also need to present their research plan to the other students as well as to write the Master's thesis and briefly present their study in a seminar session. In order to learn to evaluate research, every student also has to act as an opponent for another student. All of this has proved to be a very empowering process. After defending their Master's thesis in a small group of students, as well as being an opponent for their peer student, they should also have the skills required for scientific thinking, applying research methods and scientific communication.

7. Some features of Primary Science Education in Finland

Training of students to teach primary science for children age 7- 13 is mainly based on lectures and guided laboratory activities and project work that students do in groups of 2-4 persons.

Science lectures consist of many different topics and they vary a little year by year. Main thing is to learn the meaning of the nature of scientific knowledge. Also it is important to learn what it means to use different type of models in teaching science and what type of different models there can be. A great emphasis is on finding out pupils' and students' preconceptions that will be basis for the further learning. Also students need to be aware of assessing their pupils as well as be critical when reading science study books as well as absorbing all kind of scientific information available nowadays. (Harlen & Qualter, 2004). Students will also get some tools to design the lectures and longer teaching periods at school when teaching primary science. Teaching provides learning through different phenomena and gives tools for integrating chemistry, physics, biology, and health science.

8. Project based learning

One important part of primary science teacher training is the project –which is small research study - which teacher students carry out during the second year of their university studies. The purpose of the study project is to get acquainted with one certain topic in primary science area.

The methodological framework of the Model of Educational Reconstruction is employed. (Duit, 2000; Komorek, & Duit, 2004). The project includes the following parts:

1) orientation to science teaching
2) knowledge of science curriculum
3) knowledge of pre-concepts of students themselves as well as primary pupils

© 2012 HSci. ISBN 978-989-98032-0-6

whom they are going to teach the chosen project topic
4) knowledge of assessing and
5) knowledge of teaching methods

The whole project study produces as a result pedagogical content knowledge for the students involved in the project. Students will be encouraged to pick the topic that is taught on primary level and that they would like to learn more than they already do.

Students are allowed to form small (2-4) persons group that are interested in the same topic. In the beginning of the project students are advice to be aware of their own as well as their peer students' thinking and possible misconceptions. This they learn through drawing mind maps followed by concept maps. Later this will be widened to the knowledge about their target age group of primary pupils' thinking that students will find out usually by interviewing pupils or asking them to draw their mind maps of the subject. They are also advised to go through their science study books and analyze critically how this topic they have chosen is described there. They should think over what is missing and is it something essential for understanding? They are obliged to read some didactic literature and based on this entire knowledge make their plans of what would be the best way to teach the topic they had chosen.

As a product of the project students will write a project work that includes the description of all the project steps they have gone through and literature they have used. They need to describe exactly what they have been studying and what results they have got as well as assess their own project. In the end the whole project will be presented as a research paper that will be assessed and they will present their study in research seminars for the other students in the end of the year. These seminars have tree steps:

First students present their own work in their own home group of about 20 students;

Secondly they present their work in a poster session for all a year group of about 90 students. This presentation should mainly concentrate on telling others about the research methods as well as introducing equipment used in active learning for getting information on the topic. The poster session should be as interactive as possible and other students should try to carry out some laboratory activity planned for pupils and give their comments to the presenters;

Thirdly some volunteered students present their whole project study using power point presentation and conference format for the whole year group of about 90 students. They will have 15 minutes time for presentation and 5-10 minutes for questions. These students will have extra study points from presentation.

All these steps are meant to give students tools for studying their own work in the future when they will work as teachers at schools.

References

[1] Asunta, T., Husso, M.-L. and Korpinen, E. 2005. Tutkivaa opettajuutta rakentamassa (Building Research based Teachership). Ritva Jakku-Sihvonen (ed.) Uudenlaisia maistereita. Kasvatusalan koulutuksenkehittämislinjoja, 231-251. Keuruu: Otavan kirjapaino Oy.

[2] Asunta, T. 2005. Different school-commercial enterprise models in teacher training. Presentation at the International Conference on Science and Mathematics Education (CoSMED), Penang, Malaysia (CoSMED 2005/A614TA).

[3] Asunta, T. & Viiri, J. (eds.) 2006. Pathways into research-based teaching and learning in mathematics and science education. (Polkuja tutkimukselliseen opettamiseen ja oppimiseen matemaattisissa aineissa). University of Jyväskylä, Department of Teacher Education, Research report 84, 244p. Jyväskylä: University press.

[4] Duit, R. 2000. A Model of Educational Reconstruction as a Framework for Designing and Validating Teaching and Learning Sequences. Paper presented at the International Symposium "Designing and Validating Teaching-Learning Sequences in a Research Perspective" Paris, November 23–25, 2000

[5] Finnish National Core Curriculum for Basic Education 2004. Assessing : http://www.oph.fi/download/47674_core_curricula_basic_education_5.pdf

[6] Harlen,W. and Qualter, A. 2004. The teaching of Science in Primary Schools. London:David Fulton.

[7] Komorek, M. & Duit, R. 2004. The teaching experiment as a powerful method to develop and evaluate teaching and learning sequences in the domain of non-linear systems. International Journal of Science Education 26: 5,619–633.

[8] Koppinen,M-L., Korpinen,E.& Pollari, J. 1994. Arvionti oppisen tukena [Assessing supporting learning]. Opetus 2000. Porvoo: Söderström.
[9] Orlenius, K. 2001. Värdegrunden – finns den? [Fundamental values – is there such a thing?; in Swedish]. Malmö, Sweden: Runa.
[10] Sandström Kjellin, M., Stier, J., Einarson, T., Davies, T. and Asunta, T. 2010. Pupils' voices about citizenship education: comparative case studies in Finland, Sweden and England. European Journal of Teacher Education Vol. 33, No. 2, May 2010, 201–218.
[11] Viljanen, E. 1992. Koulumestarin koulutus. Opettajankasvatuksen perusteita.

ALTERNATIVE APPROACHES IN SCIENCE CLASSROOM: CONCEPTS OF CHEMISTRY AND PHYSICS FROM ASTRONOMY FOR TEENAGERS

J.M. Fernández Novell[1], C. Zaragoza Domènech[2]
[1]*Department of Biochemistry and Molecular Biology, University of Barcelona. Spain.*
[2]*IOC. Department of Education, Government of Catalonia. Spain.*
jmfernandeznovell@ub.edu, czaragoz@ioc.cat

Abstract. *To improve teaching secondary schools chemistry and physics is necessary to adopt new educational methodologies focused on the progress of teenagers' understanding. In this way, a successful proposal applied in Catalan secondary schools is exposed. Solving astronomy questions related with chemistry and physics and working on the book from European Organization for Astronomical Research was used as an educational tool to increase the knowledge on (astronomy), chemistry, physics and science. Experimentally, a 10% error in measuring the circumference of the Earth was obtained and students' interest to science concepts was increased by answering chemistry and physics questions related to space.*

Keywords: Secondary school students, teaching methodology, (astro) chemistry, (astro) physics.

1. Introduction

Studies on Chemistry and Physics are frequently rejected by the young students and teenagers. In Catalonia, one of the 17th Spanish Autonomous Communities with their own independent education system [1], the social interest in science is low [2]. However, this lack of science's interest is evident across Europe, from the Lisbon Agenda some actions in the field of education were established "*Europe must do more to encourage children and young people to take a greater interest in science, and to motivate more young people to choose studies and careers in the scientific and technical fields*" [3]. These actions comprise the development of world citizen for the future with the best practices of science education.

Why are teenagers and young students not attracted by chemistry and physics? Preliminary studies [4-5] showed that the majority of students thought that "*Chemistry and Physics are not easy because of the difficulty of the contents into the curriculum*". However, students believe that Chemistry and Physics are useful for society although interest in both sciences in school did not increase. In addition, studying the motion or the chemical elements is a difficult and complex task for the most of secondary school students.

Usually, the students' works, in the fields of physics and chemistry, ranged from memorizing mathematical formulas to solving numerical problems related to gravity and satellites' speed (physics) or from memorizing chemical symbols to solving numerical problems related to chemical reactions (chemistry).

To improve teaching secondary schools chemistry and physics is necessary to adopt new educational methodologies focused on the progress of teenagers' understanding, which frequently proceeds from the simple to the complex. For this, the authors present a proposal that was successfully applied in Catalan secondary schools with 4th ESO students (15 years old, in their last year of secondary school) from the students' simple astronomy knowledge to the chemistry and physics complex and unknown.

This new approach reinforces the student's comprehension by introducing astronomy information and solving astronomy questions used as education tools to increase the knowledge on (astronomy), chemistry, physics and general sciences.

Some examples show the relationship between students' interest to astronomy and study of chemistry and physics: Every day, teenagers and young students experience the effects of outer space on Earth. The cycles of day and night, the phases of the Moon, and the seasons are all

© 2012 HSci. ISBN 978-989-98032-0-6

determined in part by the motions (related to physics) of objects through space. The Sun is a star; its internal chemical reactions give heat and light to the Earth (related to chemistry).

Furthermore, students know that satellites are used for sending images to their Television or connecting their telephone and even surfing the Internet, most communication satellites are flying 36000 km above the Earth surface. All of this is related with physics. In addition, the material of astronauts' dress and how to remove the carbon dioxide produced by breathing inside their spacesuit are related to chemistry. Science secondary school teachers could use these examples in their classroom.

Learning about astronomy, about the solar system, is a constructive process [6, 7]. Activities involving measurements and observation can be used to teach science. For these reasons, the authors decided to introduce the astronomy approach into physics and chemistry classroom. Firstly by measuring the radius of Earth, using the same method developed during "The International Year of Astronomy 2009" [8], and secondly by answering questions related with astronomy and any science field (physics and chemistry included).

The objective of this work is to show how teaching chemistry and physics through astronomy can make them more attractive to secondary school students. The proposal is based on the inquiry and it aim to familiarize the students in several of the methods employed by scientists. Using this methodology in chemistry, physics and astronomy activities, students should develop evidence-based explanations and justify the results.

This approach increases the involvement of students in their own learning process, increases their interest in chemistry and physics and increases their interest in how science is worked and how science is built.

2. Methodology

2.1. Process skills

Scientists make deductions and explanations from their observations. They often use models to help them make suppositions and they also use numbers and equations to support or change their conclusions. Scientists use thinking tools called process skills when they try to find an answer to a scientific question, in Table 1 you can see some of these process skills.

Furthermore, students also use these process skills when they are thinking and studying (listen, read and write)

Table 1. *Process skills*

Process Skills	Definitions	Examples
Observe	Using the senses to learn about scientific and common things.	Students have observed an eclipse and the movements of the Sun.
Compare and classify	Observing characteristics of things and organize them into groups based on these characteristics.	Students have compared the geocentric and heliocentric models of the solar system.
Independent, dependent and controlled variables.	Knowing and control the factors that affect the result of an observation.	The darkness of the night sky is a factor in optical astronomy.
Experiment	Designing ways to collect data under controlled conditions in order to prove a hypothesis.	Is the Earth flat or round in shape?

2.2. Astronomy questions in physics and chemistry classroom

All of the questions in Table 2 were posed by secondary school students (4^{th} ESO) in a chemistry and physics classroom. A clear relationship between physics or chemistry and astronomy was observed.

Table 2. *Astronomy questions*

Related with physics.	Why does the Moon follow me at night? We know that the earth revolves around the Sun but seems to be upside down! Why? Is the Earth flat or round in shape? How can we calculate the radius of the Earth?
Related with chemistry.	What kind of chemical reactions are producing at this instant into the Sun? What kind of chemical elements are present in a star? In a planet? In a comet? Why would different stars have different composition?

© 2012 HSci. ISBN 978-989-98032-0-6

The colleagues had to answer and, obviously, try to justify their answers. Initially, this task was an impossible mission. To try to help students, some biographies from the history of science such as Eratosthenes, Galileo Galilei, Alexander Oparin and Stanley Miller were selected [9].
Then, students worked on them and finally, they had to explain the life and discoveries from these scientists to their classmates. The use of storytelling in the classroom helps to attract students' attention and implicate even the most indifferent of them to the learning process. Scientists' biographies humanize science and cultivate the students' imagination.
At this point, it was proposed to work in groups [10]. Each classroom was divided in 5-6 student groups with no more than 5 students in each group. Students had to:
- answering the posed questions above and
- measuring the radius of the Earth.

2.2.1. Why measure the radius of the Earth?

The answer is comprehensible. It is possible that each generation could repeat the experiments and calculations that have led to a scientific discovery. In addition, students must learn how this discovery has been completed using the Scientific Method. Furthermore, the authors were in contact with three Catalan schools interested in measuring the radius of our planet.

2.3. Experimental approaches

2.3.1. Measuring the radius of the Earth

First of all, students found information about two questions: who was Eratosthenes? How was the radius of the Earth calculated? A summary of the best students' approximations is presented below.
Eratosthenes knew that in Assuan, right at noon on summer solstice, the sun's rays fell completely perpendicular to the ground, or whatever it is, the sun was at its zenith. However, Eratosthenes noted that this was not the case in Alexandria. This difference could only be explained if the Earth was not flat.
Eratosthenes made a brilliant hypothesis: consider that the Sun is far enough away so that its rays reach the Earth completely parallel. He found that the angles from the shadows in both cities are different. He made a deduction "the Earth is round" and he calculated the radius of the Earth. Fig 1 shows the Earth is flat and Fig 2 shows the Earth is round.

Figure 1

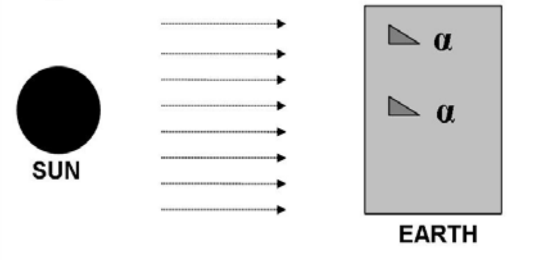
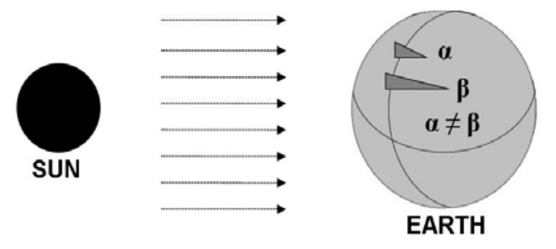


Figure 2



Under this hypothesis, at noon on summer solstice, the sun's rays directly affect Assuan, but make an angle with the vertical at Alexandria. This angle is equal to the difference of latitude between both cities. Eratosthenes reasoned that if he could measure this angle, and determine the linear distance between Assuan and Alexandria, he could estimate the radius of the Earth with the equation: $R_E = (360^o \cdot D) / (2 \cdot \pi \cdot \theta)$

A gnomon is defined as a vertical stick that projects a shadow on a horizontal surface. Students used different gnomos, as you can see in Fig 4 and 5, to measure the shadow of the Sun in a determined day at the same hour. Students had to organize (their cellular telephones were so important) the days and the exact hour when the experiment should be done in the three secondary schools from three different Catalan cities: Badalona, L'Hospitalet de llobregat and Ripoll.

Table 3. *Geographical constants*

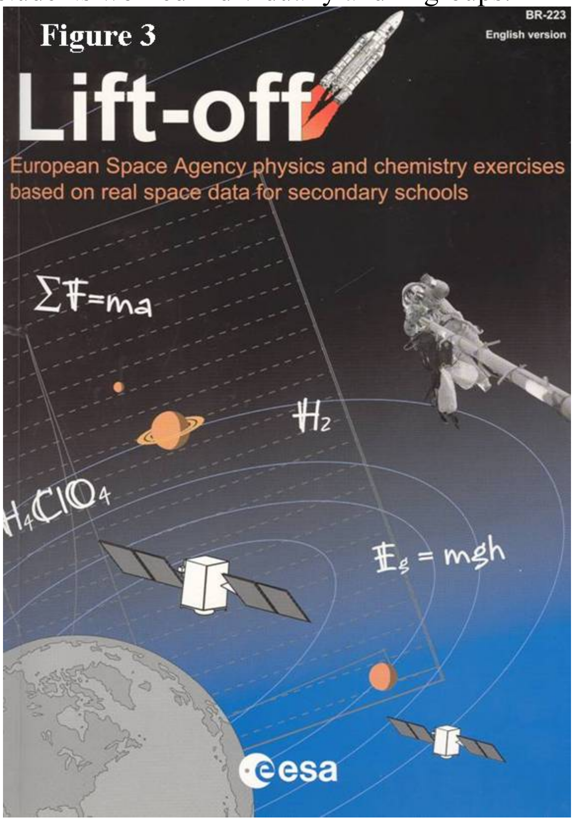
City	Latitude	Longitude	Distance to Ripoll
Badalona	41.27 N	2.15 E	91
L'Hospitalet	41.22 N	2.08 E	114
Ripoll	42.12 N	2.12 E	0

The geographical constants of the cities are represented in Table 3. Each group of each school was in direct contact with its corresponding group of another center.

© 2012 HSci. ISBN 978-989-98032-0-6

2.3.2. The European Organization for Astronomical Research in the Southern Hemisphere (ESA)

In an effort to achieve high success in chemistry and physics knowledge, working in ESA book "Lift-off" was established for secondary school students, Fig. 3 shows the book cover. To address the questions proposed in the book, students worked individually and in groups.



Questions about the speed of XMM-Newton satellite, the elliptical orbit of a satellite, the speed to arrive to Moon or the gravity in Mars are examples related to physics obtained from the ESA book.
Questions about absorption of carbon dioxide, nuclear reactions into the Sun, the atmosphere of Mars or the origin of chemical elements are examples related to chemistry obtained from the ESA book.

3. Results

3.1. Results from astronomy's questions

Table 4 shows the planetary information obtained by secondary school students before the measurement of the radius of the Earth. This was the first step to introducing astronomy in young students.

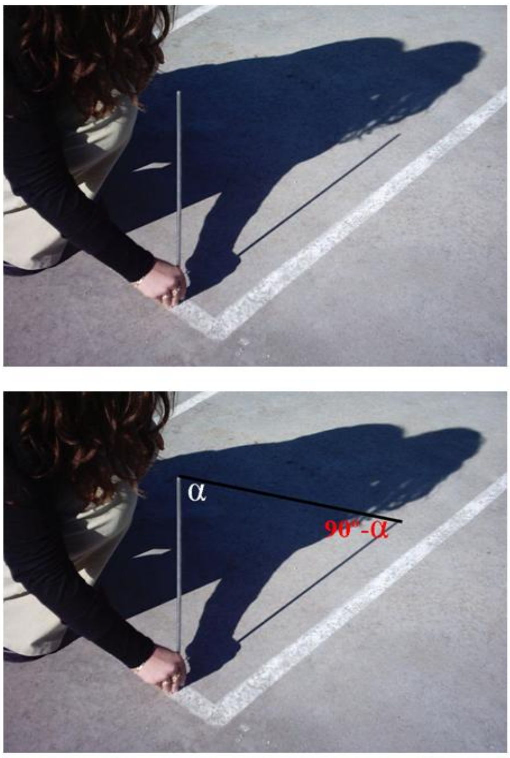
Table 4. *Planetary information*

Planet	Diameter (km)	from Sun (10^6 km)	Moons
Mercury	4878	58	0
Venus	12100	108	0
Earth	12756	150	1
Mars	6786	228	2
Jupiter	142984	778	16
Saturn	120536	1424	19
Uranus	51108	2867	17
Neptune	49538	4488	8

3.2. Results from the measurement of the radius of the Earth

You can see in Fig. 4 and 5 two moments of these measurements with the accurate location of α and β angles and their complementary.

Figure 4



Just the day D at h hours, secondary school students had measured the gnomon height and its shadow. Then, they could calculate the angles α, in the city of Badalona for instance, and β in the city of Ripoll, from the equations:

Tangent (90-α) = Gnomon (1) height divided by length of its shadow.

Tangent (90-β) = Gnomon (2) height divided by length of its shadow.

© 2012 HSci. ISBN 978-989-98032-0-6

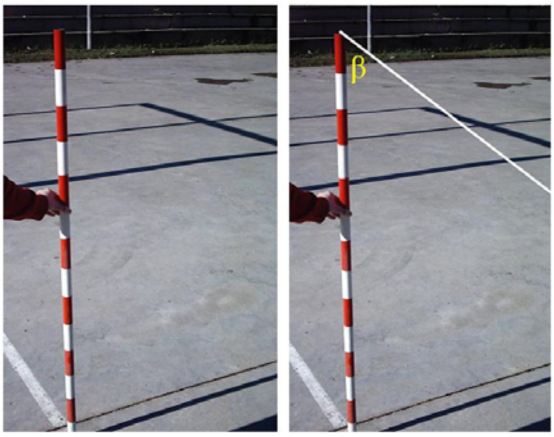
From α and β values, students calculated the difference (α - β = θ), θ another angle which is related with the lineal distance between the two cities where measures were done.
Finally, students obtained the radius of the Earth applying the Eratosthenes' formula:

$$R_E = (360^o \cdot D) / (2 \cdot \pi \cdot \theta)$$

where:

R_E : Radius of the Earth.
360º: Is the entire circumference arc.
D: Distance in km between two cities.
2: Number
π: Constants.

Figure 5



A 10% error was obtained in measuring the circumference of the Earth (acceptable value for students from secondary school), the best results were 1.8% and 3.2% of error.
It is known that the Earth has an average radius of 6371 kilometers.
Students understood the importance to observe a shadow well defined on the surface and the exact moment to make the measure, the same for all three schools.

3.3. Results from chemistry's questions

In Fig 6 is presented some chemistry exercises based on real space data. Students were more motivated to chemistry study with "real data". This was the first step to make a relationship between astronomy and chemistry in young students.

Figure 6 — Chemistry in Space

	Formula	Chemical name
Used as chemical adsorption of CO2 exhaled by astronauts.	LiOH	Lithium hydroxide
The heaviest element produced by stars in their normal life.	Fe	Iron
95.32% of the atmosphere of Mars	CO_2	Carbon Dioxide
Constituents of the atmosphere of Titan lakes form on the surface.	CH_4	Methane
Nuclear electricity generated on Cassini / Huygens is based on this element.	Pu	Plutonium
Envisat's batteries are made of this	Ni-Cd	Nickel-Cadmium

3.4. Results from physics' questions

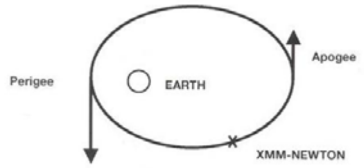
Figure 7 Discovering the secrets of the Universe

XMM-Newton, with a mass of 3.8 tonnes, is the biggest science satellite ever built in Europe. It studies the violent universe by detecting the emitted X-rays from what happens in and around *black holes* to the formation of *galaxies* in the early Universe.

XMM-Newton was launched on 10 December 1999 by the launcher Ariane 5 from Kourou (French Guiana). XMM-Newton has a 48-hour elliptical orbit. The orbit's apogee is 114.000 km above the Earth and the orbit's perigee is 7000 km above the Earth, where it passes the Earth at a speed of 24.120 km/h.

1) Find the speed of XMM-Newton at the apogee of its orbit.
2) In which part of the orbit is XMM-Newton at its slowest?

The elliptical orbit of XMM-Newton is inclined 40 degrees to the Earth's equator, with its long arm on the southern side. Data: Radius of Earth = 6378 km



In Fig 7 is presented some exercises from physics based on real space data. It was the first time that most of the students had made

 ISBN 978-989-98032-0-6

calculations with real speed data from the real ESA satellites. All of this has increased students motivation towards physics.

4. Conclusions

This educational methodology could allow science teachers to linking students' work with:

- Mathematics, students use equations and calculations;
- Reading and writing, some informs about the experiment, the biographies and the exercises must be presented;
- Social studies, the contributions of scientists and their stories were added to the classroom;
- Art, students make some drawings and models from the Solar system;
- Technology, communications and space are present in teenagers' life.

This process allows giving students

- Knowledge to preparing experiments and interpreting newly generated scientific data.
- Knowledge to increasing some basic concepts in chemistry and physics
- Finally, enhance students' interest in basic research.

A reasonable evaluation system has been established to improve the effectiveness of teaching, which includes four items:

- A group presentation,
- Self-evaluation,
- Work responsibility, and
- Experimental reports.

Evaluation is an essential point in any educational methodology; it is the best indication for continuing or changing the method applied. Students were evaluated, individually and in groups, teachers evaluated them in qualitatively form and quantitatively form (the most important for students). Secondary school students who have participated in this proposal always knew the characteristics of their evaluation.
Finally, the most important thing, between teenagers and participants in this project it was detected an increase in their interest towards chemistry and physics.

5. Acknowledgements

We thank secondary school students' participants for their input and their science teachers from secondary schools for their cooperation. We thank Jordi Fernàndez Zaragoza for him assistance in preparing the English manuscript.

6. References

[1] www.mec.es/educa/sistema-educativo [20/06/12]
[2] http://icono.fecyt.es [20/06/12]
[3] http://europa.eu.int/comm/education/ [15/05/12]
[4] Fernández-Novell, J.M. & Zaragoza, C. A Study of the perceptions and opinions of children and teenagers toward science in IATED ed. Proceedings of ICERI2011 Conference: 4th International Conference of Education, Research and Innovations; 2011 Nov 14-16; Madrid, Spain, p. 3571-3576.
[5] de Suso, E., & Bohigas, X. (2008) Opinió de l'alumnat de 3r d'ESO sobre la Física i Química. Ciències 10, 33-36.
[6] Sharp, J. G., Bowker, R. & Merrick, J. (1997). Primary astronomy: Conceptual change and learning in three 10-11 year olds. Research in Education 57, 67-83.
[7] Sharp J. G. And Kuerbis P. (2006) Children's Ideas about the Solar System and the Chaos in Learning Science. Wiley Periodicals, Inc. Sci Ed 90: 124-147.
[8] www.astronomy2009.org [12/05/12]
[9] Asimov, I. Enciclopedia biográfica de ciencia y tecnología translated from Asimov's Biographical Enciclopedia of science and technology. Alianza editorial, Madrid, Spain 1987.
[10] Dennick, R.G. and Exley, K (1998) Teaching and learning in groups and teams. Biochemical Education 26, 11-115.

 ISBN 978-989-98032-0-6

PROBLEM BASED LEARNING IN SCIENCE AND TECHNOLOGY TEACHING IN THE DEPARTMENT OF PRIMARY TEACHERS EDUCATION OF THE UNIVERSITY OF CRETE

P. G. Michaelides
Department for Primary Teachers Education, The University of Crete, GR-74100 Rethymno-Crete, Greece
michail@edc.uoc.gr

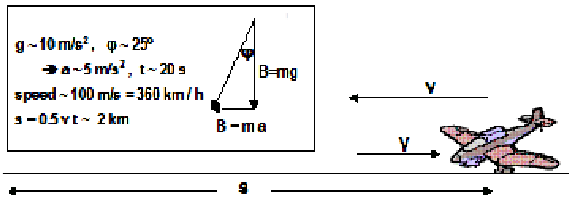
Abstract. *Critical and creative thinking is considered as an objective of education, especially in modern 'knowledge based societies'. Inquiry Based Learning has been proposed as an appropriate approach towards this objective. Consequently, teaching skills of Inquiry Based Learning should be a qualification of effective teachers, especially teachers of the compulsory education. Teaching approaches of Inquiry Based Learning require, apart from the necessary knowledge to be applied, and a firm 'way of conduct' from the teacher. This 'way of conduct' as an emotional skill is developed better by paradigms than by formal teaching. We have used Inquiry Based Learning at the Department for Primary Teachers education of The University of Crete in three distinctive courses, a/Laboratory of Educational Robotics, b/Everyday observations in Science Teaching, c/Science Teaching experiments with self made equipment. Although the main objectives of these courses were different, we have found indications that the teaching approach we adopted has inspired our students a positive attitude towards Inquiry Based Learning and we present our data in this work.*

Keywords: Problem Based Learning, Science and Technology teaching, Inquiry Based Learning.

1. Introduction

The rapid developments in Science and Technology coupled with the short time between the discovery of a new idea, product or service, and its commercial exploitation has lead to the necessity of a more effective education, especially in the modern, knowledge based societies. Education, especially when combined with professional training, vocational or technical, should be longsighted and provide not only specific contemporary knowledge and facts but, also, the necessary skills to apply this knowledge in their professional career. More important, especially for higher education, where the graduates of today are expected to be professionally active for some decades, they should have acquired during their education skills necessary to adapt to the changes expected in their profession. These skills include self-directed learning and team working. In this context, instructional designs incorporating problem based, inquiry based or project based learning became important [1], [2], [3] [4] and [5]. Traditional instruction based on knowledge and facts, although it appears more time effective on the short term, provides temporary professional skills and dexterities that become outdated very soon. This was firstly discovered in higher education medicine schools [6] but applies equally well to other professions, notably schoolteachers [7].

Figure 1. *Airplane landing speed*



We have used Problem based, Inquiry Based and Project based Learning at the Department for Primary Teachers education of The University of Crete in three distinctive courses. The main objectives and other details of these courses have been presented elsewhere. In this work, aspects of Problem based, Inquiry based or Project based learning are presented in **2. Description of the Courses**, while non-structured observations related to the aforesaid teaching approaches are presented in **3. Commentary**.

2. Description of the Courses

The courses described here refer to the Science and Technology sector. They were developed with the following objectives in mind:

a- To provide future schoolteachers knowledge and facts directly useful to school practice and operation.

b- To provide future schoolteachers with sound higher education knowledge and facts useful to their professional development.

c- To develop skills and dexterities appropriate for self centred learning in order for the future schoolteachers to be able to adapt to changes expected during their professional career.

Point a- implies a syllabus centered on themes from the school program. Point b- implies higher education and, in connection with point a-, an alternative but scientifically valid teaching with

© 2012 HSci. ISBN 978-989-98032-0-6

simple representations, i.e. avoiding unnecessary possible complex mathematics of a high level. Point c- implies use of Problem based, Inquiry based and/or Project based learning.
We have implemented these guidelines in three different courses, namely, 'Everyday observations in Science Teaching', 'Science Teaching experiments with self made equipment', and 'Laboratory of Educational Robotics'. These courses have been included into the undergraduate program of study of the Department for Primary Teachers' education of The University of Crete. They are taught every or every other semester for more than 6 years. At the end of the course an assessment including formal evaluation from the students and/or free discussions between the students and the tutors was effected. These assessments together with observations from the tutors are briefly presented in the following.

2.1. Everyday observations in Science Teaching

The objective of this course is to relate observations that may result in everyday life with the teaching of Science and a specific target to develop skills of Science observations [8]. The syllabus and other details are described in [9]. It includes themes covering most of the areas of school Science. The themes are presented picturesquely in the form of open type questions or problems to which the students have to elaborate and explain their answers. Tutoring is of a mentor type [23] mostly in the form of questions appropriate to enable students to find their own (hopefully valid scientifically) answers. Guidance is oriented towards methodology of problem solving, i.e. the sequence: clarification of the problem, relation with other known situations and previous relevant knowledge, exploration of areas of possible solutions, analysis into smaller tasks - time scheduling –monitoring the progress, completion of tasks – assessment – retrospection. This is done using real problem solving examples in the introductory to the course teaching hours, for example:

2.1.1. Estimate an airplane's landing speed by a passenger of the plane (see **Fig. 1**).

Applying the problem solving methodology described previously, the necessary steps include:

- Realization that actually is a problem to find the distance travelled by a moving object under deceleration, which is assumed constant, until it stops (neglecting the taxi speed in first approximation).
- Necessary parameters are the time and the deceleration.
- The time may be estimated by using a wrist clock or counting with a constant rate from the moment of touching the ground until the stop.
- The deceleration may be estimated from the angle the passenger feels the direction of his/her weight with the normal (see inset triangle in Fig. 1)
- In assessment – retrospection simplifying assumptions (i.e. taxi speed assumed zero, constant deceleration …) may be examined.

2.1.2 A Fictitious (?) problem (see Fig. 2).

A Science expedition was measuring the end of the shadow of a vertical rod together with the time as shown in the picture. Suddenly, a bear just awakened attacked them. What color the bear was? (note: the curve in real situations is almost a straight line).
The analysis may proceed as follows: bears are white or brown (grey). White bears natural habitat is in polar areas. Consequently the question is transformed to determine the latitude of event on the assumption that the bear was in its natural habitat and not escaped from a zoo – in which case the story would have not used the expression expedition. Just awakened for bears usually denotes awake from hibernation i.e. the event took place in early spring.
This is a simple experimental arrangement to measure the geographical coordinates of a place. The red line is along the minimal shadow of the rod and denotes the North-South direction while the time ('local noon') may be used to get the longitude. The angle between the vertical rod and the sun rays at the time of local noon is related to the latitude (is equal to the latitude at the solar equinoxes). This drill seems to be very popular among students of all ages busting their self esteem towards Science [10].

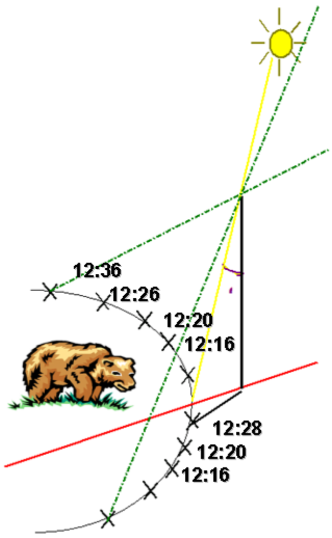


Figure 2. *A Fictitious problem.*

2.1.3. A TV Commercial Realistic or Myth? (see **Fig. 3**)

A saloon in the middle of nowhere at twilight. A cowboy strikes a match to light a cigar when, far in the horizon, one light catches his attention. He freezes staring it. Sometime later a car (vroom, vroom, vroooo…m) is passing. At this time the match burns the finger of the 'freezing observer'. A realistic fiction or a myth?

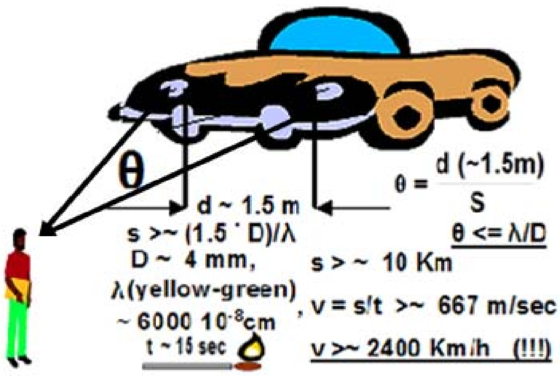


Figure 3. *A TV commercial - Reality or Myth?*

In this situation, the speed of the car is to be estimated. In contrast to case **2.1.1** now the situation is one of a constant speed so we need the distance, **s**, travelled in the time interval , **t**. The time interval may be estimated from the time of burning a match (a hands-on [11] observation) ~ 15s. To estimate the distance, **s**, we use the information supplied (one light) that the car is so far away that the two headlamps are confused as one. We use the formula for the resolving power of an optical instrument, approximately **$\theta \sim \lambda/D$** (actually $\sin\theta = 1.22\lambda/D$ for a circular aperture), where **λ** is the wavelength (about 6000Å for yellow green maximum sensitivity of a normal eye) and **D** is the diameter of the lens (in this case the eye's pupil about 4mm). This same angle, **θ**, is equal to **d/s**, where **d~1.5m**, the separation of the car's headlamps. The result is a speed of more than 2,400km/h impossible for the car advertised (actually for any known car) so this is rather a myth [12].
The process described makes use of the notion of resolving power of an (optical) instrument, a rather detailed technical fact not widely known. School children of 5th class (age 11) have proposed other valid alternatives, what about you – can you find any [13].

2.1.4 Other examples

Using simple models try to elaborate on the following:

- **Surveillance satellites**. It is said that surveillance by artificial satellites [14] might reveal the plate numbers of a car or the brand of a pack of cigarettes. Is it possible? What techniques should be used to achieve this resolution?
- **Driving**. What is the minimum distance to stop a car speeding with 36km/h? How much is this distance increasing if driver's response is late, for example due to drinking or to absent mind, by 0.2s? The default speed limit in urban areas is 50 km/h. However in most villages this limit is less 40, 30 or even 20 km/h. Any justification? To how many glasses of wine the alcohol driving limit of 0.5% corresponds?
- **Circulatory System**. Why is it lethal to inject air bubbles in an artery or a vein? How food eating and air inhale may affect arteries and veins?
- **Kinetic Theory**. How the 'sweating pottery' (they are porous pots used to have cool water during the hot summer days) from Aegina works? Is there any connection with the chilling after a warm bath or the mild skin anesthesia with a volatile substance? How, in the sunny very hot summer Mediterranean days, a warm to hot water melon may be transformed into a refreshing (and hopefully delicious) meal? Why mouth air blowing may blank out a candle but explode a fire, or may warm our hands but cool down our hot soup? Why our tea cools down sooner when we stir it with our spoon? Why adding salt in iced roads produce melting of the ice? Why adding

© 2012 HSci. ISBN 978-989-98032-0-6

sugar to tea brings down the tea's temperature even if sugar and tea have the same temperature? Why frost (hoarfrost) is mostly observed during clear sky winter to spring nights?

- **Various subjects**. Where do you expect the Earth's crust to be thicker, in mountainous areas or in low altitude plains – why? Can you estimate the endurance of the tendons in the legs or in the arms? Why are there usually rivers in the gorges? Why the string for drying the laundry has to be loose? How fuel consumption may relate to the fact that commercial ships do not usually sail on their full speed? Why long car queues are formed even in slight road narrowing, for example in double lane car parking?
- etc.

2.2. Laboratory of Educational Robotics

The content of this course has been described elsewhere [15], [16], [17], [18], [19]. Its main objectives include: a/understanding the basic concepts of robots, b/familiarization with robot programming, c/apprehension of the possibilities and limitations of robots, d/development of problem solving skills.
As developments in this area are very rapid, aspects of project based learning are used throughout the course with the aim to develop self-learning skills in order for the teachers (in- and pre- service) to be able to retain any relevant competence they have acquired. Into the syllabus the following are included:

- familiarization with the material used (Lego© Mindstorms©). After presenting the basics of the construction and of the robot programming, students are encouraged to experiment making simple constructions and programs. They are asked to foresee the effect of their programming, test its correctness and try to plan an error correction strategy.
- construction of simple robots under guidance. Students are asked to construct simple robot artifacts, program them to perform tasks with increasing complexity. In every step they are asked to rethink shortcuts in their programming with advances to more complex programming tools.
- either design and construct a robot on their own to participate in a robot contest or design and realize a teaching in schools. In this step project based learning is fully implemented.
- design and, if feasible, implement, part of a)smart house. This is given as a drill of self-learning activities.

In all steps, students are encouraged to seek and use knowledge relevant to the task from other subjects, especially Science and Mathematics. Students at all levels seem to respond successfully, although no previous technical or programming skills were required from them.

2.3. Science experiments with self made equipment

The syllabus and other details of this course are described in [20]. The course originated from the quest:

a. to offer a higher level education,
b. to provide higher education knowledge and skills which may be applied as directly as possible to school bypassing the, sometimes significant, effort required to transform scientific knowledge to school practice.
c. to overpass the fact that most of the students have very limited or inadequate background in Science
d. to change the negative attitude towards Science and Mathematics that the majority of them dispose.
e. To provide long lasting knowledge, skills and dexterities.

Point **a.** means that teaching should include scientific valid constituents even if, due to **c.** simplifications (e.g. metaphors, approximate or simplified models,) are necessary. Point **b.** means that the syllabus must include *Polymorphic practice* [21], [22]. Point **d.** makes necessary the active participation of the students with mentor type guidance and counseling rather than classical tutoring [23], i.e. using problem – inquiry – project based learning.
The objectives of the course include developing the following skills and dexterities:

- selection or construction of appropriate Science models,
- Science observations including measurements and their treatment,
- using simple materials construction of mechanisms to measure a quantity or to demonstrate a phenomenon from the school Science program,
- self-learning and self-esteem development.

The syllabus includes two parts. In the first part the concept of measurements and their parameters (accuracy and sensitivity, systematic

© 2012 HSci. ISBN 978-989-98032-0-6

and random errors, calibration, …) in Science and their treatment is introduced and students are guided to construct their own equipment and measure some physical quantities, for example the geographical coordinates (see **Fig.2**) or the acceleration of gravity, **g**, temperature using their own gas thermometer, measure the distance to a distant object using triangulation, measure the weight of an object using their own weight or spring balance, etc (see more in [20]). In the second part students choose a project to construct a device and measure or demonstrate, at least in principle, a phenomenon from the school Science curriculum. Such projects include [24]:

- types and construction of thermometers,
- types and construction of weight balances,
- visualization – measurement of electromagnetic force,
- construction and calibration of a hydrometer,
- types and construction of electric motors,
- wind power generator,
- mechanical resonance,
- types and construction of a battery cell,
- construction of a variable focus lens,
- etc.

3. Commentary

With some obvious exceptions in courses 'Everyday observations in Science Teaching' and 'Science experiments with self made equipment' students were working in groups of two, three and, exceptionally in cases of many enrolments, of four. At the end of teaching of every course an assessment was made based on teachers' observations during the course, on discussions between teachers and students and on students' anonymous questionnaires. The questionnaires contained mostly open type questions related to the contents of the course (for example, 'state up to two of the best characteristic of the course', 'state whatever you think was negative to the course' …) or more general (for example, 'how were you feeling towards the course', 'what do you think you have learned from the course', 'what do you think you will remember after 5 or more years from this course', ...). Based on these assessments, some comments related to the adopted forms of teaching and the students' responses are presented (see other details of the assessments in the detailed descriptions of the courses at [9], [15], [16], [17], [18], [19], [20], and [22]). Students responded in a very similar mode to all three courses.

With one or two, if any, exceptions, all students report a very positive opinion on the courses although they also think it as a 'difficult' course. In the discussions they explained 'difficult' as 'requiring effort' on their part more than in other courses they had attended (a characteristic response: 'with the effort required I should have passed two or three other courses'). However, all of them said that they would enroll to a similar course and that they will recommend this course to other students.

When asked how they were feeling during the course, students used the expressions 'perplexed', 'surprised (with their outcomes)', 'delighted', 'creative', 'enthusiastic'.

Students were actually involved in the learning process showing a continuous interest. It is remarkable that the drop-out percentage is almost zero [25] although the courses are optional.

The previous responses may indicate a change to a positive attitude towards Science. It also seems that their self esteem and confidence has increased as the following responses indicate (note also the previous comment on students' feelings during the course):

Students finishing the course achieved, in general, high marks, an indication that the objectives related to cognition were achieved. This is supported also by students responses, for example, 'doing Science experiments is not so difficult as it seems (from students with little or no Science background from school), 'I was thinking that Science requires special laboratories and equipment but you can do a lot with simple materials and observations', 'I realized that there is a difference between what we see and what we conclude', 'in books all measurements fall in smooth lines while actually they are scattered', 'I realized that what we learned in school Science have practical applications', 'it required a lot of effort but it was useful to life and to school', … .

It seems that students developed positive attitudes towards problem, inquiry, project based learning as may be inferred from responses such as 'I started boring as with all courses but then I became lovesick with it', 'I would always remember the quests to solve the problems', 'I liked the teamwork', 'I liked teaching this way to school children – they were continuously interested', ….

The previous two remarks indicate also that, when implemented correctly, problem based learning, inquiry based learning and project based learning are also as effective (or more effective) alternatives to knowledge and other cognition related learning in all levels of education. This is supported by the following remarks: 'I liked playing detectives' (from a school child), 'do not exactly remember what I learned but I remember and use in my teaching the way you used (from an in-service teacher - former student to the courses).

Although the comments above are non-systematic they indicate clearly a positive trend towards the use of problem based, of inquiry based and of project based learning as effective teaching approaches. As a possible drawback we note the increased effort required from the teachers and from the students but as ancient Greeks were saying 'τα καλά κόποις κτώνται – no pain, no gain' (attributed to Aristotle, 384-322 BC but also to others).

4. Acknowledgements

This work in its current form has been partially financed by the European Commission (project "Pri-Sci-Net" Grant agreement no. 266647). The views expressed represent the author. Neither the European Commission nor the authors may be held responsible for any use of the information provided here.

Informal discussions during teaching in The University of Crete with other fellow teachers, especially S. Anagnostakis for his help on the course 'Laboratory of Educational Robotics', M. Tsigris for his ingenuity in the projects of the course 'Science experiments with self made equipment and A. Margetousaki for her overall help and observations are acknowledged.

5. References and Notes

[1] Problem based learning, Inquiry based learning and project based learning are teaching approaches within the broader scope of constructivism. For the purposes of this paper, we use the following simplified working definitions: In problem based learning students are guided to obtain knowledge through their attempts to solve the problems or answer the (open type) questions posed by the instructor. In inquiry type learning students face also the requirement to think up and apply appropriate techniques to discriminate between different possible alternatives to their solutions or answers. In project based learning, the problems and the questions students are faced are connected towards the making of a project (a construction, an essay, a study …). See more in [2], [3], [4] and [5].

[2] David Boud and Grahame Felleti editors, The challenge of Problem Based Learning, Kogan Page Limited, London 1998.

[3] Lillian C McDermott, Peter S Shaffer and C P Constantinou, "Preparing teachers to teach physics and physical science by inquiry", Phys. Educ. 35(6) November 2000, pp. 411-420

[4] Buck Institute for Education (2003). Project Based Learning Handbook: A Guide to Standards-Focused Project Based Learning for Middle and High School Teachers.

[5] John W. Thomas, Ph. D 'A Review of Research on Project-Based Learning', March, 2000, visited 20-8-2012 at http://173.226.50.98/sites/default/files/news/pbl_research2.pdf.

[6] Problem-based learning: A review of literature on its outcomes and implementation issues. Albanese, Mark A.; Mitchell, Susan, Academic Medicine, Vol 68(1), Jan 1993, 52-81

[7] Teaching future school teachers within the framework of Problem based, Inquiry based or project based learning is essential because, a/the relevant skills and dexterities, in order to be effectively applied have to be an inclination rather and not a simple knowledge – consequently they have to be taught at early ages, b/school teachers are confronted with continuous changes of the syllabus and reforms of the curricula and should be adaptive to these changes, c/in a humanistic education, critical and creative thinking is considered as an objective and the previous forms of teaching are most appropriate towards this goal, d/despite what knowledge teachers have acquired, the majority are inclined to teach the way they themselves have been taught.

[8] According to the Concise Oxford Dictionary, within the framework of a scientific investigation, 'observation' means the accurate watching and noting of a phenomenon etc. or a measurement or other result so obtained' and, more generally, it means 'perception; the faculty of taking

© 2012 HSci. ISBN 978-989-98032-0-6

notice' (see also the ancient Greek 'νους ορά και νους ακούει', i.e. we see and hear with our minds). Effective Science observations require special cognitive skills, for example within the Bloom's taxonomy of Learning, the skills of analysis, of synthesis and of evaluation.

[9] P. G. Michaelides, "Everyday observations in relation to Natural Sciences" in Learning in Mathematics and Science and Educational Technology, University of Cyprus July 2001, Volume II pp. 281- 300. See a copy in http://www.clab.edc.uoc.gr/pgm/71.pdf.

[10] It is characteristic that when a group of primary school students (ages 11-12) were asked to check their results by looking at a World Atlas book their comment was 'they have found the same with us'

[11] The notion of Hands-on Science may be attributed to Johann Heinrich Pestalozzi (1746-1827) a Swiss educator who as a follower of J. J. Rousseau was against the then authoritarian type of education and advocated, especially in small ages that natural phenomena are better understandable through actual involvement in observation and experimentation of the learner.

[12] But it was a nice pictorial movie (although not a realistic one)' was the grim comment of little Maria with whom we were watching this TV commercial → do not let your pragmatist self to spoil the magic.

[13] The alternatives suggested by the school children were: a/turn on the headlamps and walk away until you confuse the two headlamps as one and measure the distance. On my comment that this require a very flat surface of more than 7 km a very unusual situation they came with the next alternative, b/put two small lamps on a cardboard separated by a small distance and a battery start walking away measure the distance and make a proportional extrapolation - a very good approximation (the real situation is not exactly proportional). Alternatively in the context of a/ previously, the situation could be realized if sea comes between the observer and the car, for example, in sea gulfs with seaside roads, so often found in the Greek islands.

[14] Satellite surveillance is useful for weather broadcasting communications, etc. An increasing number is also used for security and antiterrorist purposes.

[15] Simos Anagnostakis, P. G. Michaelides, 'Laboratory of Educational Robotics' - An undergraduate course for Primary Education Teacher - Students, proceedings pp. 329-335, HSci 2006 - 3rd International Conference on Hands-on Science, 4th - 9th September, 2006, Braga, Portugal, proceedings published by University of Minho. (http://www.hsci.info/hsci2006/index.html).

[16] Simos Anagnostakis, P. G. Michaelides, 'Results from an undergraduate test teaching course on Robotics to Primary Education Teacher – Students' 4th International Conference on Hands-on Science, 23 – 27 July 2007, Universidade dos Açores, Ponta Delgada, Portugal, Proceedings pp. 3-9 http://www.hsci.info/hsci2007.html,.

[17] Anagnostakis S., Margetousaki A., Michaelides P. G., 'The Feasibility of a Laboratory of Educational Robotics in Schools (in Greek)', 4th PanHellenic Conference on the Didactics of Informatics, University of Patras, Patra, 28 – 30 March 2008 (http://www.ecedu.upatras.gr/didinfo/).

[18] Margetousaki A., Anagnostakis S., Michaelides P. G., 'Informal Learning in the context of Educational Robotics (in Greek)', 4th PanHellenic Conference on the Didactics of Informatics, University of Patras, (http://www.ecedu.upatras.gr/didinfo/) Patra, 28 – 30 March 2008.

[19] Simos Anagnostakis and P. G. Michaelides, Teaching Educational Robotics for Schools: some retrospective comments, presented at the 9th International Conference on Hands on Science – Hsci2012, 17-21 October 2012, Antalya, Turkey

[20] P. G. Michaelides and Miltiadis Tsigris, Science Teaching with self-made apparatus, 1st International Conference on Hands-on Science: Teaching and Learning Science in XXI century", Ljubljana 5-8 July 2004, proceedings pp.47-52.

[21] Polymorphic practice (measurements, experiments...) in Science includes a common psycho motive activity (doing measurements, experimentation...) which consequently is morphed into different levels depending on the (previous) cognitive attainment and/or the mentality of the students. They resemble multilevel teaching i.e. teaching pursuing more than one sector but extend also to different levels of

learning. The difference in the teaching levels is not only on the didactics but also on the subject matter, the attainment levels and the tools (cognitive, mathematical...) used. The need for polymorphic practice teaching arises usually in the training of Science Teachers where there is a requirement of teaching in an advanced level for the teachers themselves, and the requirement of teaching in a level more accessible for the pupils. See more in [22].

[22] P. G. Michaelides, "Polymorphic Practice in Science", pp 399-405 of the proceedings of the 1st Pan-Hellenic Conference on the Didactics of Science and the introduction of New Technologies in Education, University of Thessaloniki, Thessaloniki May 29-31, 1998 (in Greek).

[23] Traditional tutoring aims to the objectives of the teaching referring to cognition while mentor type teaching, without neglecting these objectives, puts priority on guiding the student to feel confident and become able to solve his/her problems in general – see more in M. Anne Powell, M.S.W., Academic Tutoring and Mentoring: A Literature Review, California Research Bureau, California State Library, 1997 available at http://www.library.ca.gov/crb/97/11/97011.pdf (visited Aug. 22, 2012).

[24] Miltiadis Tsigris, Self-made experimental apparatus in Science Teaching, Post-graduate degree dissertation, The University of Crete, Department for Primary teachers' Education, 2011.

[25] In the initial stages there was a drop out percentage of the order of 20% (compared to about 50% or even more in other non-compulsory courses) that was appearing when students had actually to act e.g. prepare a report, provide an answer, make a construction, take a measurement, actions for which they had no previous experience or they were despising (a characteristic early time response: be serious, we cannot go out and try to measure the shadow of a rod. The remedy came by changing from tutor type to mentor type teaching, see [23].

SCIENCE LITERACY IN PALESTINE: TRANSIT OF VENUS AS AN INFORMAL CONTEXT FOR YOUTH PEER TEACHING

S. Darwish Kirresh
Walid & Helen Kattan Science Educ. Project
Qattan Center for Educational Research and Development
A.M. Qattan Foundation
Ramallah- Palestine
samardk@science.qattanfoundation.org

Abstract. *Researchers at Walid &Helen Kattan Science Education Project (WHKSEP) found the transit of Venus, June 2012, an opportunity to raise children's literacy in astronomy. A team of 8 mail Children from East Jerusalem- Palestine, expressed interest in the event and in engaging in a peer teaching experience with patients in the Children ward at a hospital were the observation took place.*
The Children were followed up, observed, videotaped and interviewed. The social worker at the hospital was also interviewed. Children conducted two-phase contacts with the patients; a preparatory meeting and the event day. Patients, hospital administration and the Children themselves requested similar future activities.

Keywords: Informal learning, peer learning and teaching, peer recruitment, science literacy.

1. Introduction

1.1. Astronomy and science education

Astronomy is an ancient science. It contributes to society in the area of science education as it can raise the public awareness of science and convey scientific concepts to public, students and teachers. Its contributions rise from the fact that it is all around us and part of our daily life. Astronomy excites imagination and at the same time it illustrates the aesthetic value of the universe. Astronomy has long been inspiring work in arts (poetry, music, science fiction stories and movies, cartoons ….etc). It is a participatory science with scientists and nonscientists having astronomy as a long life avocation. Astronomy as such, offers open endless opportunities for discovery [10].It is not only important in education but also is deeply rooted in the practical and philosophical aspects of culture [13].

Astronomy as an exciting modern science attracts children. However its physics, geometry, abstract concepts, and demand of high cognitive skills might make it highly challenging for students to understand and teachers to teach [17]. The current Palestinian curriculum does not excite or inspire generations of students into careers related to Astronomy as a science. It's only till the third grade that Earth is introduced as a planet. And the last encounter with astronomy would be in the 9th grade. In between stages offer limited general information mainly naming and describing planets, stars and galaxies and Earth's movements and what results of it. However the more alarming issue is the absence of a relation between astronomy and students knowledge in the fields of science or mathematics. Though knowledge of astronomy lead to understanding important scientific concepts like gravity.

1.2. Role of informal learning

The researched activity is informal in nature. Informal education can be important in improving the interest of learning in areas of science. Informal practices can be conducive to learning systematic and reliable knowledge about the natural world. It is the first form of learning a person experiences and it offers real learner centered education in a learning world that is borderless and limitless.

Ainswort & Eaton [1] suggest that informal learning does not take place in a formal setting, rather offers chances of field practical opportunities with hands on experiences. The researchers emphasized the role of informal learning together with other forms of learning(formal and non-formal) as a standard structure for membership in scientific professional organizations. They quoted the Director of Education and Professional Development for the American Association of Petroleum Geologists stating that the inclusion of non-formal and informal learning: "*helps graduates (whether recent or in the past) to keep up-to-date in the science and the newest technologies. It removes the pressure from traditional programs which can provide a foundation, but which do not have the capacity of providing the latest(and very expensive) highly specialized technical/ scientific education*" p. 34.

Such is our case with astronomy as a field of study in Palestine. And through the WHKSEP we aim at providing such supporting opportunities. The project aims at improving the quality of science education in Palestinian schools. It seeks to equip teacher with modern teaching tools and methods that recognize students as interactive producers of knowledge. Scientific literacy in diverse up to date topics, including astronomy, is going to be well addressed. Collaboration between formal and informal learning will allow students and teachers to explore, understand and care about a wide range of natural settings, phenomena and cultural and historical objectives [3] that curricula miss to integrate with enough depth.

Research shows that learners' prior knowledge, interest and identity, are important in informal environments [11]. Noam [12] listed a number of building elements that guide the work in informal learning. The list included first; voluntary engagement of young in science related subjects as critical for future involvement in science careers in general to which Tai *et tal* [14] also agrees. Second; that science learning is a relationship matter was kids need to interact with each other, they need adult scaffolding and support.

Fenichel and Schweingruber [7] gave a set of reasons to look at collaborative learning and teaching as a foundational part of the process of science learning. First, individual learning is supported through interaction with more knowledgeable others and through a dynamic exchange of ideas and reflection. Second, science itself involves specialized norms for interacting and specialized forms of language. Learning science therefore involves learning those norms and language. Third, people very often participate in informal science learning experiences with other people. Therefore, the experiences should be designed with groups in mind and in a way that capitalizes on opportunities to engage with other people.

1.3. Peer learning and informal learning environments

This activity basely depends on peer learning. Roles that support learning can range from simple, discrete acts of assistance to long-term, sustained relationships, collaborations, and apprenticeships [7]. Research indicates [5] that peer learning activities typically result in team-building spirit and more supportive relationships, greater psychological well-being, social competence, communication skills and self-esteem; higher achievement and greater productivity in terms of enhanced learning outcomes.

© 2012 HSci. ISBN 978-989-98032-0-6

Peer learning is expected to transfer information or model a behavior. Peer educators (helpers) are expected to closely match their target group (helped) by age, gender or other common characters [4].

In such a form of learning a group build their knowledge in the subject they are to transfer, in aspects including science, history (UNODC, 2006) and even related myths and misconceptions. They also demonstrate excellent peer educators' characteristics of sensitivity, open mindedness and good listening and communication. Peer group education in informal education settings aims at giving the young people the responsibility for the education of other young people [4] which was the case in current research.

2. Research methodology

An activity related to a phenomenon that was to take place in 2012 and would only be repeated in 2117 was sure to raise interest of young students having a passion for science. The transit of Venus was seized as an opportunity to engage such students, and public in general, with the informal learning programme of the WHKSEP and offered an opportunity for research in peer education in informal learning contexts.

2.1. Research questions and data collection

The research aimed at studying how effective could peer grouping and learning is in an informal context and whether the school formal instruction of the children affects their roles as peer learners and tutors in an informal context. The study utilized a solely qualitative approach based on analysis of excerpts selected from transcribed audio-video recording.

The team met several times. They were observed. They were left to "grow" on their own. Data collected included videotaped recordings of the children at work during their meetings to develop either their knowledge or the teaching tools they used with the patients. The two interventions at the hospital were also recorded. The children were interviewed and so was the social worker who was responsible for following up the general social and academic wellbeing of the patients at the hospital. Later the children were asked to write their reflections on their experience. They used a white board during their meetings to note their plans and ideas that was continuously photographed.

There were different process generated products including; a written proposal for WHKSEP to sponsor their activities at the hospital, a power point presentation as a means of delivering knowledge, three games and a coloring activity for the patients in the first hospital intervention, 2 developed instruments to watch the transit and a set up of a computer, infrared adjusted web camera (using filters) and a recording program for videotaping the event.

2.2. Engagement and recruitment

The WHKSEP team developed a power point presentation to introduce the Transit of Venus Event (TVE) to an audience of students to raise their interest in astronomy in general and the TVE as a scientific current event. Hamzeh a 14 year old boy, living in Jerusalem had already followed the news and was highly interested and motivated to share in a relevant activity. He called his friends from the neighbor hood and classmates (10; 7 boys and 3 girls) and explained the opportunity of interacting with and watching the event. 5 boys were equally exited and one of them brought in his 2 brothers, while the others declined for different reasons including travel and disinterest. Two of them followed through the internet as they were staying away from home. One of them later attended the event day. They were all boys; 3aged 15, 3 aged 14, one aged 12 and the youngest was 10. They were students in three different private sector schools in Jerusalem. All group members happened to be students at the higher end of the scale of academic achievement. They knew each other through school, family and play. There was no intervention in there grouping. The group kept in contact with WHKSEP through e-mail. The author, who was a researcher at WHKSEP, decided to follow up with the students and be a participant observer.

The group met for the first time and watched the power point prepared at WHKSEP. They named themselves "Venus12". They were totally excited and began planning. They discussed possible sites for watching the transit. They settled on using the Augusta Victoria Hospital. The hospital stands on the Mount of Olives, the highest mountain area in Jerusalem those overviews the horizon. They then had the idea of having a joined experience with the patients in the children ward of the hospital. The residents there are Renal failure and Cancer patients from the Palestinian Authority area. It turned out,

through contact with the hospital, that patients lose contact with their schools and formal educational contexts due to restrains forced by the Separation Wall set by the Israeli Occupation, which prevents Palestinians from entering East Jerusalem unless with permission. Therefore the Patients have repeated lose of pedagogical time. Parents fail to follow up and avoid causing further pressure on their suffering children. Many become low achievers at school as they become disengaged and de-motivated with low self esteem. School dropout becomes an option in perspective. They were in need of such an opportunity to reengage with their learning.
There were two interventions with the patients. The patients capable of interacting were more than 20. However only 9 (7 boys and 2 girls) could leave their beds and actually interact with the group. One of the girls was interested but was suddenly in pain and had to leave. Another had to have his medication and had to leave at an early stage. Both interventions were attended by interested parents staying in with their children. Hospital staff members including nurses and social workers attended the first intervention. Doctors, nurses, social worker and other administrative members attended the TVE.

3. Results

3.1. The life cycle of the experience: an ongoing procedure

Tracking the history of the project was important in recording procedures, collecting data and narrating the team's progress. The flow of the "Venus12" group experience reflects the process of peer learning turning into peer tutoring and back into learning. It is a tracking of the cognitive build up of the group through the three stages. Each stage contributing differently to the learning of the group as a group and as individuals.
There are two concepts for the utilization of the Vygotskian perspective to explain the learning that went on among the team [16]; the inter-subjectivity; whereby the process begins with participants in a task beginning with different understanding of the task and arriving at a shared understanding during the course of communication. This was obvious in the preparation of the working plans, tutoring activities, the proposal, the tutoring tools and the power point presentation. Each child in the group had his ideas and experiences communicated to the others. They defended them as representative of their knowledge and skills. Communicating through discussions, argumentation and negotiation lead them into common understandings that were satisfactory to all. Each child had his own point of view and contributed in the final product. Tamer, a 14 year old ninth grader wrote" *we were very cooperative and each person had a role and each of us did something*". This reflects a feeling of satisfaction not only for the boy himself as a contributor, but also a satisfaction in the distribution of tasks and the contribution of
other members.
The plan for example developed from a simple plan of acquiring knowledge, into a plan that covered learning, tutoring and experimenting. It included a name for the project and the team, a starting date, a location and a job distribution with members responsible for research, power point presentation and preparation of observation tools. Two of them, Tamer and Saif, assigned tasks for the rest of the group based on their "*knowledge of the capabilities of each of them*" as they both said in one of the video records. The tasks were revised by the team, judged and read aloud for all as a form of informing agreement. They followed this procedure when they wrote their plans on paper or on the white board, and when Amer and Hamzeh wrote the proposal.
Monitoring their general planning and sub-planning in different sessions using the white board was indicative of the development of a clear vision for their tasks, the organizational level they were gaining the progression of learning associated with that vision and organization.
The children looked for observing tools from the net, experimented with web cameras and web searched for software that might help in photographing and videotaping the transit. This embodies the other Vygotskian concept [16]; the zone of proximal development as an area of development. The children went through an interrelated experience of peer scaffolding at the cognitive and skill levels. Each of them excelled in a different field of his interest, was able to build on it on his own and delivered his knowledge or skill to the rest of the group. They developed knowledge and skills in using technology, experimenting, proposal writing and game design. They continuously shared their new learning through e-mails and face book. They exchanged material and discussed their

© 2012 HSci. ISBN 978-989-98032-0-6

new learning each time they met. They chose to observe the transit from a building in the neighbor hood and decided to check the possibility. Two of them went to the roof at the same expected time for watching the transit across the sun and found that it was not possible due to existence of other higher buildings. They reported to the group. Accordingly they chose to go where observation was guaranteed at the Augusta Victoria hospital. It was actually their first experimental evidence and argument based decision.

The children went into discussions about their school learning and wanted to overcome learning problems they faced at school when tutoring others. At this point they moved from being peer learners into peer tutors. Tutoring skills gained through the group's preparation for the hospital activities was a scaffolding experience for the team, they learned a lot in different fields. At the same time the skills they gained were the scaffolding tools they used to tutor the patients.

At the first hospital session the children were full of energy and anticipation. They cleared the play room and set the chairs and tables for the activity. They were very attentive to the environment they were in. They graciously received the patients and their parents. They used simple language and short sentences interchanging Official and slang Arabic where ever they felt they would be better understood. They discussed the pictures with the patients in the coloring activities.

On the event day, the children played alternating roles of tutors and learners. They joined in before dawn and were very excited. They took position and set up there experimental tools all mechanical and technology devices. They experimented with the tools and kept on trying new additions. They restructured a totally new and very simple devise and were able to observe the transit safely and take pictures of the reflected images. As they were learning and experimenting, they were able to explain to attendants about the event and the equipment they are using and why they chose to use them. They worked as a group complementing each other without interference or dominance. They did not fear transferring their knowledge in astronomy to an adult audience. Their use of the more familiar eclipse concept to approach the transit of Venus to the audience was a good choice based on good tutoring intuition. The social worker used her newly acquired knowledge from the first intervention to relate to people present. This was in itself a proof of the group's success in transferring knowledge.

3.2. Verbal Analysis: did learning take Place?

Peer talk was of importance in evaluating learning [6]. Finding qualitative evidence and monitoring the social learning process was also important. Therefore analyzing the verbal interactions within their context was a necessity.

Though there are multiple analytical frame works that could have contributed to understanding and interpreting peer talk [9] still the context seemed to force itself on how such analysis would establish meaning for the social and cognitive development of the group. Therefore a descriptive system of analysis for investigating the situated dynamics of peer group interaction as described in Wray & Kumpulainen in [9] was considered. The method depends on an analysis of peer interactions by focusing on three analytic dimensions; First the functions of verbal interaction which focuses on the purposes for which verbal language is used in a given context. It includes language functions identified in peer group interaction across learning situations like argumentational, compositional, informative affectional just to count a few. Second; Cognitive processes which examines the ways in which students approach and process learning tasks in their social activity. It includes procedural processing, interpretative or exploratory processing and off task activities. Third; Social processing which aims at characterizing the social relationships and types of participation in peer groups. The different modes in which social processing is often constructed in peer group interaction are collaborative, tutoring, argumentative, individualistic, dominative, conflict, and confusion modes. Important to note is that each function in the framework is regarded as reflecting the social-cognitive-discursive actions of the participants as they verbally interact in their social activity.

All recordings were accordingly transcribed and analyzed collaboratively with the research team at the WHKSEP. Several verbal functions appeared that revealed the exploratory and interpretative cognitive processing. They included organization, revision, experiential, evaluative, interrogative, responsive and most importantly the composition verbal function of the team during all stages of work, where they were repeatedly able to create contextual and coherent verbal texts among them as a team (during learning) and in presence of others (during tutoring). The procedural processing *appeared during the preparation of the proposal* were the verbal functions of organization judgmental, revision, dictation and reading aloud appeared. They were learning collaboratively.

The value of their knowledge appeared through their discussion, preparation, slide content selection and presentation of the power point. It also appeared in their choice of representations in the games they prepared for the patients and the discussions they engaged in during the games. The children's simple intention of trying to make others understand concepts easily by creating a fun game, was a flow of actually a very complex collaborative work of determining design elements and the relation between them and the possible discussions that will lead into learning [8] that adult educators might find very challenging.

Different verbal functions were repeatedly used at specific junctions during the project. The children for example used argumentation to reach decisions. An example was choosing the name of the group to sign the proposal with. Amer :"*we need to have a name related to astronomy*". Saif suggested:" *Angry something*", "*yeh angry Venus watchers*" but they did not agree. Hamzeh suggested;" *the transit watching community* "and they all cried out "*no*". Hani commented "*it's not a name for anything*". Saif again suggested" *angry birds something*" and Issam responded with ridicule: "*because angry birds is all what Saif is thinking about*". They continued. Amer: " *the name should show that we are passionate about the subject*". They so continued with remarks and suggestions until they chose the name; Venus12.

The children set hypothesis when venturing into something new like planning peer tutoring They posed a hypothesis of possible low academic interaction with different levels of knowledge and interactions at the side of the patients. It was not a scientific experimental hypothesis but rather an application of scientific reasoning in a non scientific context.

Posing questions and facing their lack of knowledge or skills were noted at points of new steps, as when they prepared the proposal. They asked several questions on how to write a proposal, to whom should they address it and who should sign it.

They were informative each in his own field of interest. The group relied on Hamzeh and Issam for issues in technology as "*they are the expert*" quoted by Tamer at several occasions when technology was discussed. They negotiated the organization of each activity they did using the white board. In their reflections, they were clear in expressing their positive feelings towards the activity and the interaction with the patients and most important to the new cognitive level they believe they have reached. Amer felt that " *he did something useful*" and Hani liked the experience because " *we benefited and other young people benefited too*". The fact that they were children at the higher achievement scale might have contributed to this level of reasoning. However the interaction of the members of the group as contributed by its recruitment also played a role.

3.3. Peer grouping and learning in an informal context

The Venus12 team was a successful group in terms of group work and outcomes. Tamer wrote in his reflections that *" it was the first time that I work in such a team, and I benefited a lot*" The recruitment of this team was a contributory factor to its stability and success, based on the children's own desire rather than the use of extrinsic material, teacher or parent motivation which proved its inefficiency [2].They could be described as Brander [4] refers to it a "pure" group were interest and motivation are authentic and intrinsic as they had ventured into a learning tutoring experience believing in its importance. The relationships upon which the group was built were those of friendship, understanding and respect which had their impact on the organization of the work within the team as part of the Cognitive and Social Processing.

As the youngest of the team, a 10 year old fourth grader said:" *I also enjoyed collaborative work in our team and would like to mention what made our team special and different from other teams, was the age diversity and the inclusion of young members*". The boy's quotation implies that he felt accepted and of value in his team which made him enjoy the work.

They knew each others' points of strength and weakness, and their skills and character which helped them in distributing tasks among them. [15] believed that such peer relationship can be a motivating context for learners. They will undertake joint investigations, be cooperative,

© 2012 HSci. ISBN 978-989-98032-0-6

share questioning and generate joint understanding. It will also allow building on the knowledge, creativity and energy of the peers as educators (UNDODC, 2006). Edwards [6] took pride in her research of a small group as a self – selecting group and explained how this factor impinges on other factors including time engagement with learning and time on task. She referred to research supporting friends being better co-learners than non-friends, where explanations, suggestions and criticism are more likely to be properly directed and friends feeling more secure and more active.

All aforementioned expected interactions were noticed in the group during the different activities of the TVE. As the children implemented their plan, they were able to build up a knowledge about the history of astronomy as a science, the tools developed to better understand the astronomical world, the invention of lenses and telescopes, Galileo and his revolutionary understanding of the concept of the universe, and a general knowledge of the transit of Venus together with a relatively deeper knowledge in the physics and mathematics related to calculating the distance of earth from the sun. They also went into Greek and Indian related mythology. This was the children's knowledge flow through the power point presentation which reflected the flow of learning that took place. They revised the presentation several times before they agreed to its content and organization.

It actually was the grouping method in an informal context based on self interest, intrinsic motivation and friendship, that facilitated peer learning. In their reflections, all the children wrote that they*" learned in collaboration with their friends*". The youngest pointed out that he particularly "*enjoyed transferring the idea of watching Venus to the children and play with them*". And Hani also wrote" *we ate with the children and worked with them on the games. We had fun together and we wish them good health*". They enjoyed working at the hospital with the patients.

The interaction of the patients with the children and the games was highly satisfactory with the patients repeatedly asking for a new turn and the children emphasizing the stations as names of planets, their arrangement in the solar system, the concepts of comets, stars, planets, rocket, and even the black hole.

In her interview, the social worker mentioned the relative ease by which the patients learned new things, from peers of their age, through fun games and less lecturing in "*an informal context that relieved patients from the pressure they face in more formal tense conditions*" she said. It was learning out of school.

The experimental part was interesting. Hani said " *practical work is much more fun than theoretical work were we only watch*".

All of them expressed their willingness in sharing in future events. " *I am willing to repeat the experience*" wrote Hamzeh and "*we hope to continue doing such activities*" Amer said. Saif wrote that he was "*dazzled*" by the event and Hani asserted*" it was absolutely amazing*".

3.4. Effect of formal instruction

There was no point at which the Venus12 decided they would want to plan for tutoring the other group. Their discussion simply began to flow into the direction of "*how are we going to teach the patients*" as they kept asking each other, and "*what are we to do*". Answering those questions put them back into their formal learning contexts and each began contributing an idea based on either transferring a wish of a better form of teaching, or an advice of some form of teaching that needs to be avoided. Few were the ideas related to a positive learning experience.

They faced their fears of not being able to teach the children at the hospital not only in terms of content, but also strategies. When they revised their presentation, they agreed not to go deep into physics so as " *not to complicate things for the audience of whom they had no clear information*" as Issam pointed out. Accordingly they built their plan for tutoring the patients considering the information they want to pass, how they are going to pass it in an "attractive" way and the delicate health conditions of the patients.

Tamer suggested explaining things in steps with intervals to examine understanding. He suggested drawing" *to examine the children understanding*" as he said,. He added "*it will allow chances for all of them to express what they learned or felt*" and he explained how it would be difficult to ask each patient what he learned. Saif made it clear that they should not keep on giving a bulk of information with patients " *not being able to follow up*" and " *it should be kept simple*". Issam agreed and added"

 ISBN 978-989-98032-0-6

yes, each category of children has a different capacity of understanding" and they agreed not to go into details unless asked.

They chose games rather than any other strategy as it will be" *fun and informative. Children will not be bored*" as Saif explained and they all agreed. They felt as Tamer said in the interview after the first hospital intervention" *we did better when we explained through games than through explanation and presentation*". Amer answered to the question on whether their tutoring will have an impact on the future learning of the patients, that " *they [patients] will surely remember things because they had games and explanation*", he continued "*we must use more than one way to make sure that they learned*" and Issam added " *now they have a reference point of information*" The discussion was totally dependent on, and thus indicative of, what they face in their formal learning environment.

4. Conclusion

The TVE posed an opportunity for exploring peer learning in an informal context and whether formal learning had an effect on informal tutoring in a peer group. It appears that successful peer recruitment and grouping depends on the independent choice of the learners in joining the group at the level of both personal interactions of the members and interest in the aims of peer collaborative work. Peer groups built on friendship and common study, play and social interaction experiences proved to be highly successful. A common history of the group members fosters a future cooperation that contributes to successful collaborative learning.

Tutoring responsibilities of a pear group drove the children away from the formal teaching model they have at school. It put them into the mode of problem solving, were the problem was teaching that can result in learning and the solution was designing fun learning. Knowledge of the learner's context and his cognitive abilities are pedagogies to which the children expressed an understanding and used to develop into successful peer educators.

The informal context allowed time on task. The restrictions of formal learning environments did not exist. The children took responsibility for their learning and the learning of others. The informal context allowed a space for reviewing formal learning and the reflection of a requested image of teaching.

Hopes are that this paper we would be a starting point for reflecting on working with peer groups in informal contexts and understand how they can contribute in developing science literacy in Palestine. The success factors of the group should be leading in similar future peer learning and tutoring projects.

5. References

[1] Ainsworth H. & Eaton S. (2010). Formal, non-formal and informal learning in the sciences. Calgary, Canada: Onate Press

[2] Backett-Milburn K, Wilson S. Understanding peer education: insights from a process evaluation. Health education research, theory and practice.

[3] Bevan B, Dillon J, Hein G, Macdonald M, Michalchik V, Miller D, Root D, Rudder-Kikenny L, Xanthoudaki M, Yoon S. Making science matter: collaboration between informal science education organizations and schools. A Center for Advancement of informal Science Education(CAISE) Group Report; Washington D.C.:CAISE; 2010

[4] Brander P, Angst D, Gomes R, Taylor M. Domino: A manual to use peer group education as a means to fight racism, xenophobia, anti-Semitism and intolerance. Council of Europe Youth Campaign "All different-all equal". 2005

[5] Christudason A. Peer learning. Successful learning. 2003; 37.

[6] Edwards, J. Exploratory talk in peer groups: exploring the zone of proximal development. In, Fourth Congress of the European Society for Research in Mathematics Education (CERME 4), Sant Feliu de Guíxols, Spain, 17 - 21 Feb 2005. Spain, European Society for Research in Mathematics Education; 2005. P 831-840

[7] Fenichel M, Schweingruber H. A, National *Research Council.* Surrounded by Science: Learning Science in Informal Environments. Washington, DC: The National Academies Press, 2010.

[8] Hämäläinen R. Using a game environment to foster collaborative learning: a design-based study. Technology, Pedagogy and education 2011; 20(1): 71-78

[9] Hartas D, editor. Educational Research and inquiry : qualitative and quantitative approaches. London, England: Contnuum International Publishing Group; 2010
[10] National Research Council (2001). Astronomy and astrophysics in the new millennium. National Academic Press
[11] National Research Council. (2009). Learning Science in Informal environments: People, places and pursuits. Bell P., Lewenstein B., Shouse A. W. & Feder M. A. Editors. Committee on learning Science in Informal environments, Board on Science Education. Washington, D. C. : The National Academic Press.
[12] Noam G. (2010). Youth development, science learning and out of school time: the Triple Alliance. Project Exploration
[13] Percy J.R. (1998). Astronomy education: an international perspective. *Astrophysics and space science*, v258, p 347-355
[14] Tai, R., Lui C, Maltese A, Fan X (2006). Planning Early for Careers in science. Science 26: 1143- 1144
[15] Thurston A. et al. Peer learning in primary school science: Theoretical perspectives and implications for classroom practice. Electronic Journal of research in Educational Psychology 2007; n13, 5(3): 477-496
[16] Tudge J. Processes and consequences of peer collaboration: a Vygotskian Analysis. Society for Research in Child Development. 1992; 63: 1364-1379
[17] Yair Y., Schur Y. & Mintz (2003). A “Thinking Journey” to the planets using scientific visualization technology: Implications to astronomy education. *Journal of Science Education and Technology*. V 12, n 1, p 43-49.

EDUCATION SHOULD PLAY A CENTRAL ROLE BETWEEN YOUNG PEOPLE AND UNHEALTHY EATING HABITS

C. Zaragoza Domènech[1], J.M. Fernández Novell[2]
[1]*IOC. Dept. of Education, Government of Catalonia. Spain*
[2]*Department of Biochemistry and Molecular Biology, University of Barcelona. Spain*
czaragoz@ioc.cat, *jmfernandeznovell@ub.edu*

Abstract. *Nowadays, it has been exposed that obesity has become a big problem, simply in terms of quantity and particularly among young people. The objective of this work is to determine some parameters such as weight and height from secondary school students that are used to calculate the body mass index (BMI) a good indicator of total body fat. In addition, the dietary habits and changes in eating habits from secondary school students were studied from two surveys. Finally, an effort to educational authorities is solicited; they have to include the nutrition knowledge into primary and secondary schools curriculum.*

Keywords: Secondary school students, obesity, overweight, nutrition knowledge.

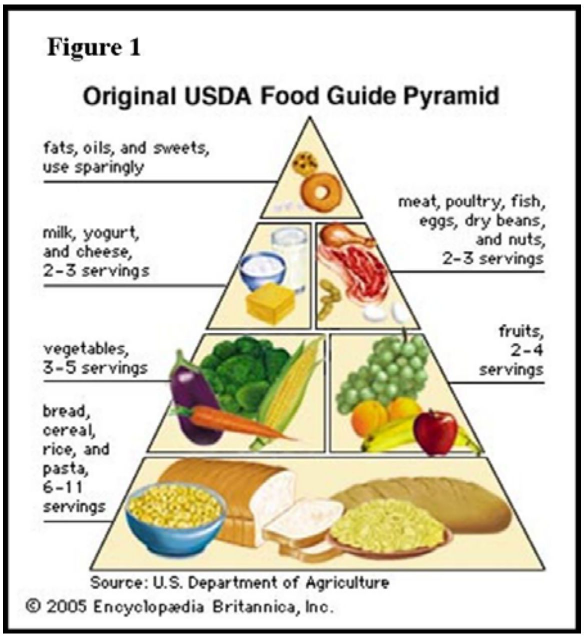
1. Introduction

In our time, it has been shown that obesity has become, socially and medically as “the” big problem for the XXI Century [1], simply in terms of quantity and especially among young people. Obesity appears when intake exceeds output and the excess energy is stored as fat; there is a delicate balance between the amount of energy intake and output.

Several studies performed in Catalonia [2], Spain [3] and Europe [4] have demonstrated that obesity is a problem present in all industrialized countries; in the last twenty years the number of obese people are increased more than three times. Despite its great relevance, there are not clear instructions against overweight and obesity available for kids, young students and teenagers (Are they the next "obese" generation?).

Obesity and overweight are key factors for development of many diseases, including Type 2 diabetes [5], coronary heart disease, hypertension and stroke [6, 7]. Previous work [8] provided a way to alert the young population to the risks of obesity and the consequent diseases.

What can we do to preventing overweight and obesity in our future adults? Giving nutrition knowledge to the society, we have to explain the concepts of nutrition in schools, to young students from primary and secondary schools. In Fig 1 you can see The Food Guide Pyramid [9], a good help in the prevention and fight against obesity. Teachers must to give this chart or “visual aid” to their students.



Is nutrition knowledge present in primary and secondary schools curriculum? Authors analyzed science curricula from Catalonia. Catalonia is one of the seventeenth Spanish Autonomous Communities with their own independent education system [10].
In Catalan primary schools [11], students aged 6 to 12 years old can only gain a few nutritional knowledge from personal and food hygiene. In addition, Catalan’s science curricula from secondary schools [12, 13] (students over 12 years old) presents few concepts in food sciences and nutrition such as calories (measure of amount of energy) and biological molecules (carbohydrates, proteins, lipids, vitamins, minerals and water).
Preliminary studies [14-15] performed in Catalan secondary school (more than 2500 students participated, aged 12 to 16 years old) from Badalona and L’Hospitalet del Llobregat (both cities near Barcelona city) showed 25% of overweight and obesity in young students. In addition, a clear difference on dietary habits between boys and girls was detected and more worried was that both sexes were far away to the healthy diet, the Mediterranean diet.

Our proposal was focused on Catalan secondary school students 15 and 16 years old because this group of teenagers has a degree of liberty in choosing their foods. The main objective is to present proposals for the future from the students' perception of obesity.
This work presents a study from:

- Measuring parameters such as weight and height from these students are used to calculate the body mass index (BMI) a good indicator of total body fat.
- Analyzing a survey on secondary school students’ dietary habits, their changes and the major causes of the unhealthy diets.
- Analyzing students’ perception on obesity and healthy lifestyle, it was studied from a different survey.

Working with teenagers and nutritional habits has revealed a reasonable need to explain the concepts of nutrition in schools, both primary and secondary schools.

2. Methodology

The methodology used in this proposal was based on:

- The measurement of some biometric parameters as weight and height
- The analysis of two surveys filled in by Secondary school students (15-16 years old).

2.1. Biometric parameters

Body Mass Index (BMI) was calculated in target students. Results were confronted against the patterns and overweight and obesity were detected.
For adults, The World Health Organization (WHO) define BMI = 25-29.9 as overweight and BMI ≥ 30 as obese. The authors used an internationally acceptable definition of child overweight and obesity [16]. Table 1 shows the BMI intervals for overweight and obesity applied to students (men and women) 15-16 years old.

Table 1.		
BMI values (students 15-16 years old)		
	Overweight	**Obesity**
Men	23.9 – 29.2	≥ 29.3
Women	24.4 – 29.6	≥ 29.7

© 2012 HSci. ISBN 978-989-98032-0-6

2.2. Survey 1: Changes in eating habits and diet

Table 2 shows the first questionnaire presented to secondary school students. In which it can observe several kind of questions:

- Personal information.
- Changes in eating habits.
- Changes on diet.
- Final questions.

<table>
<tr><th colspan="3">Table 2. Survey 1</th></tr>
<tr><td colspan="3">Personal information</td></tr>
<tr><td>Course:</td><td>Age:</td><td>Gender:</td></tr>
<tr><td>Weight</td><td>Height:</td><td>BMI:</td></tr>
<tr><td colspan="3">Date of the survey:</td></tr>
<tr><td colspan="3">Changes in eating habits</td></tr>
<tr><td>12 years old</td><td colspan="2">Nowadays</td></tr>
<tr><td>Breakfast at home</td><td colspan="2">Breakfast at home</td></tr>
<tr><td>Breakfast at “school”</td><td colspan="2">Breakfast at “school”</td></tr>
<tr><td>Lunch</td><td colspan="2">Lunch</td></tr>
<tr><td>Evening snack</td><td colspan="2">Evening snack</td></tr>
<tr><td>Dinner</td><td colspan="2">Dinner</td></tr>
<tr><td>After dinner</td><td colspan="2">After dinner</td></tr>
<tr><td colspan="3">Changes in diet</td></tr>
<tr><td colspan="3">Which food you didn’t use to eat in the past and now you eat because they are good for your diet?</td></tr>
<tr><td colspan="3">Which food you did use to eat in the past and you don’t because they aren’t good for your diet?</td></tr>
<tr><td colspan="3">Final questions</td></tr>
<tr><td colspan="3">How do you think your diet has changed since you were 12 until nowadays?</td></tr>
<tr><td colspan="3">Why do you think that some your eating habits have changed?</td></tr>
</table>

In-depth explanation of the above survey questions is presented.

2.2.1. Personal information:

The first part of this survey consists of personal information.

Depending on **age,** several factors can come into play regarding the natural progression of metabolism such as expression of genes, physical activity, stage of professional development, living situation, sexual maturity, exposure to different foods, height and weight ranges.

Sex, or **gender**, can be used to illustrate the role of hormones in metabolism, fat storage, muscle growth, etc. Social standards can also dictate differences in diet between male and female students.

Depending on **weight** and **height**, it can be determined whether the individual is within normal limits for their age/sex. It can also be determined the body mass index, **BMI**, and indicator of total body fat. With these tools, physicians can classify patients as underweight, overweight and obese, allowing them to deduce as an association with health problems.

The **date of the survey** is needed to keep record of different years or seasons. If this survey is repeated several times in a year, with the date we can determinate the variations in same individuals over the time. Specific holidays like Christmas and seasons such as summer are times of the year where diet and habits can differ drastically.

It should be noted that this is an anonymous survey; which allows participants to answer questions with maximal freedom.

2.2.2. Changes in eating habits

Depending on the meals that are crossed out from the list it can be inferred how the eating habits of polled individuals have changed.

The time frames chosen are very crucial for body development, sexual maturity, social status, life style, participation at school/job, social / sexual activity, home and peer pressures. Males and females start puberty around 12 years old, girls a little bit earlier than boys. Puberty is the process of physical and sexual changes that kids undergo to become adults. During this process changes in bone, muscle, brain and reproductive organs occurs because of the effect of the hormones, mainly testosterone and estradiol. Along with puberty, psychological changes also occur. For this reason, at this period, eating disorders as anorexia, bulimia and compulsive overeating appear

This survey is addressed to science students at their last year of secondary school, 15-16 years old. All of them live at home but also have some independence and have a tight schedule.

According the nutritionists, doing 5 meals, 3 medium sized meals and 2 snacks per day, is the most appropriated choice. The three main meals are **breakfast, lunch and dinner**. Breakfast at school and evening snack are the two snacks that prevent you from eating bigger lunch and dinner.

Dinner should be done 3 hours before going sleep. Crossing out **after dinner** can indicate that the polled individual eats dinner too early according to the time he or she goes to sleep and his hungry before going sleep.

2.2.3. Changes in diet

There are few differences in the composition of these meals from when we were 12 years old to nowadays, some from the life style, global diet changes, and overall social concerns. In relation to social life, it is important to remember that the age of 11-12 all students would go to school and have a controlled schedule, whereas secondary school students 15-16 years have some independence and have a choice when it comes to selecting meals.
Also, the Mediterranean diet is undergoing a profound change; there is an increase in fat intake in the majority of students.
The answers of this point can indicate if the person answering is conscious about his or her diet. In addition there is an indication about which is a healthy food or not.

2.2.4. Final questions

These last questions led students to do a conclusion. From the answers you can analyze what are the major causes of the unhealthy diets and the eating disorders as well as the concerns of students related to diet.

2.3. Survey 2: Obesity and healthy lifestyle perception.

This second survey started with the personal information as the survey 1. For the rest of questions (twelve) students have to mark an X in the correct answer that they think in your case.

2.3.1. Type of questions.

These twelve questions were divided as:

Relationship between family and obesity, two questions (Table 3a).

Table 3a	
Are your parents obese?	
A	Yes, both are obese.
B	Yes, my father / mother is obese
C	No, none of the two.
Are your brothers/sisters obese?	
A	No.
B	Yes, my brother/sister is.
C	Yes my twin brother or twin sister is.

Relationship between sports/television and obesity, four questions (Table 3b).

Table 3b	
Do you practice any sport?	
A	No, no, the school gym is more than enough!
B	Yes, just sometimes
C	Yes, 2-3 times a week
Which do you prefer the elevator or upstairs?	
A	Often prefer upstairs.
B	Depending of the day.
C	Always the elevator.
How many hours do you watch television?	
A	1 hour or so a day.
B	Between 2 and 3 hours a day.
C	More than 4 hours a day.
Do you have Internet at home? How often do you chat?	
A	Yes, every day. A lot of time.
B	Yes, checking email and write to some friends.
C	Yes/No, but I don't use it every day.

Relationship between a few food habits and obesity, three questions (Table 3c).

Table 3c	
Do you usually eat fruits and vegetables?	
A	No, the grass is for cows.
B	If there is no choice ...
C	Almost every day.
How often do you eat sweets?	
A	Every day.
B	Once a week.
C	Occasionally.
Do you have the habit of eating between meals?	
A	Yes, when I pass through the kitchen
B	Only on weekends.
C	No, never

Relationship between healthy Lifestyle and obesity, three questions (Table 3d).

Table 3d	
Do you smoke?	
A	No, never.
B	Few cigarettes on weekends.
C	Yes
Do you think you are wearing a Healthy Lifestyle?	
A	No, I am a little far from "Mediterranean diet"
B	I should do more exercise but not bad.
C	Yes, I often eat healthy and practice sports.
Do you believe that your eating habits could induce adult obesity risk?	
A	Yes.
B	Maybe.
C	No.

 ISBN 978-989-98032-0-6

2.3.2. Answers evaluation.

All of these questions were quantified. You can examine several examples:

- Question "Are your parents obese?" answer A was 15 points; answer B was 10 points and answer C was 0 points.
- Question "How many hours do you watch TV?" answer A was 0 points; answer B was 2 points and answer C was 5 points.
- Question "Do you smoke?" answer A was 1 point; answer B was 2 points and answer C was 5 points.

Each student obtained a final score which was included in one interval of obesity's. Authors could contrast it with student's answers from questions "Do you think you are wearing a Healthy Lifestyle? Do you believe that your eating habits could induce adult obesity risk?".

Three intervals were applied:

- Score 3 -12: Low risk
- Score 13 – 22: Moderate risk
- Score ≥ 23: High risk

3. Results

Biometric parameters and survey's answers were obtained from 845 Catalan secondary school students (406 males and 439 females) between 15 to 16 years old. Participants were in their last year of secondary school from Barcelona, Badalona and L'Hospitalet de Llobregat secondary schools. Since the main objective is to present proposals for changing the future and the students' perception about obesity, all data were grouped.

3.1. Biometric parameters

The biometric data was focused on weight and height. BMI was calculated and confronted against patterns (age and sex) to finding students' overweight and obesity.

Table 4 shows results which were similar to that authors obtained [14, 15]. However, an increase of the overweight, which went from 19.5 [15] to 25.1 was detected. In the same way, an increase of the obesity, which went from 2.9 [15] to 4.2 was also detected.

Table 4

	Overweight	Obesity
Global	25.1%	4.2%
Men	26.1%	4.6%
Women	24.2%	3.9%

3.2. Analysis survey. Changes in eating habits and diet

No changes were observed on have a lunch (100%), dinner (100%) and after dinner (20-25% has it). However, the number of students that have breakfast at home, have breakfast at school and have evening snack was decreased markedly as you can see in table 5.

Table 5. *Differences in %*

	12 years	16 years
NO Breakfast at home	15 %	32 %
NO Breakfast at school	9 %	16 &
NO Evening snack	0 %	20 %

When changes in diet were analyzed, students ate more fruits, vegetables and fish than when they were 12 years old and ate fewer sweets and pastries than when they were 12 years old.

Analyzing the final questions, most of the students think that their diet was changed because nowadays they are trying to eat all kind of food (different idea when they were 12 years old) and, obviously, because changing eating habits could become them to be better.

3.3. Analysis survey. Obesity and healthy lifestyle perception.

After quantify all questions, each student obtained a score and it was posed in obesity risk interval: low risk, moderate risk and high risk. Global results are showed in Table 6.

Table 6. *Perception of obesity*

	Global %
Low risk	14 %
Moderate risk	55 %
High risk	31 %

Initially, it seems results from healthy lifestyle perception are going in parallel with results obtained from BMI calculation. However, there are significant differences when results from Table 6 are confronted with student's answers from two vital questions "Do you think you are wearing a Healthy Lifestyle? Do you believe that your eating habits could induce adult obesity risk?"

About 45% of students in Moderate risk thought they are wearing a healthy lifestyle and their eating habits must not induce them to adult obesity. Furthermore, only the 20% students in high risk and BMI > 25 recognized the possibility to becoming an adult obese

© 2012 HSci. ISBN 978-989-98032-0-6

4. Conclusions

Students have learnt that daily calorie needs depend on age, size, gender, level of activity and vary from person to person. However, an unhealthy diet including too many calories and the lack of exercise is the most general behavior obtained from the surveys' analysis.

According to the results, it may conclude that many initiatives are need to change the situation about worldwide obesity. These initiatives have to allow young students and general society to assume new and healthier food habits based on the Mediterranean cooking.

Some of these initiatives/propositions for the future could be:

- Avoid selling pastries and soft drinks in schools.
- Enhancing the sandwich presence in breakfast and evening snack.
- Increase physical activity in children and adolescents.
- Explain concepts of nutrition in primary and secondary schools.
- Increase nutritional education for adults, for parents, for general society.

Finally, an effort to educational authorities is solicited. So, they have to include the nutrition knowledge into science curriculum directed to young students. It is an essential need because our teenagers will be the next adult society.

5. Acknowledgements

We thank secondary school students for their contribution and cooperation. We also thank Jordi Fernàndez Zaragoza for him assistance in preparing the English manuscript.

6. References

[1] Trayhurn P. Obesity-what role now for nutritional science Br. J. Nutr. 2005; 93: 1-2.

[2] Serra Ll, Ribas L, García Closas R, Ramon JM, Salvador G, Farran A, et al. Avaluació de l'estat nutricional de la población catalana. Generalitat de Catalunya. Depart. Sanitat i Seguretat Social. 1996.

[3] Aranceta J, Pérez-Rodrigo C, Serra Ll, Ribas L, Quiles J, Vioque J, Foz M and Grupo Colaborativo Español para el estudio de la obesidad. Prevalencia de la Obesidad en España: estudio SEEDO97. Med Clin 1998; 111: 441-445.

[4] Bonney R.C. European clinical laboratory 2005; 24 (4): 6-8.

[5] Zimmet P, Alberti K, Shaw J. Global and societal implications of the diabetes epidemic. Nature 2001; 414: 782-787.

[6] Bertchold P. Obesity and hypertension: cardiovascular response to weight reduction. Hypertension Suppl 1992; 1150-1155.

[7] Eliahou H.E. Body weight reduction necessary to attain normotension in the overweight hypertension patiens. Int. J. Obst. 1982; 5: 157-167.

[8] Pereira da Silva JM. Prevention of Teenager Obesity. In: Proceedings of the International Conference on Hands on Science; 2009 Oct 27-31; Ahmedabad (Gujarat) India. National Council for Science and Technology Communication 2009. p. 271-275.

[9] www.MyPyramid.org [12/05/12]

[10] www.mec.es/educa/sistema-educativo [26/06/12]

[11] www.xtec.cat/estudis/primaria/ [26/06/12]

[12] www.xtec.cat/estudis/eso/ [26/06/12]

[13] www.xtec.cat/estudis/batxillerat/ [26/06/12]

[14] Zaragoza C, & Fernández-Novell J. M. Sobrepeso, obesidad y hábitos alimentarios en estudiantes de enseñanza secundaria obligatoria de los alrededores de Barcelona, Rev. Esp. Nutr. Com. 2004; 10 (1): 26-29.

[15] Zaragoza C, & Fernández-Novell J. M. Evolución del estado nutricional en estudiantes de secundaria obligatoria a lo largo de esta etapa educativa, Rev. Esp. Nutr. Com. 2006; 12 (2): 82-85.

[16] Cole T, Bellizzi MC, Flegal KM, Dietz W. Establishing a standard definition for child overweight and obesity worldwide: international survey. BMJ 2000; 320: 1-6.

TEACHING EDUCATIONAL ROBOTICS FOR SCHOOLS: SOME RETROSPECTIVE COMMENTS

S. Anagnostakis, P.G. Michaelides
Department for Primary Teachers Education, The University of Crete, GR-74100 Rethymno-Crete, Greece
sanagn@edc.uoc.gr, michail@edc.uoc.gr

Abstract. *The welfare of modern 'knowledge based societies' depends largely on an effective education, especially in the areas of Science and Technology. The Laboratory of Educational Robotics has been proposed as a teaching environment promoting effective education. We have, for a number of years, delivered courses on Educational Robotics to various classes including in-service and pre-service school teachers and students in primary and secondary schools. Main results, related to formal aspects of the teaching such as the objectives, the selection of the syllabus, the students' achievements and the course evaluation, the feasibility of educational robotics as a school subject etc have already been published. In this work we present non-structured observations related to other aspects, e.g.: a/technical, such as the differentiation between computer programming and programming for robots where real time situations and response to events must be resolved, b/aspects related to informal training, such as the behavior of trainees, either school students or in-/pre- service teachers, the feasibility of educational robotics as a teaching environment, etc..*

Keywords: Educational Robotics, Teaching, Teachers Education.

1. Introduction

The welfare of modern 'knowledge based societies' depends largely on an effective education, especially in the areas of Science and Technology. The 'Laboratory of Educational Robotics' has been proposed as a teaching environment promoting effective education. We have, for a number of years, delivered courses on Educational Robotics to various classes including in-service and pre-service school teachers and students in primary and secondary schools. The main objectives of this course include:

a. understanding the basic concepts of robots,
b. familiarization with the programming of robots,
c. apprehension of the possibilities and limitations of robots,
d. use of educational robotics as a teaching environment in a similar way to the LOGO© teaching environment to which, educational robotics is an evolution.
e. development of problem solving skills,
f. development of self learning skills.

The last objective is essential because developments in this area are very rapid and the teachers (in- and pre- service) should be able to retain any relevant competence they have acquired. To meet this objective, we used a teaching approach evolving from problem based learning to project based learning while inquiry based learning techniques are used [1] especially to 'debug' (correct) or improve the robot programming.
Into the syllabus the following are included:

g. familiarization with the materials used (Lego© Mindstorms©). After presenting the basics of the construction and of the robot programming, students are encouraged to experiment making simple constructions and programs. They are asked to foresee the effect of their programming, test its correctness and try to plan an error correction strategy.
h. simple robot construction under guidance. Students are asked to construct simple robot artifacts, program them to perform tasks with increasing complexity. In every step they are asked to rethink shortcuts in their programming with advances to more complex programming tools.
i. either: a/design and construct a robot on their own to participate in a robot contest or b/design and realize a teaching in schools.
j. design and, if feasible, implement, part of a smart house or another complex (e.g. a production line, a service queue …). This is given as a drill of self-learning activities.

In all steps, students are encouraged to seek and use knowledge relevant to the task from other subjects, especially Science and Mathematics.
Main results, related to formal aspects of the teaching such as the objectives, the selection of the syllabus, the students' achievements and the evaluation of the course, the feasibility of educational robotics as a school subject etc have already been published elsewhere [2], [3], [4] and [5], while, aspects related to the development of self learning skills are presented in [6].
In this work we present in **2. About the course** some details on the course while in **3.**

© 2012 HSci. ISBN 978-989-98032-0-6

Commentary we present non-structured observations related to:

k. technical, e.g. the differentiation between computer programming and programming for robots where real time situations and response to events must be resolved,

l. aspects related to informal training, such as the behavior of trainees, either school students or in- and pre- service teachers, the feasibility of educational robotics as a teaching environment,

m. other aspects.

2. About the course

Administration

The course is included as an optional choice in the area of Informatics in Education of the Department for Primary Education of The University of Crete. Graduates of this Department are qualified to be appointed as teachers in primary schools. The course is taught every or every other semester to students on the 5th or greater semester. Most of these students have already completed their basic courses in Science and in Methodology of Teaching. Their majority are computer literate. In the announcement of the course there is no formal prerequisite of previous attainments or of specific previous knowledge.

Materials used

The equipment used was the LEGO© Mindstorms© because their purchase was easier (http://mindstorms.lego.com/). It has the added advantage that its parts are familiar to most (almost all) of the students. The programming was made on PCs with Windows© or Macs with OSX© using the Robolab© Software supplied by LEGO©, an icon based programming language.

Teaching. The course was delivered in intervals of three teaching hours per week for at least 13 weeks. Students however were free to use the laboratory for more hours, if they wanted to prepare for their assigned tasks or for further study. Students work in groups of two, three or 4 (only exceptionally when many students enroll to the seminar. During the first 3 weeks, students are introduced to concepts related to robots and robot programming (indicating also applications using robots). They also use the equipment to become familiar with the parts, the sensors, the robot unit, the programming language …. During the next 4 weeks students are assigned tasks of constructing specific robots performing relatively simple tasks, the objective being to become familiar with the peculiarities of robot programming, i.e. response in real time specific events. They should also start planning their strategy for their choice to teach in school or to participate in the contest (see i por encima de) a task which has to be completed within the next three weeks together with their study on the concepts of smart home or other applications (see j) which have to be presented and discussed during the next two weeks. The last week is devoted to retrospection and assessment. In all stages students are asked to optimize, at least once, their completed tasks. A logbook is required to be kept from the students in which, after every 3 hour session they have to fill in retrospectively their work and other comments (e.g. cooperation in the group, problems …).

Differentiations

Within the above organizational frame, differing arrangements are made in order to observe specific aspects such as the effect of detailed instruction, the effectiveness of different teaching approaches, the influence of previous knowledge of students in programming or in technology, etc.

Remarks

The arrangements described in administration ensure best similarity to the in-service school teachers. Mentor type [7] teaching was implemented by the authors of this work (in some cases external observers were also used to check on the observations). This course, adapted as intensive training seminar, is also taught to in-service teachers in Greece and to school teachers from Europe (as a Comenius seminar). Specific parts of it have also been adapted and taught to school children and to school teachers as awareness courses on educational robotics. In all teachings an assessment was included. The assessment of the course was based on teachers observations (including the students' achievements in final examinations), on anonymous Questionnaires from the students, and on teachers – students discussions during and at the end of the course.

3. Commentary

From the assessments following every teaching of the course, the achievements of students from the different classes which are related to cognition and knowledge are similar. In all

© 2012 HSci. ISBN 978-989-98032-0-6

classes students performed well, succeeding with high marks and with zero drop-out [8]. There was no difference between boys and girls apart from a slight, not statistically significant, tendency for girls to complete their tasks sooner. Although all students agree that it is a very demanding course they also report a very positive opinion for the course adding that they will take a similar course and those they will recommend this course to other students. We interpret this as an indication of active involvements of the students to the learning process. Students at all levels i.e. school students, university students (pre-service teachers), and educators (in- service teachers) seem to respond successfully, although no previous technical or programming skills were required from them.

Learning to use effectively educational robotics the following specific points are noted:

- The computer programming background of students from school is within the frame of 'linear programming' while programming of robots is based on responses to events, such as sensor readings, time period elapsed, etc. It seems that students have difficulties to apprehend the difference especially the students with sound background in computer programming from school. Best way we have found is to assign them a related specific task and provide to students with mentor type guidance to help them complete the task.
- Similar remedies should be used to apprehend the time scale between the processor clock and human behavior. For example, assigning the task *wait to hear a sound then start the motors and wait to hear a 2nd sound then stop the motors* students usually program the robot as *wait for sound sensor to be above (a high value e.g. 60)→start motors→ wait for sound sensor to be above (a high value e.g. 60)→stop motors* and then are surprised that the artifact robot does not behave as expected and conclude that their program does not run properly although we assure them that their program completed successfully. The clue is to analyze what *2nd sound* means (i.e. *sound level from first sound should drop to very low level and then check for the second sound*) they realize that the time the robot processor takes to execute the commands is within the time duration of the first sound which is misinterpreted also as *2nd sound*.
- Comparison of differences and similarities between the commands *wait for an event* and *loop until an event takes place* is learned effectively by trying to complete tasks specific to these differences and similarities. This seems to be essential to programming for more complex events for example checking more than one sensors, conditions, or situations. These are tasks which promote logic skills and also creative thinking and, possibly, lateral thinking.
- Many students use the arrangement to be in the laboratory outside teaching hours, some to cover up falling behind schedule but most to extend their study on the subject.
- All students report that the will remember always the project, competition or teaching to schools, assigned to them (see point i). Also they will remember the cooperation and their efforts to complete tasks assigned.

A significant part of some of the objectives, for example d, e and f, is pursued by informal learning through discussions in the groups. We believe that this approach has longer lasting effects as it develops attitudes which may be used by the students in their professional career compensating the lack of learning by society interaction (in a Vygotski context) and the insufficient or expensive formal training available. We have studied this aspect (see details in [4] and [5]) by concurrent comparative teaching in two similar classes. In class A the assignment of tasks took place very early (e.g. from the stage to open the box and start working) and with minimum guidance while in class B there was close guidance at the first stages of familiarization and basic techniques to use the robotic materials. Main conclusions are summarized below:

- In class A students were able to construct and operate simple robots earlier than students in group B. However, in the end there was no difference to the marks achieved between the two classes.
- Students in class A seem to have a better understanding of the subject (they complete their complex projects earlier and with a wider variety of strategies) and report more positive opinions about the different aspects of the course.
- All students note that the challenges to complete themselves the tasks boost up their self esteem and they liked it with those in class A being more enthusiastic.

© 2012 HSci. ISBN 978-989-98032-0-6

- In all the groups there was satisfactory cooperation of different kinds. However, there was a tendency in groups of class A to function on a peer scheme without strictly prescribed roles while in groups from class B the tendency was to function in a role playing scheme (i.e. facilitator, constructor, programmer …).
- Cooperation and completion of the tasks assigned was more efficient when the members of the group adopted as their own the objectives of the task. This led us to negotiate with the groups which specific task between equivalent ones to be assigned letting the group to choose.
- About half of the students in both groups report as the most negative aspect of the course the 'bureaucracy' to fill in the logbook of their activities during the course – this is, however an essential constituent of the teaching approach adopted.

All students report the course as very demanding, however they embark of their own on other non required relevant tasks, for example translate the English manuals into Greek, organizing related events (festivities) ….

The majority of the students report that they consider themselves able to teach a similar subject in school or to use educational robotics in their teaching justifying their opinion on the teaching approach they were exposed to and which they are going to use. It is notable that almost all of the negative responses 'put the blame for their negative responses' to the lack of materials in schools and to the 'rigidity' of the school curriculum, namely is to causes unrelated to their competences.

From the observations of the teachings that our students effected in schools, we note:

- Students' teaching approach was within the frame they were themselves exposed as described earlier although, due to time restrictions, they not always allowed enough time for pupils' deliberation.
- They were very inventive to cover the robot programming task. Instead of using the computer immediately, they produced cards with the commands and asked pupils to arrange them the way they think it will work, study it and comment on the sequence constructed and, afterwards, implementing and actually testing it. This proved a very time and concept effective tool.
- With one exception, to comment later, in all teachings:
  - Pupils show a vivid continuous interest (for 2 or 3 hours!) and they are asking to repeat it at a more advanced level.
  - Although groups were formed, pupils were transferring themselves between the robot sets assuming every time different roles, forming thus continuously changing groups. When succeeding in a task they were going to demonstrate their achievement to their fellows in other groups.
  - Pupils were assuming any role (facilitator, constructor, programmer…) interchangeably when moving between groups.
  - Pupils revealed real creativity to suggest robot applications and modes of implementation.
  - Pupils acquired essential concepts of robots, of their functioning and of indicative applications as was found from the assessments following the teaching interventions.
- In one school there was an imbalance between construction of the robot artifacts and the programming towards which pupils focused their interest. It was found that pupils there were mostly immigrants from former East European countries who had not experience with Lego© type toys, they were, however, exposed to computer and other electronic devices and were interested in the nice Mac Book© type computers used.
- In a test case, teaching was effected by our students within the frame of their degree dissertation to pupils of a problematic school in an isolated mountainous area [9], [10] and [11]. In this school pupils had lost their interest in school from which they did not expect anything useful to their lives, had developed offending tactics and a large percentage was classified as having learning difficulties and attention problems. These pupils, after a short first stage of indifference and suspicion, realized that the concepts involved could be useful to their intended occupation (mostly sheep farmers), showed an increasing interest and get actively involved for the whole teaching (3 interventions, 3 to 4 hours each). Moreover they showed real ingenuity in constructing the robot artifacts. Their interest to school was revived and they started visiting the University to learn more on the various options. Most of these pupils

© 2012 HSci. ISBN 978-989-98032-0-6

(grown up adults now) keep a contact with the authors of this work. Similar observations were made in another similar school with a onetime intervention.

- A number of our students participate voluntarily to the Pan-Hellenic Educational Robotics Competition (WROHellas) an indication of their interest while some of them have won prizes, an indication of an effective learning, at least at the knowledge level.

5. Summary

Educational Robotics, an evolution of the LOGO© environment is imperative to include in school activities, especially in compulsory education, either as a teaching environment or as a subject aiming to Science and Technology literacy [12]. Our studies on different parameters towards this introduction have shown that this is feasible and, using the teaching approach we have described, it is also compatible with the general objectives of a humanistic education [13].

6. Acknowledgements

This work in its current form has been partially financed by the European Commission (project "Pri-Sci-Net" Grant agreement no. 266647). The views expressed represent the author. Neither the European Commission nor the authors may be held responsible for any use of the information provided here.
Informal discussions during teaching in The University of Crete with A. Margetousaki for her overall help and observations are acknowledged.

7. References

[1] Problem based learning, Inquiry based learning and Project based learning are teaching approaches within the broader scope of constructivism. For the purposes of this paper, we use the following simplified working definitions: In problem based learning students are guided to obtain knowledge through their attempts to solve the problems or answer the (open type) questions posed by the instructor. In inquiry type learning students face also the requirement to think up and apply appropriate techniques to discriminate between different possible alternatives to their solutions or answers. In project based learning, the problems and the questions students are faced are connected towards the making of a project (a construction, an essay, a study …). See more in relevant literature.

[2] Simos Anagnostakis, P. G. Michaelides, 'Laboratory of Educational Robotics' - An undergraduate course for Primary Education Teacher - Students, proceedings pp. 329-335, HSci 2006 - 3rd International Conference on Hands-on Science, 4th - 9th September, 2006, Braga, Portugal, proceedings published by University of Minho. (http://www.hsci.info/hsci2006/index.html).

[3] Simos Anagnostakis, P. G. Michaelides, 'Results from an undergraduate test teaching course on Robotics to Primary Education Teacher – Students' 4th International Conference on Hands-on Science, 23 – 27 July 2007, Universidade dos Açores, Ponta Delgada, Portugal, Proceedings pp. 3-9 http://www.hsci.info/hsci2007.html,.

[4] Anagnostakis S., Margetousaki A., Michaelides P. G., 'The Feasibility of a Laboratory of Educational Robotics in Schools (in Greek)', 4th PanHellenic Conference on the Didactics of Informatics, University of Patras, Patra, 28 – 30 March 2008 (http://www.ecedu.upatras.gr/didinfo/).

[5] Margetousaki A., Anagnostakis S., Michaelides P. G., 'Informal Learning in the context of Educational Robotics (in Greek)', 4th PanHellenic Conference on the Didactics of Informatics, University of Patras, (http://www.ecedu.upatras.gr/didinfo/) Patra, 28 – 30 March 2008.

[6] P. G. Michaelides, Problem Based Learning in Science and Technology teaching in the Department of Primary Teachers Education of the University of Crete, presented at the 9th International Conference on Hands on Science – Hsci2012, 17-21 October 2012, Antalya, Turkey

[7] Traditional tutoring aims to the objectives of the teaching referring to cognition while mentor type teaching, without neglecting these objectives, puts priority on guiding the student to feel confident and become able to solve his/her problems in general – see more in M. Anne Powell, M.S.W., Academic Tutoring and Mentoring: A Literature Review, California Research Bureau, California State Library, 1997 available at http://www.library.ca.gov/crb/97/11/97011.pdf (visited Aug. 22, 2012).

[8] High dropout rates are observed in other courses. In the area of Science, Mathematics and Technology dropout rates may raise to 50% especially if the course includes activities such as a construction, Science measurements, conducting experiments, etc. However, students completing these courses usually achieve high marks. Similar high marks are observed also to students completing this course although dropout rate is zero.

[9] Kalamara Thomais, Educational Robotics in school. A case study in Middle school of Krana', degree dissertation in the Department for Primary Teachers' Education of The University of Crete, Rethymno, 2009 (in Greek).

[10] Staikou Constantina, 'Educational Robotics in school. The prospect of teacher's self training', degree dissertation in the Department for Primary Teachers' Education of The University of Crete, Rethymno, 2009 (in Greek).

[11] Stoumpou Christina, 'Educational Robotics in school. The feasibility of teaching in middle school', degree dissertation in the Department for Primary Teachers' Education of The University of Crete, Rethymno, 2009 (in Greek).

[12] As contemporary Societies are based on Science and Technology (S&T) developments, Science and Technology Literacy (STL) are essential for the welfare of these societies. As more and more regulations (laws, decrees …) are dependent on S&T developments, STL literacy is also crucial for Democracy as a system where citizens participate to the discussions and influence the decisions on their own capacity and not as followers of a politician or Faithfull to a dogma. As developments in S&T are very rapid, STL cannot be acquired (in a Vygotski or Bakhtin framework) through the interaction with the society (there is no related experience in the society) leaving as the only alternative the formal education and training, especially the compulsory education which is addressed to all citizens.

[13] *To come to a more fundamental cleavage; there can be no agreement between those who regard education as a means of instilling certain definite beliefs, and those who think that it should produce the power of independent judgment. Where such issues are relevant, it would be idle to shirk them……..* passage from the book 'On Education, Especially in Early Childhood, 1926) 'by Bertrand Russell (1872-1980), the third Earl Russell, Mathematician (Logic- see Russell's paradox), one of the greatest philosophers who wrote many of his works in jail where he was imprisoned because of his political activity (peace movements during the era of post WWII cold war).

CYBERCHONDRIA IS ON THE RISE: ARE INFORMATION TECHNOLOGY ADVANCES MAINTAINING HEALTH ANXIETY?

I. Berezovska[1], O. Olhova[2], O. Matsyuk[1]
[1]*Department of Computer Sciences, Ternopil State Technical University*
56 Ruska St., Ternopil 46001, Ukraine
[2]*Andrey Krupynsky Lviv State Medical College*
70 P. Doroshenko St., Lviv 79000, Ukraine
iberezov@hotmail.com, Olya_olhova@ukr.net
kuba.molva@ukr.net

Abstract. *Recent data from research studies and surveys supports the view that cyberchondria seems to be on the rise, partly enabled by new information technology advances.*
This paper will continue the discussion of the phenomena in broad and evolving context and present an overview of some of the recent Internet services which impact on the health consumers' behaviors and a traditional model of doctor-patient interrelation.
Findings from a recent survey, carried out in a population of students attending Lviv State Medical College (Ukraine) will be summarized to compare the search habits and health-related anxiety data of the medical student survey population to data related to the concept of cyberchondria that has been previously reported in the engineering student research population and other research populations.

Keywords: Cyberchondria, mobile access, consumer health information, the Internet, information seeking.

© 2012 HSci. ISBN 978-989-98032-0-6

1. Introduction

Health care consumers have been using the Internet to access health information for more than a decade. Researching medical concerns on trust websites helps health care consumers become more knowledgeable about their health.
However, in doing so, people who have poor health literacy or no medical training, may become excessively anxious about their health status, if they employ the Internet to self-diagnosing as they are not able to evaluate the reliability of the health-related content [2]. This anxiety is known as cyberchondria.
Recent data from research studies and surveys supports the view that cyberchondria seems to be on the rise. Additionally to "search engines, chat rooms, diagnostic internet sites, applications" [11], vast amounts of technology-supported medical information are generated by "global health scares carried by media and television shows that demonstrate the intricacies of surgery" [11]. Patients searching online for reassurance become anxious, and "cyberchondria has almost become a formal diagnosis" [11] that is partly enabled by new information technology advances.
Ensuring that health care consumers are well-informed about treatment options, medicines and adverse effects are becoming more challenging since the Web-base information sources have proliferated.
This paper will continue discussing the phenomena of cyberchondria in broad and evolving context, presents recent survey data, and review some of the recent Internet services which impact on the health consumers' behaviors and a traditional model of doctor-patient interrelation.

2. Healthcare consumers' interaction with the Internet; motivation, habits, levels of anxiety and new tools

Recent data on Internet health information search activity indicates a new uptick in cyberchondria after a relatively short period during which the Internet had seemed to take a more proper third-party position in the doctor-patient-Internet communication triangle [7].
It is not surprising, considering the national-wide use of the Web to seek information in many counties.
US consumers began seeking health information much earlier than those in other countries. Now 74 % of Americans use an online search engine, according to a May 2011 Pew Research Center survey [9, 13], while this number was only 52 % in January 2002. Eight in 10 American Internet users look for health information [13]. Surveys have been conducted since 1998 by Harris Poll in addition to similar studies by Pew Internet & American Life Project since 2002. The latest Harris Poll survey in 2010, reported that "while the percentage of adults who go online (79 %) has not changed significantly for several years, the proportion of those who are online and have ever used the Internet to look for health information has increased to 88 % this year, **the highest number ever** "[14].
In Japan, it was only in 2008 that a population-based study revealed that "the Internet finally had an equivalent status as a health information source as other traditional sources (with 60.6% for ''Internet'' vs. 61.8 % for ''family and friends'')" [16].
In the United Kingdom, an increase in health-related Internet use has come with the rise of Internet access up to the 70% of households in 2009, and the "proportion of UK Internet users using online information on health matters increased from 37 % in 2005 to 68 % in 2009" [8].
In Ukraine, 38 % of Ukrainians that translates in 14.7 million adults use the Internet in the first quarter 2012. However health-related topics do not seem the most frequent: only 20% searches deal with health information. Health topics are of the highest priority for new Internet users who got the access 1 year ago or later (13 % of all information searches) and the population group over 50 years (14 % of all information searches) [5].
More people develop the habit of online researches related to their health as broadband and mobile Internet access spreads and new services such as social network websites are launched. Hence, the Internet is becoming both communication and social media [13].
The use of social network sites like Facebook has increased rapidly. Thus, as of September 2010, 62 % of Americans used social networks [13]. This factor is dealt with from several viewpoints: as a subdivision of Internet addiction connected to social media or to consider addiction to social networking as an activity, rather than addiction to a specific product like Facebook [3, 10]. Though these sites are popular, they are used mostly for health updates and queries by

© 2012 HSci. ISBN 978-989-98032-0-6

Americans, according to a May 2011 Pew Research Center survey: 23% users followed their friends' health experiences; 15% requested any health information [13].

It is important to understand how healthcare consumers interact with the Internet-based media in learning about health care matters. In order to understand more about online health information seeking behaviors we continued surveying student population and carried out a survey to determine health-related search habits and levels of health-related anxiety in medical students at Lviv State Medical College (LSMC, Ukraine).

The survey form shown in the Appendix includes some similar questions from Table IV and Table X , used by the Microsoft researchers in their classic survey research [15].

White and Horvitz distributed their survey within the Microsoft Corporation, to randomly selected employees (350 males and 165 females; average age 36.3 years). They argue that they "have no evidence that the employees' experiences with medical Web search differ significantly from those of the general user population" [15].

Table 1. *Responses to the survey questions at TNTU, Ukraine (66 student respondents) and LSMC, Ukraine (74 student respondents)*

Survey question	TNTU	LSMC
1. Average number of health online searches per month	1.72	4.82
2. Average number of health-related online searches (for *professionally undiagnosed medical conditions)*	1.05	1.60
3. End-consumer of online search results (%):		
• Yourself	65.9	82
• Relative	6.8	20
• Friend or work colleague	11.4	14
• Other	15.9	12
4. Type of information sought (%):		
• Information on symptoms	34.1	41
• Information on serious medical conditions	9.1	47
• Medical diagnoses	29.6	23
• Forums or pages describing others' experiences with similar conditions	27.3	16
• Other	29.6	16
5. Average self-rating of health-related anxiety (1-10 scale)	4.37	5.0
6. Being a hypochondriac – self-opinion (%):		
• Yes	0	18
• No	100	82
7. Being a hypochondriac – opinion of the people around (%):		
• Yes	2.3	14
• No	97.7	86
8. Unjustified self-diagnosis of a serious medical condition (%):		
• Yes	29.6	40
• No	70.4	60
9. Escalation of illness anxiety fueled by online search (%):		
• Always	2.3	8
• Often	13.6	15
• Occasionally	27.3	43
• Rarely	29.5	20
• Never	27.3	14
10. The ranking of online search results is considered an indicator of the likelihood of diseases (%):		
• Always	0	6
• Often	0	11
• Occasionally	43.2	38
• Rarely	29.5	24
• Never	27.3	21
11. The use of online search as a medical expert system (%):		
• Yes	29.6	35
• No	70.4	65
12. Scheduling an appointment with a health professional may be urged by the online health care information obtained during searches (%):		
• Yes	29.6	41
• No	70.4	59
13. The appointment disproved health concerns (%):		
• Yes	34.1	47
• No	65.9	53

At the LSMC, survey forms were completed by 74 students (5 males and 69 females; average age 19.2 years) who study nursing. Their responses to the survey questions are summarized in Table 1 along with the data collected in the survey among Ukrainian and International students at Ternopil National Technical University (TNTU, Ukraine) [7]. In the discussion section we compare some of the survey data obtained from the both student populations to data reported by White and Horvitz [15].

3. Discussion of survey results

The medical student population in our survey performed fewer online health-related searches per month than the Microsoft employees in the White and Horvitz study – 4.82 versus 10.22 per month, but more than the TNTU student research population – 1.72. Similarly to the engineering students in the TNTU, the medical students' average health anxiety rating is much higher: 5.0 versus 2.78 in the Microsoft study. (Rating scale 1-10).

The elevated health anxiety level reported by both student population groups may be explained by high morbidity in Ukraine where 10 % of the students suffer from chronic diseases.

In the overwhelming majority of cases (82 %), the medical students in our survey population were the end-consumers of search results. Similarly to the Microsoft employee survey population, they target information on the serious medical conditions, not on general symptoms and possible medical diagnoses that were typical search targets of the TNTU students.

Comparable proportions of the LSMC and Microsoft respondents (four in ten) reported self-diagnosing a serious medical condition based on their own observations, when no professionally diagnosed condition was present, though this proportion was three in ten in the TNTU survey group.

The LSMC students were also far more inclined to review search content on more serious illnesses – only 14 % of this student population responded that they never did so versus 27 % in the TNTU survey population. However, in the Microsoft survey the escalation of illness anxiety was significantly higher – only 8 % of respondents never reviewed content on more serious diseases.

An interesting difference was noticed in the data related to how respondents interpreted the ranking of online search results between the both student surveys and the Microsoft study population. While all (100 %) of the TNTU student respondents interpreted the ranking of online search results as indicating the likely presence of disease only occasionally, rarely or never, close to one-quarter of Microsoft respondents and 17 % of the LSMC respondents interpreted search results in this way always or often. Perhaps engineering students' knowledge of probability theory and ranking algorithms plays a role in this case, although a significant proportion of them (29.6 %) as well as 35 % of medical students had used Web search engines as if Web search functioned as a medical expert system.

The LSMC students are more likely to schedule an appointment with a health professional based on their review of online medical content – 41 % versus 29.6 % in the TNTU survey group. No wonder that fewer medical students reported that they actually had a medical condition that warranted consulting a health care professional (their worries were justified) – 53 % versus 65.9% in the TNTU survey population. However, only one in four of the Microsoft respondents were reassured that their worries were justified after consulting.

Of some note is that, in comparison with engineering students in the TNTU survey group, the LSMC respondents were also far more inclined to consider themselves hypochondriac (18 % versus 0 %). The so-called "medical school syndrome" may explain this tendency.

Our findings show that this group of young Internet users who study medicine could be typified as rather discriminating consumers of online health information, however their level of illness anxiety fueled by online search seems higher than that in engineering students who study computer science.

4. Doctor-patient-Internet triangle: a "shared decision-making" model

There is a general consensus that technology has impacted positively on self-management of health and on the traditional doctor-patient relationship [12].

According to a 2010 study of Australian internet users [6], the four most frequently cited sources for information were doctors (81.3 %) the Internet (42.2 %) the media (14 %) and family or friends (11.8 %). A recent population-based survey, conducted in Japan [16], showed that doctors remain the respondents' first choice as a health-related information source (57.0 % of used sources), though the Internet has gained greater popularity (44.3 % of used sources).

Most of participants in many surveys see the use of health-related Internet as "a supplement to existing health service provision rather than a replacement for it" [8]. In the United Kingdom, an online questionnaire survey, offered to users of the National Health Service (NHS) Direct website, supports "the idea that online health resources are enmeshed with other (offline)

© 2012 HSci. ISBN 978-989-98032-0-6

approaches to seeking help…, and that health-related Internet use is now embedded in everyday health practices" [8].

The literature, however, highlights some negative aspects of the emerging online search trend, such as misinterpretation and anxiety.

Cyberchondria demands taking longer than a standard physician office visit as doctors discuss why patients think they have a particular disease, and educate them on why their self-diagnosing is unlikely. Open access to complex medical information may alter the traditional role of doctors as the conventional doorkeepers of knowledge and diagnostic competence.

Thus, physicians need to approach cyberchondria as teachers, and patient education remains a challenge [4].

5. Conclusion

The findings of recent surveys and research on behaviors and motivations of online health information seekers are relevant for healthcare professionals and IT specialists, as the impact of the Internet on patient behavior and healthcare management is likely to increase steadily over time.

Health care consumers have become more knowledgeable in some aspects than they were in the past, but the lack of proper guidance can cause anxiety or fear. The "volume and accessibility of health-related information online, along with search facilities and intuitive medical diagnostic websites that may prompt awareness of symptoms, may make the web particularly attractive for those of a hypochondriacal disposition" [11]. This is a particular concern given the quality of much of the content available online.

In order to lessen these risks, it is important that health professionals are involved in the design, dissemination and evaluation of web-based health and medical information [1].

The question remains, how new information technology accomplishments can best be used to deliver efficient health information in a manner that would not overload health care consumers with medical knowledge and would not cause unfounded anxiety. For example, it was found that "in avoiding misinformation and identifying which information to trust, participants put great emphasis on recognition of brands such as the NHS, which were trusted in the non-Internet world, together with using common sense approaches to navigate the health Internet. The reported value of official branding of health websites in determining trustworthiness is supported by previous work" [8]. Recent research findings support "a model of evolutionary rather than revolutionary change in health information use, with real-world trusted brands being used online, in conjunction with traditional consultations" [8].

The medical ethics maxim of *Primum non nocere* "First, do not harm" needs be upheld by all medical professionals, including "Dr. Google".

6. References

[1] Benigeri M, Pluye P. Shortcomings of health information on the internet. Health Promot Int. 2003; 18(4):381-6.

[2] Berezovska and K. Buchinger. Access to Consumer Health Information: Changes under Influence of IT Progress: Is Information Technology Progress Enabling Cyberchondria? Proceedings of the 6th International Conference on Hands-on Science. Costa MF, Dorrío BV, Patairiya MK (Eds.); 2009, 27-31 October; Science City, Ahmedabad –India. 2009. 175-180.

[3] Cecilie Schou Andreassen, Torbjorn Torsheim, Geir Scott Brunborg, and Stale Pallesen. Development of a Facebook Addiction Scale. Psychological Reports, Apr 2012, Volume 110, Issue 2, pp. 501-517; doi:10.2466/02.09.18.PR0.110.2.501-517.

[4] Christine S. Moyer. Cyberchondria: the one diagnosis patients miss. AMA News. January 30, 2012. http://www.ama-assn.org/amednews/2012/01/30/hll10130.htm [07/08/2012].

[5] Hleb Vyshlinski. Number and Structure of the Internet Users in Ukraine. GfK Ukraine. http://www.gfk.ua/imperia/md/content/gfkukraine/presentations/20120517_imu_vyshlinsky.pdf [27/08/2012] (in Ukr.).

[6] Hogue M-CB, Doran E, Henry DA (2012) A Prompt to the Web: The Media and Health Information Seeking Behavior. PLoS ONE 7(4): e34314. doi:10.1371/journal.pone.0034314.

[7] Iryna Berezovska, Karen Buchinger, Oleksandr Matsyuk (2010). Evolving Facets of Cyberchondria: Primum non nocere "First, do no harm" M.

Kalogiannakis, D. Stavrou & P. Michaelidis (Eds.) Proceedings of the 7th International Conference on Hands-on Science. 25-31 July 2010, Rethymno-Crete, pp. 125 – 130.

[8] John Powell, Nadia Inglis, Jennifer Ronnie, and Shirley Large. The Characteristics and Motivations of Online Health Information Seekers: Cross-Sectional Survey and Qualitative Interview Study. J Med Internet Res. 2011 Jan-Mar; 13(1): e20. doi: 10.2196/jmir.1600.

[9] Kristen Purcell. Search and email still top the list of most popular online activities. Pew Internet & American Life Project. Aug. 9, 2011. http://pewinternet.org/~/media//files/reports/2011/pip_search-and-email.pdf [27/08/2012].

[10] Mark D Griffiths. Facebook Addiction: concerns, criticism and recommendations - a response to Andreassen and colleagues. Psychological Reports, Apr 2012, Volume 110, Issue 2, pp. 518-520; DOI:10.2466/01.07.18.PR0.110.2.518-520.

[11] Mary Aiken, Grainne Kirwan, Mike Berry, Ciaran A O'Boyle. The age of cyberchondria. Royal College of Surgeons in Ireland Student Medical Journal 2012; 5: 71-74.

[12] Sillence E, Briggs P, Harris P, Fishwick L. Changes in online health usage over the last 5 years. In: CHI '06 extended abstracts on human factors in computing systems – CHI '06. New York, New York, USA; ACM Press, 2006: 1331.

[13] Susannah Fox. The Social Life of Health Information, 2011. Pew Internet & American Life Project. May 12, 2011. http://pewinternet.org/Reports/2011/Social-Life-of-Health-Info.aspx [31/08/2012].

[14] The Harris Poll®. ''Cyberchondriacs'' on the rise? Those who go online for healthcare information continues to increase. 2010 Harris Interactive, Inc. http://www.harrisinteractive.com/NewsRoom/HarrisPolls/tabid/447/mid/1508/articleId/448/ctl/ReadCustom%20Default/Default.aspx [30/08/2012].

[15] White RW, Horvitz E. Cyberchondria: Studies of the Escalation of Medical Concerns in Web Search. ACM Transactions on Information Systems 2009 Nov;27(4):23:1-37.

[16] Yukiko Sakai, Chihiro Kunimoto, Keiko Kurata. Health information seekers in Japan: a snapshot of needs, behavior, and recognition in 2008. J Med Lib Assoc 100(3) July 2012: 205-213.

Appendix

Health-related search habits and levels of health-related anxiety survey

1. On average, how many health-related Web searches do you perform per month?
2. On average, how many health-related Web searches for *professionally undiagnosed medical conditions* do you perform per month?
3. Who are your health-related Web searches primarily for?
4. When you seek health-related information online you generally search for? (multiple responses permitted)
5. On a scale of 1 to 10, how would you rate your overall anxiety about potential medical conditions that are not present or currently undiagnosed (1 = don't worry about health issues, 10 = severe anxiety)
6. Do you think that you are a hypochondriac?
7. Have you ever been called a "hypochondriac" by friends, family, or a health professional (e.g., a physician)?
8. Have you ever been concerned about having a serious medical condition based on your own observation of symptoms *when no condition was present*?
9. How often do your Web searches for symptoms / basic medical conditions lead to your review of content on serious illnesses?
10. If your queries contain medical symptoms, how often do you consider the ranking of Web search results as indicating the likelihood of the illnesses, with more likely diseases appearing higher up on the result page(s)?
11. Have you ever used Web search as a medical expert system where you input symptoms and expect to review possible diseases ranked by likelihood?
12. Do you believe you have been in the situation where Web content "put you

over the threshold" for scheduling an appointment with a health professional, when you would likely have not sought professional medical attention if you had not reviewed Web content?

13. Did the appointment reassure you that your worries were not justified?

THE EVALUATION OF THE OPINIONS OF ELEMENTARY SCIENCE TEACHER CANDIDATES ON THE QUESTION OF 'WHO IS CALLED SCIENTIST?'

S. Özdeş, O. Aslan
Necmettin Erbakan University, Ahmet Keleşoğlu Faculty of Education, Science Education Department, 42090 Konya-Turkey
Sema.Sozdes@gmail.com, oktayaslan@gmail.com

Abstract. *In our age, the developments in science and technology have affected social and educational fields as well as economic areas. That is; it is impossible to make the educational system, which has been supporting the development and advance of the society and helping the progress of the individual, independent of technological changes and systems forming the structure of the society. That is why; it has become a necessity to bring up individuals capable of reading and writing in the field of scientific and technological changes and developments. To reach this goal, it is required to make teachers have satisfactory understanding with respect to the nature of science (NOS) because comprehending the nature of science (NOS) is the critical and fundamental component of being a reader and writer of science. As Mc Comas describes [1], The nature of science is composed of answers to the inquiries such as 'What is science, and in which way does it work?', 'Whom do we call scientist, and how do they study?', 'What is the effect of social and cultural contexts on science?'.*
In this study it is aimed to determine the visions of science teacher candidates towards the concept of "scientist". 134 volunteers from the last year students of Science Teaching Division of Necmettin Erbakan University participated in the study. Firstly, the participants are requested to write the names of scientists that come to their minds by using an open-ended questionnaire while collecting the data of the research. Next, a semi- structured interview concerning the questions 'Who is called scientist?", 'What are the features of a scientist in your mind?' was realized together with 79 volunteers out of 134. The study is a qualitative one and the way of content analysis is used in the analyzing of data. This study contains some findings concerning the thoughts of preservice teachers for questions 'Who is called scientist?', 'In which areas do the scientists whom they wrote in the survey usually study?' and about their gender and also it contains their misconceptions concerning the question of 'Who is called scientist?'. At the end of this research, sadly we have come face to face stereotypical images which exoterically negative connected with scientists.

Keywords: Nature of science (NOS), scientist, science teacher candidate, science literacy, history and philosophy of science (HPS), Program for International Student Assessment (PISA), misconceptions.

1. Introduction

Understanding the nature of science (NOS) is a major dimension of the scientific literacy and because of the link between nature of science and perceptions relating scientists, a lot of researchers have been interested in the opinions about scientists in educational research for a long time.
Mc Comas describes [1], The nature of science is composed of answers to the inquiries such as 'What is science, and in which way does it work?', 'Whom do we call scientist, and how do they study?', 'What is the effect of social and cultural contexts on science?'. Understanding the nature of science is the basic element of science literacy because, [2] the aim of science literacy is to provide individuals transferring scientific knowledge to their life and culture of their own society. Cases suggest that knowledge of the NOS advocates students in learning science content. For example, [1] Songer and Linn (1991) illustrated the importance of students having dynamic rather than static views of science in developing a conceptual understanding of topics such as thermodynamics. The static view of science is the idea that science is a group of facts that are best memorized. The dynamic view of science posits that scientific knowledge is tentative and the best way to understand this knowledge is by understanding what scientific ideas mean and how they are related.
Several methods have been used in order to capture students' images of a scientist. Likert-Scale items, word association test (WAT), draw-a-scientist test (DAST), interviews are some of

© 2012 HSci. ISBN 978-989-98032-0-6

these method. But when we analyze the studies, we can see there are stereotypical images of scientists among students of all ages and the images are commonly negative. As explicated through Schibeci [3], it is quite discouraging that scientists usually have an unfavorable and a negative image among the students at any school level. Moreover, Chambers found that not only students, but also teachers had negative images of scientists. Besides, teachers also held these stereotypical images of a scientist and the images had a tendency to affect their teaching in negative manner. Lederman (1996) states, common result of science education researches is students and teachers are not adequate understanding regarding to the nature of science. [2] The results are parallel with the educational researches in Turkey.

2. Purpose of the Study

The purpose of this research is to elicit the findings and evaluations of our study about the opinions of elementary science teacher candidates on the question of 'Who is called scientist?' for why, not only students, but also teachers come to classrooms holding their prior knowledge about science and scientist.

3. Problem

What are the visions of science teacher candidates towards the concept of "scientist"?

4. Method

The study is a qualitative one and the way of content analysis is used in the analyzing of data.

5. Data Collecting Tools and Analyzing of Data

134 volunteers from the last year students of Science Teaching Division of Necmettin Erbakan University participated in the study. Firstly, the participants are requested to write the names of scientists that come to their minds by using an open-ended questionnaire while collecting the data of the research. Next, a semi-structured interview concerning the questions 'Who is called scientist?", 'What are the features of a scientist in your mind?' was realized together with 79 volunteers out of 134.

6. Findings

6.1. Findings Relating to 'Write the Scientists Who Come to Your Mind' Test

6.1.1. In the test 'Write the Scientists Who Come to Your Mind' it is seen that while the frequency of the scientists dealing with the positive sciences is 687, of the scientists dealing with the human sciences is 170, of the scientists dealing with the ideal sciences is 114.

6.1.2. In the test 'Write the Scientists Who Come to Your Mind', Albert Einstein, Isaac Newton, Farabi and Ibn Sina (Avicenna) in order have the highest frequency among the scientists.

Table 1. *Popular Scientists*	**f**
Albert Einstein	108
Isaac Newton	83
Farabi	69
Avicenna	67
Al-Biruni	35
Archimedes	30
Charles Darwin	27
Gregory Mendel	26
Eric Ericson	26
Al-Harezmi	25
Aristotelian	25
Sigmund Freud	21
Omer Khayyam	21
John Dewey	19
Jean Piaget	18
Dalton	17
Thomas Edison	17
Blaise Pascal	16
Frederic Skinner	15
Mehmet Oz	12
Marie Curie	12

6.1.3. In the test 'Write the Scientists Who Come to Your Mind', when the periods that the scientists belong to have been examined, the scientists who lived in 10., 19., 11. and 18. Centuries A.D. in order and those who lived in 10. Century BC have the highest frequency among the scientists. The frequency of the scientists who belong to 21. Century has been found low. When the reason was interrogated, all of those who participated in the test specified that they could not follow the scientific developments of today sufficiently and so they had no opinion about the scientific studies of scientists living at the present time except for certain names.

© 2012 HSci. ISBN 978-989-98032-0-6

6.1.4. In the test 'Write the Scientists Who Come to Your Mind', it is seen that while the frequency of the male scientists is 1077, 20 has been found to be the frequency of the female scientists.

Table 1. *Female Scientists*	**f**
Marie Curie	12
Kathie Nunley	6
Rachel L.Carson	2

6.1.5. When the papers of 134 volunteers have been examined separately, it has been found that the total frequency of the philosophers is 96. Aristotle, whose frequency is 25; Mevlana, whose frequency is 53, Confucius, whose frequency is 18. Aristotle is not only philosopher, but also scientist. It is seen that 71 out of 134 volunteers who participated in the test have considered Sufi persons as scientists.

6.2. The Findings relating to the interview with the topic 'The Scientist in Your Vision'

6.2.1. Gender

While the gender of the scientists dreamed by 48 out of the 67 volunteers participating in the interview is male, the 19 have dreamed their gender as female. 37 female pre-service teachers have participated in the interview. 16 of them have clarified the scientist in their mind as female. As for 30 male pre-service teachers participating in the interview, they have clarified that the gender of the 3 scientists in their dream is female, the gender of other the 27 scientists in their dream is male. The findings obtained from this interview are seen to be parallel to the findings obtained from the test 'Write the Scientists Who Come to Your Mind'. When the volunteers have been interrogated about the factors determining the gender of the scientist that they dreamed, their answers and frequencies are as follows:

Table 3. *I have imagined a male scientist*

Because	**f**
The gender of the leading scientists who come into question is male.	**25**
In the books we read, the life stories and photographs of male scientists take place commonly; whereas the life stories and photographs of female scientists are seen rarely. In short, the exceptions do not disturb the rule.	**22**
Women should look after their babies and pay attention to their home and husbands.	**10**
The inventors of the matters invented are male scientists	**9**
The desire in the males for research and learning is higher.	**6**

Table 4. *I have imagined a female scientist*

Because	**f**
Females are more attentive; they do not overlook details.	**21**
Females are more creative.	**15**
The desire in the females for research and learning is higher.	**22**

6.2.2. Marital Status

45 of the 67 volunteers participating in the interview have clarified that the marital status of the scientist whom they have dreamed is single, 20 of them are married and 18 of them are divorced. When they have been interrogated about the factors determining the marital status of the scientists they have dreamed, the answers and frequencies are as follows:

Table 5. *Unmarried*

Unmarried	**f**
He/she has no time to marriage.	**27**
He/she cannot establish sound relations with others because of intensive studies.	**12**
The female scientist has not married for she cannot allow time for her husband and baby.	**6**

Table 6. *Married*

Married	**f**
The intension of the studies does not prevent the love.	**14**
The individual who realized himself/herself	**3**
He/she likes children	**3**

Table 7: Divorced

Divorced	**f**
He could not take care of his wife and child for he dedicated himself to knowledge. Therefore, he gave the guardianship of the child to its mother.	**7**
He could not take care of his husband and child for he dedicated himself to knowledge. Therefore, he gave the guardianship of the child to its husband.	**11**

When the findings relating to the gender and marital status of the scientist have been compared with one another, 11 of the 19 persons who clarified the gender of the scientist dreamed by them as female have opinions that a female scientist cannot be a fine spouse and a mother.

6.2.3. Social Life

While 33 of the pre-service teachers participating in the interview has clarified the scientists in their dream as asocial, the other 31 pre-service teachers clarified them as social. The factors and frequencies determining this qualification are as follows:

Table 8. *Social Life*

SL	Answers	f
Social	He/she must not break off the life to catch the problematic situations and to see whether the results obtained from his/her studies are positive or not.	**49**
Asocial	He/she does his/her studies/findings alone.	**26**
	For he/she studies much	**21**

If we analyze the Table 8, we can see, the preservice teachers consider the goal of the scientist to be social as an activity required to be done; that is, in their opinion a scientist cannot have an aim of being social to have a good time.

6.2.4. Mental Balance

39 out of the 67 volunteers participating in the interview have stated that the mental status of the scientist dreamed by them is unbalanced due to his/her intensive studies; the other 28 volunteers have stated that those men who cannot take reasonable decisions cannot do useful workings for humanity; therefore a scientist must have the mental balance.

6.2.5. Personal Care

While 33 out of the 67 volunteers participating in the interview have qualified the scientist dreamed by them as well-cared for the reason that a person neglecting him/herself cannot be useful for humanity; the other 34 volunteers have qualified the scientist dreamed by them as uncared for he/she can't allow time for him/herself because of his/her intensive studies.

6.2.6. The Place She/he Pursue His/her Studies

Laboratory, which frequency is 34; Nature, which frequency is 10; Studying Room at Home, which frequency is 6; Schools, which frequency is 2; Observation House, which frequency is 2; Library, which frequency is 1; Research Centre, which frequency is 2 and It can be everywhere, which frequency is 4 are the answers of Preservice teachers. But, we can say, laboratory is popular place.

6.2.7. The Physical Features of the Studying Medium

According to the answers of volunteers, 24 elementary science teacher candidates whose frequency is 24 expressed, the physical features of the studying medium must be a place there is no connection with the outer world because they must be asocial. Otherwise, he/she is disordered to be able to think more creative and he/she is disordered because he/she has to do the combination of jobs together.

Table 9. *Studying Medium*

Studying Medium	f
Furnished with the Latest Technology	**26**
There is no connection with the outer world	**24**
Silent	**19**

6.2.8. Findings Relating to the Studying Field

When the findings relating to the fields in which the scientists make researches have been examined, it is seen that the frequency of the positive sciences is 46, the frequency of the human sciences is 17, and the frequency of the ideal sciences is 4. The findings obtained from the interview seem parallel to the findings obtained from the test 'Write the Scientists Who Come to Your Mind'.

7. Results and Discussion

Understanding nature of science is an important matter for all levels in education. [4] Misconceptions about NOS regarding to what science is, how science works and the life and characteristics of scientists are damaging to general scientific literacy (Eccles, 2005; Tobias, 1990).

7.1. A Scientific Myth: Science is a Solitary Pursuit

This exoterically common misconception is the idea that science is a solitary pursuit. But there is a naked fact that many problems in science are too complex and this complexity doesn't give permission a solitary working. Out of this fact, as interpreted by Mc Comas [5], scientists work in research teams within a community of like-minded researchers.

7.2. Scientists Works at Only Laboratories

This is another misconception about scientists. The Elementary science teachers usually think, a scientist carry out her/his researches at laboratories but today, most investigators are working on problems from outside their laboratories.

7.3. The Lack of Importance is given to Understanding of Nature of Science at Education Systems

There are various advantages for the containment of the understanding NOS in the science education. [6] Driver, Leach, Miller and Scott (1996) have suggested five arguments supporting the inclusion of the NOS as a goal of science instruction that the understanding of NOS enhances learning of science content, understanding of science, interest in science, decision making in science related issues and science instructional delivery. Regarding to this advantages, Driver (1996) points out that understanding of the nature of science must be core matter in education systems. He says, if we carry out to improve scientific literacy; that is, increase the numbers of scientifically literate adults in society and thus to improve public understanding of science. Otherwise, Students will not go on to use their science understanding directly in their future careers and they will not be willing to carry out scientific researches.

Program for International Student Assessment (PISA) Exams' solutions support Driver's ideas. At PISA, there are six levels. Level 1 is accepted the lowest level. Level 2 is accepted basic capacity grade. Students who are at this level can display reading abilities which provide their active participation to the life. Students who are at level 5 can make critical assessments on knowledge and they can create hypothesis using special information. In the evaluation of PISA, countries which have parallel welfare level can display different exam solutions. But there is a clear-cut distinction between in the countries with low-income and high-income. In the countries with low-income, the ratio of students who can reach at level 5 is under the %1. When we compare the education systems of countries with low-income and high-income, science is the core subject in the countries with low-income but in the countries with high-income, understanding the nature of science matter is core subject. This finding underpins Driver's note: "In low-income countries, science is a priority subject but in technologically advanced countries, they have high-income, science provision of all students throughout their school career becoming the norm [7]."

7.4. The Negative Effects of Media and Books

As Driver (1996) clarified, misconceptions about nature of science come from expose to media images and books of science and scientists, from everyday experience of the technological products of scientific knowledge and from the using kinds of descriptions in everyday talk.

7.5. The Lack of History and Philosophy of Science (HPS) Instruction at Curriculum of Education Faculties

NOS embodies a wide variety of themes related to history, philosophy and sociology of science. [1] The phrase 'history and philosophy of science (HPS)' has been used to describe the interplay of disciplines that inform science education about the character of science itself. In spite of this fact, at education faculties in Turkey, the adequate instruction can't be given to the elementary science teacher candidates.

Matthews (1994) reports that in the United States, only the state of Florida requires to prospective science teachers to complete a course in the history and philosophy of science. The lesson is clear that preservice science teachers arrive with largely unexamined belief about the NOS and, too often, graduate with such beliefs unchallenged in their teacher education programs [1].

King (1991) investigated beginning teachers' knowledge of HPS. At the end of this research, the author determined that the lack of science teachers' background in the history and philosophy of science clearly influences the teaching of science [8].

7.6. Sufi Persons are considering as Scientists

The Elementary science teachers have considered Sufi persons as scientists. This is another misconception because 'Science' must have a special systematic and research area, and it must be developed. Sufi philosophy is a kind of human sciences, it makes mysticism research subject. For instance, it investigates history of mysticism. Scientists, their research area is Sufi philosophy, have a systematic evaluating system

 ISBN 978-989-98032-0-6

they don't use senses. They use both their reason and variant scientific inquiry methods. But Sufi Persons such as Mevlana, intend to reach God (Allah). He prefers right ascension by heart/soul to the reason. In consequence of this, Sufi Persons are not scientists.

8. Suggestions

The course entitled Nature of Science in the curriculum of the education faculties is not sufficient enough. The courses of Fundamental Philosophy, History of Science and Philosophy of Science should be given gradually from the firs education year.

9. References

[1] Mc Comas W.F. The Nature of Science (NOS)in Science Education; Rationales and Strategies. New York: Kluwer Academic Publishers; 2002: p 11-30

[2] Köseoğlu F, Tümay H, Budak E. New Understandings Related to Changing and Instruction of Paradigm About Nature of Science. Ankara: Journel of Gazi Education Faculty; 2008; 28 (2): 221-237.

[3] Schibeci R. Student images of scientists: What are they? Do they matter?. Teach Sci; 2006; 52: 12-16

[4] Olson J.K, Clough M, Bruxvoort C.N, Vanderlinden, D. Improving students' nature of science understanding through historical short stories in an introductory geology course. England: Eight International History, Philosophy, Sociology & Science Teaching Conference; 2005.

[5] Mc Comas W.F. The Principal Elements of the nature of science: Dispelling the myths. Netherland: Kluwer Academic Publishers; 1998: p 53-70

[6] Buaraphan, K. Thai inservice science teachers' conceptions of the nature of science. Journal of Science and mathematics Education in Southeast Asia 2009; 32 (2): p 189.

[7] Driver R. Young People's Images of science. England: Open University Press; 1996: p 9

[8] Lederman, N.G. Students and teachers conceptions of the nature of science. Journal of Research in Science Teaching; 1992; 29(4), p 854.

THE SEARCH FOR TOLERANCE IN DIVERSITY: A CLASSROOM APPLICATION

M.J. Barros[1,2], A. Santos Leite[1], I. Drumond[1], M. Matos[2], O. Pinto-Carnide[2], S. Pereira[3,4]

[1]*Oliveira Júnior Secondary School, S. João da Madeira, Portugal*
[2]*University of Trás-os Montes and Alto Douro, Portugal*
[3]*Faculty of Sciences, University of Porto, Portugal*
[4]*BioFIG, Center for Biodiversity and Integrative Genomics, Portugal*
mariajb8@gmail.com

Abstract. *The use of Al-tolerant cultivars contributes to increase crop productivity and future agricultural expansion onto acid soils. Rye is the most Al tolerant cereal species and tolerant genotypes constitute an important genetic resource.*
Laboratory activities were designed for students of different levels (7th to 12th grades) to assess aluminum tolerance of different rye cultivars Younger students determined soil acidity, using Hydrangea macrophylla as an acidity indicator. More advanced students planned methods for assessing the aluminum tolerance after a short exposure of seedlings to aluminum in hydroponic solution. They observed morphological root changes, the presence or absence of root regrowth finally classifying plants as tolerant or sensitive. Biochemical markers such as pigment quantification and proline content were quantified.

Keywords: aluminum tolerance, rye, science education, science and society.

1. Introduction

The biology curriculums of secondary education have experienced, in recent years, significant changes in the organization of the contents and topics related to the recent advances in molecular genetics and genetic engineering have been introduced. For students, most of these contents are substantially abstract and difficult to understand and grasp. So, it is crucial an approach involving them actively in the construction and development of knowledge. Laboratory activities, of investigative nature, are considered motivating strategies facilitating the teaching-learning process.
Galvão et al. (2002) [5] reported the importance of "student involvement in experiences where they can apply scientific knowledge and develop

skills of processual knowledge, and problem solving strategies which characterize investigations in science". Freire (2004) also emphasized the use of teaching and learning resources that enhance the investigative laboratory work and encourage the active involvement of students in the classroom, from passive listeners to actors, promoting the relationship between Science, Technology, Society and Environment.

This perspective of science education, defended nowadays, enhances the relationship between "the knowledge of students" and "the knowledge of science." Besides, it reinforces the learning through research in order to restructure the knowledge and make the appropriate conceptual change. On the other hand, it allows students to develop scientific skills, attitudinal and behavioral, essential for the correct interpretation of problems and making decisions. In this methodology experimental and laboratory work is implemented allowing students to contact with scientific and technical issues of social interest and prepare them for the exercise of responsible citizenship [1], [3].

According to Verissimo and Ribeiro, (2001), [9] and from the educational point of view, biology must be seen as fundamental in shaping the general citizen, since the freedom to take informed decisions depends on the degree of biological literacy.

The active participation of students in the experimental work requires a series of steps. One of the most complete models of problem-solving, called "problem-solving chain", was proposed and used by the "Assessment of Performance Unit" (APU) in England (DES, 1984). The phases considered, according to this model include: problem recognition; transformation of the problem, planning and design of experiments; practical implementation of experimentation and evaluation. To Hodson (1992) [6], the first three stages correspond to the "thinking part" of an experimental investigation and are crucial to the achievement of the experimental work. The experimental work involves the direct participation of the student because the "hands-on" is important to increase the scientific literacy of students. So, the laboratory activities should be a priority in our schools. This strategy/methodology of work is encouraged by several national ("Ciência Viva") or International (The European Learning Laboratory for the Life Sciences) institutions with very positive and encouraging results. European programs also encourage initiatives which will implement inquiry-based science education (IBSE) bringing together research scientists and science and teachers for the development of innovative science education initiatives that introduce real scientific experience in the classroom.

The research presented here was developed in the framework of nationwide education projects in two consecutive academic years with the participation of students from different levels and taking advantage of the knowledge and technical expertise of recognized life science academic and research institutions (University of Trás-os-Montes e Alto Douro and University of Porto). The student's participation in nationwide projects is a strategy that is considered relevant to increase the scientific literacy and the responsibility of work that may be considered of interest for scientific community.

The problematic of the toxic effects of aluminum (in soluble form, such as Al^{3+}) was presented to the students in the context of the classroom and fitted in the respective programmatic content. In the area of geology the students had the opportunity to relate the lithological composition with soil formation and correlate the acidity of soils with aluminum toxicity. The students were confronted with several issues: the influence of the changes occurring in soil in the plant development; different plant responses to aluminum toxicity; the emerging need for arable and producible land to fight the world hunger; and how science can answer these questions and how to proceed.

Some topics that were considered important for the students in relation to this project were developed in the classroom. In the 8th grade, the concepts of the biotic and abiotic components of ecosystems and the interrelationships that are established between the abiotic environment and living beings were studied. In the 11th and 12th grade attention was drawn to themes like plant nutrition, plant anatomy, transport systems, DNA replication, and mechanisms of translation and transcription.

The active participation of the students in the entire process, from the reflection and the awareness of the problem, through the experimental setup and the assembling of the materials and resources needed to an experimental run, demonstrates the important

 ISBN 978-989-98032-0-6

role that this type of education has in process learning.

2. Material and methods

This project started in the academic year 2010/2011 with the organization and inventory of supplies/reagents and equipment within the school. This activity, involving students in 12th grade, allowed them to contact with material and equipment, verify their functioning and proper handling. Safety rules were elaborated relating to the physical space and the handling of different materials and reagents. Even within this activity, students were responsible for checking the materials/reagents and equipment required for implementation of the different project activities as well as costs and potential suppliers.

Figure 1. *Construction and preparation of structures used for hydroponic crop culture*

From the several materials required, students had to design and construct stand out structures to place the seeds in the selected treatments (with and without aluminum) and structures for installing the hydroponic culture. The former was designed and built by one of the working groups. For the second structure students adapted a school aquarium (Fig.1). The subsequent activity was performed by the students of 12th grade and consisted, initially in: placing seeds in structures suitable for hydroponic culture; preparing the nutrient solutions used in hydroponics (with and without 5 ppm aluminum); controlling and adjusting the pH of the solutions to 4; controlling the temperature (25 °C) and the photoperiod (16 hours light) of hydroponic crop. In a second stage, this group of students proceeded to staining the roots with hematoxylin for evaluation of the behavior of these plants to aluminum, following the protocol of Sasaki et al. (1997) [8] described by Yamamoto et al. (2001)[10]. After staining, all the seedlings were placed again in a new nutrient solution without aluminum for two days to evaluate the recovery factor of the seedling stress through root regrowth (Fig.2).

The project developed in second year was the continuation of the previous project. The activities included in the project were divided into three areas and they were conducted by students of different levels considering the appropriateness of the content to the level of education.

The activities related to collecting the soil and laboratory analysis of physical and chemical properties of soil samples were developed by students of the 8th grade. Students designed an experiment to determine the soil acidity, using *Hydrangea macrophylla* where the flower color can be related with soils acidity as a pH indicator. These activities fall under the programmatic topics, "Ecosystem Dynamics" and "Sustainable Resource Management."

The theme developed by students of the 11th grade was related to content taught at the 10th grade, through the integrated units of the discipline of biology, "Getting matter by autotrophic" and "Distribution of matter - Transport in Plants" and with content taught at 11th grade in the unit "How to explain the great diversity of living things in nature?".

Finally, this study was also integrated in the program unit "geologic materials and processes important in earth environments." in the discipline of geology.

The activities of this class included: growth of plants in hydroponic solution with and without aluminum (5 ppm); marking the root apices of the plants subjected to treatment with aluminum with "nail polish" and "marker waterproof"; analysis of possible changes caused by aluminum in the internal and external morphology and

© 2012 HSci. ISBN 978-989-98032-0-6

evaluation of biochemical markers used to access different plant responses to aluminum toxicity, such as photosynthetic pigment quantification and proline content.

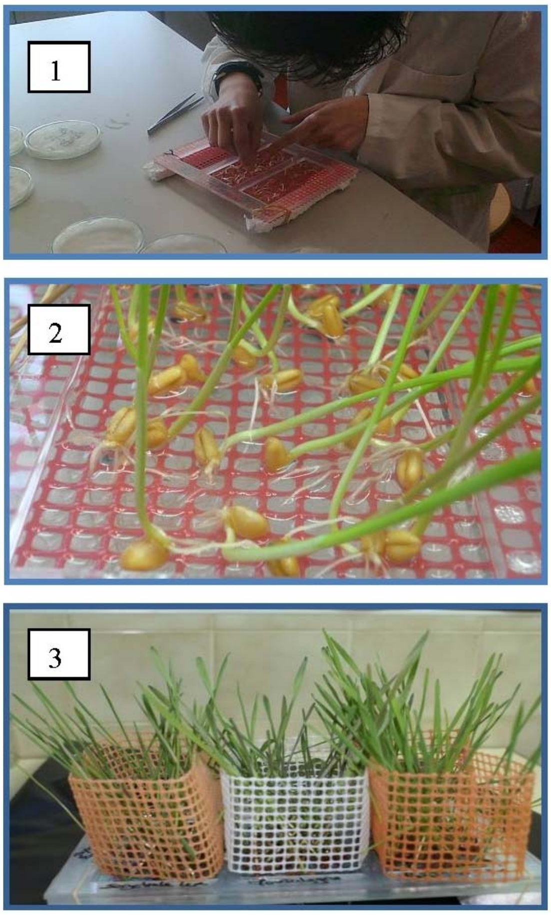


Figure 2. *Stages of germination and seedling development: 1. Germination 2. Placing germinated seeds on structures that will be introduced in hydroponic cultures with and without aluminum; 3. Development of seedlings in nutrient solutions with and without aluminum*

The seedling root tips were marked with varnish and marker after two days in nutrient solution with aluminum. Marks were placed in the approximately 20 mm distal region of the root at 5 mm intervals. After labeling, plants were again placed in a new nutrient solution without aluminum, for 4 days. At this time, morphological root changes were observed and recorded and plants were classified as tolerant or sensitive according respectively to the presence or absence of root regrowth as ascertained by the differences in the distance between the marks.
For the analysis of external morphology and internal anatomy root and leaf sections were fixed by the students and the histological staining with toluidine blue and definitive mounting on slides performed in UTAD. For analysis and photographic record of external morphology and internal anatomy students used the imaging software "Motic Images Plus."
The extraction of chlorophylls and carotenoids was performed by students of the 11th grade according to the protocol of Lichtenthaler, (1987)[7]. Pigments were extracted from leaves of the plants subjected to treatment with aluminum and leaves of the plants without treatment. Free proline content was measured according to the Bates method [2].
Wheat (*Triticum* spp) and different rye (*Secale cereale*) varieties were selected considering the respective behavior in aluminum, previously analyzed. The seeds were provided by UTAD corresponding to Riodeva (rye inbred line – sensitive), Montalegre (tolerant), Beira (tolerant).

3. Results and Discussion

This research was conducted over two consecutive school years and the results were analyzed and interpreted by the students of 12th and 11th grade. The plant response to this stress factor is evidenced, as described, by morphological and anatomical changes, which include destruction of the root apex, inhibition of root growth and changes in the internal morphology.
The first analysis was performed on the results of germination. From the 20 seeds of each variety used the variety that originated fewer plants was the rye Riodeva while the rye Montalegre showed the highest germination rate (Fig.3). The methodology used for the evaluation of aluminum tolerance was easy to perform by providing indications of plant behavior in the presence of this metal. A simple method was designed for labeling the root tips using varnish and marker pen which provided useful indications about the behavior of these plants to aluminum that deserve further confirmation of the results. The evaluation of root regrowth, after temporary exposure to aluminum, allowed us to conclude that the 'Beira' has the greatest percentage of root regrowth and is, therefore, considered the most tolerant variety. In contrast, 'Riodeva' showed no root regrowth confirming the sensitive behavior of this line (Fig.4). The results obtained with the different laboratory activities are in agreement with experimental results of research in this area and that are described in the literature.

© 2012 HSci. ISBN 978-989-98032-0-6

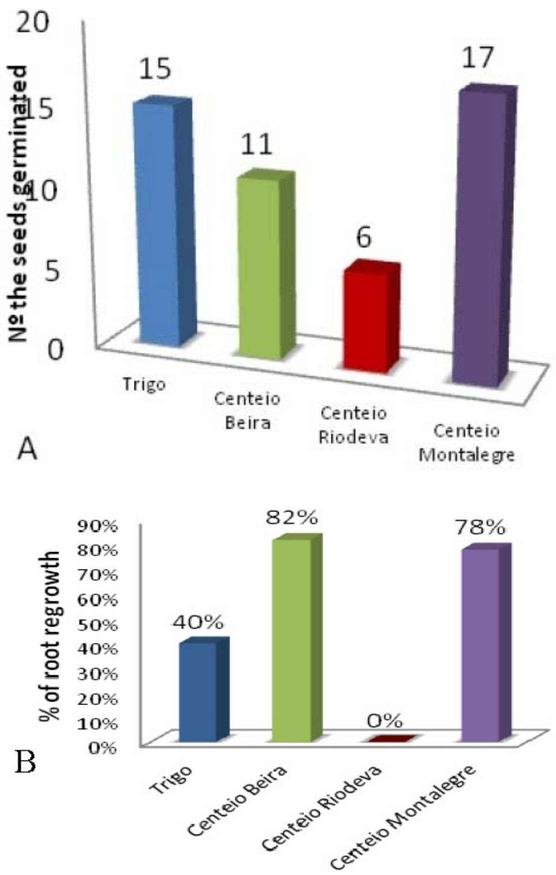


Figure 3. *Germination of seed of varieties used (A) and percentage of root regrowth obtained after exposure to 5 ppm aluminum for 2 days (B)*

Figure 4. *The marking of the root apex, with the varnish and the marker, distinguishes sensitive plants (inhibition of root growth) than tolerant (with recovery of root growth)*

Root and leaf sections were prepared for definitive mounting on slides for microscopic observation. For the observation of root anatomy only the varieties of rye with comparable results were considered. Changes in the organization of the central cylinder and differences in the thickening of endoderm were recorded. For the study, each working group, made the observation of three slides per variety and per treatment. The plants subjected to aluminum evidenced, in general, a disrupted central cylinder and a thicker endoderm layer with larger cells when compared to the same variety not subjected to treatment (Fig.5).

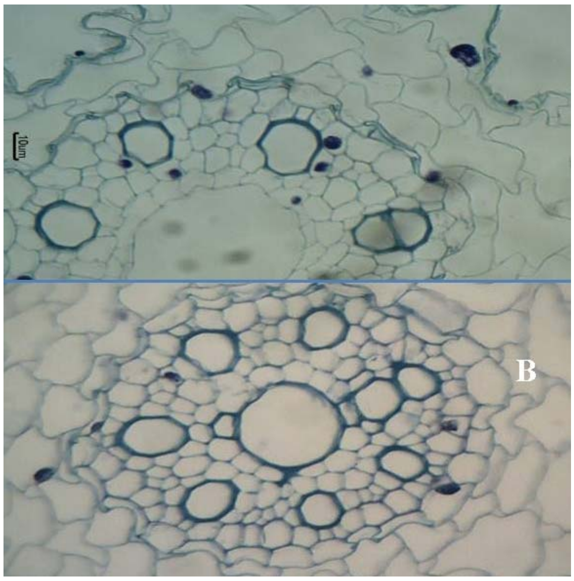


Figure 5. *Root of Montalegre rye: no aluminum (A) and with aluminum (B)*

Leaf sections were also studied since they provide indications of changes resulting from exposure to aluminum. As with the roots, each workgroup observed three blades per variety per treatment. The results allowed to conclude that, overall, leaves subjected to treatment with aluminum were thinner, had more intercellular spaces in the mesophyll and chloroplasts were less dispersed (Fig.6).

The biochemical analysis using some biomarkers of stress, such as photosynthetic pigments, allowed us to conclude that the varieties of ryes used have different answers considering their behavior to aluminum. Thus, in Riodeva rye, which presents a sensitive behavior to aluminum treatment, the content of Cla + Clb decreased while in the Montalegre and Beira ryes the chlorophyll content increased slightly, although the difference is more significant in Montalegre rye(Fig.7). The chlorophyll degradation can be associated with changes in the photosynthetic process as a result of exposure to the stress factor.

© 2012 HSci. ISBN 978-989-98032-0-6

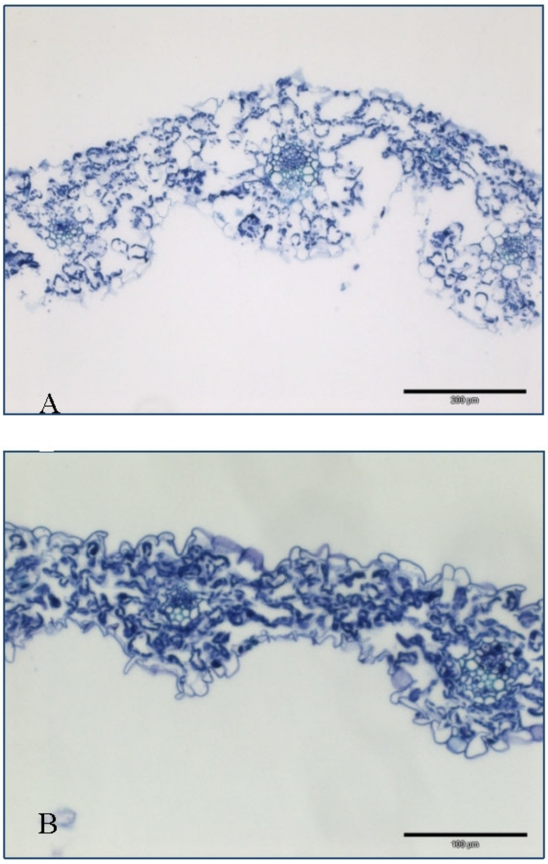


Figure 6. *Rye leaves Riodeva to 0 ppm (A) and 5 ppm of aluminum (B)*

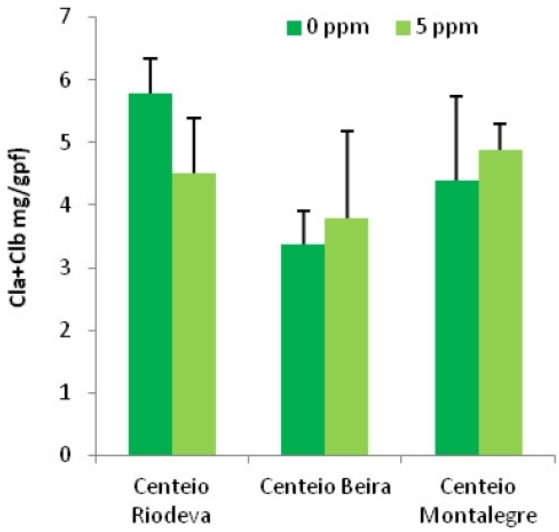


Figure 7. *The quantification of chlorophylls revealed that the plants more susceptible to aluminum (Riodeva rye) show degradation of these pigments indicating changes in the photosynthetic process.*

± DP (n=3)

Regarding carotenoids, that have an antioxidant role, is verified that only the behavior more tolerant varieties, the Montalegre and Beira ryes show an increasing in the concentration of carotenoids when they are exposed to aluminum (Fig.8). This may indicate an activation of antioxidant defenses as a protective mechanism of the plant and, therefore, the response of these plants to aluminum is more effective than the variety of Riodeva. The results are consitentes with the evaluation of the free proline content (Fig.9).

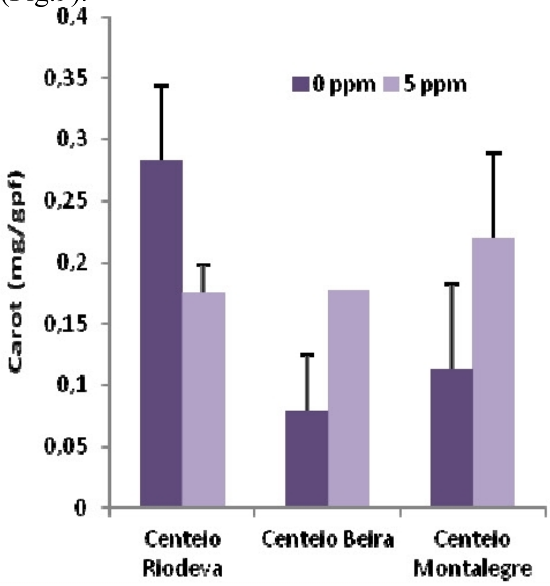


Figure 8. *Quantification of carotenoid pigments with antioxidant role, showed that plants tolerant aluminum (Montalegre and Beira ryes) present the most effective antioxidant system because they respond to stress with increasing these pigments. Values correspond to average ± SD (n=3)*

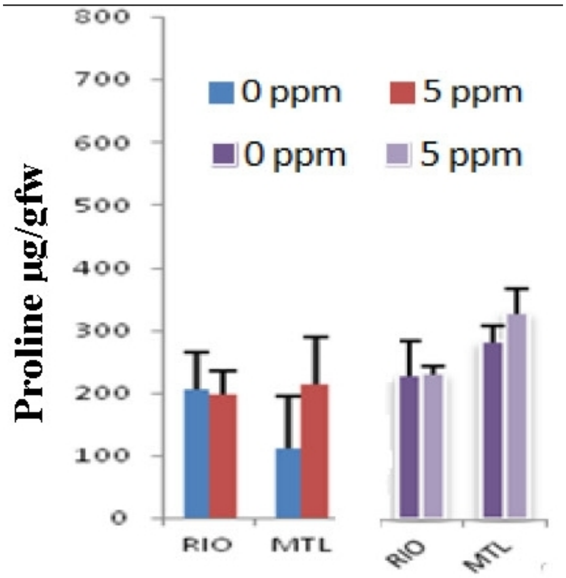


Figure 9. *Free proline content in leaves (A) and roots (B) in two rye varieties, in the absence (0 ppm) and in the presence of Al (5 ppm). Values correspond to average ± SD (n=3)*

 ISBN 978-989-98032-0-6

Proline is an osmoprotective aminoacid and its accumulation under various abiotic stresses in important crop plants is considered as a tolerance mechanism. Proline estimation in leaves and roots revealed that free proline content in leaves and roots increased significantly in tolerant rye variety Montalegre.

.Finally, the results obtained from the analysis of the pH of the three different types of soils, performed by students of grade 8 showed, as expected, that the soil of the blue hydrangea was the most acidic of the three soils tested. The hydrangea was used as an indicator of the pH of soil samples collected. These soils were used for the growth hydrangeas and, in the school year 2011/2012, were used to effectuate these mentioned soils analyzes. The soil A, collected from an area of the school zone, was the one that showed less acidic characteristics (Table I). Rye varieties were planted in these three soils with the aim of analyzing their respective development, over time.

	Soil of the blue flower	Soil of pink flower			Soil A			
	Sample	Sample 1	Sample 2	Mean	Sample 1	Sample 2	Sample 3	Mean
pH in H_2O	4.33	5,44	5,2	5,32	5,84	5,92	5,9	5,89
pH in $CaCl_2$	4,1	4,85	_	4,85	5,34	5,33	_	5,34
pH in KCl	3,98	4,67	_	4,67	5,29	5,26	_	5,28

Table I. *Results of the analysis of the pH of three soils*

The plant breeding through selection of genotypes more favorable to certain environmental conditions may be the answer to some of the world's current problems. This project has enabled the perception of students for this reality and the importance of science in response to questions like this. The school curricula emphasize the importance of relationships between Science, Technology and Society. However, this goal is not always achieved. One way to achieve this goal is to transport and apply research to real classroom facilitating the perception from students the importance of these relationships. Partnerships between universities, research centers and high schools allowed us to create the necessary conditions for the experimental teaching.

These activities develop students critical thinking and promote advanced cognitive abilities; allowed contact with advanced scientific activity, combined with activities that are feasible in laboratory school; allowed contact with original scientific articles that allowed the critical analysis of scientific results as well as understand the "peer-review "and the concept of collective construction of science.

In these projects it should be emphasized: the reuse of materials, constructed by students as containers used for hydroponic crop; using simple and inexpensive materials for the evaluation of aluminum tolerance as varnish and marker. In this aspect the students had to consider the use of water resistant materials that allowed the clear assessment of root growth and recovery of plants subjected to aluminum action; and understand the usefulness of these procedures in the characterization of genotypes suited to the selected soils.

At last, in terms of learning, students showed an improvement in the cognitive performance and in the interpersonal relationships.

4. References

[1] Aikenhead, G. Renegotiating the culture of school science. *In* R. MILLAR, J. LEACH & J. OSBORNE (eds). Improving Science Education – the contribution of research. Buckingham: Open University Press, 245-264, 2000.

[2] Bates LS, Waldren RP & Teare ID. Rapid determination of free proline for water-stress studies. Plant and Soil **39**, 205-207, 1973.

[3] Fensham, P., Law, N., Li, S. & Wei, B. Public understanding of science as basic literacy. In R. T. Cross & P. J. Fensham (Eds.), Science and the citizen for educators and the public (pp.145-155).Melbourne: Arena Publications. 2000.

[4] Freire, A. M. Mudança de concepções de ensino dos professores num processo de reforma curricular. In ME-DEB (Coord.), Flexibilidade curricular, cidadania e comunicação (265-280). Lisboa: Departamento da Educação Básica. 2004

[5] Galvão, C. O ensino das Ciências Físicas e Naturais no contexto da reorganização curricular. Boletim da APPBG, 17, 7-15. 2002.

[6] Hodson, D. Redefining and reorienting practical work in school science. School Science Review, 73(264), 65-78. 1992

[7] Lichtenthaler, HK. Chlorophylls and Carotenoids pigments of photosynthetic

 ISBN 978-989-98032-0-6

biomembranes. Methods Enzymol. 149:350-382. 1987.

[8] Sasaki, H., Hui, C. C., Nakafuku, M. and Kondoh, H. A binding site for Gli proteins is essential for HNF-3β floor plate enhancer activity in transgenics and can respond to Shh in vitro. Development 124, 1313-1322. 1997.

[9] Veríssimo, A. & Ribeiro R. (2000). Os Conceitos de Trabalho Prático e Experimental na Educação em Ciências - uma visão oriunda da Biologia. In Sequeira M. et al. (Orgs).Trabalho prático e experimental na educação em ciências. Braga: Universidade do Minho, 139-142. Verissimo e Ribeiro. 2001.

[10] Yamamoto Y, Kobayashi Y, Matsumoto H.. Lipid peroxidation is an early symptom triggered by aluminum, but not the primary cause of elongations inhibition in pea roots. *Plant Physiol* 125:199-208. 2001.

EXAMINING OF THE PREDICTORS OF PROSPECTIVE TEACHERS' PERCEPTIONS OF THE QUALITY OF THE SCIENCE FAIR PROJECTS

H.S. Tortop

Bulent Ecevit University, Eregli Faculty of Education, Science Education Department, 67300, Zonguldak, Turkey

hasansaid@yahoo.com

Abstract. *Science fairs allow students to present their projects generally evaluated or judged based on certain criteria. In science fairs, the best of projects is praised. Students conduct scientific research and pass enjoyable time at science fairs. The quality of science fair project evaluation affects students' emotions. Perspectives of the teachers, who are project mentors on project phenomenon, are important for the achievement of the goals of science fairs. This study aimed at examining the predictors of quality of science fair projects in the light of prospective teachers' evaluation of science fair rubric' domains.*

In this study, thirty projects were determined for evaluation by preservice teachers. These projects were selected by judges in Isparta city for the Antalya District Exhibition of "Science and Mathematics Project Study for Primary School Students: This is My Work" (web address: http://tegm.meb.gov.tr/bubenimeserim/) for the academic year of 2009-2010. The researcher was also a mentor in this science fair. The science fair projects were evaluated by thirty prospective teachers who took the Projects Based Learning Applications course at Bülent Ecevit University Ereğli Faculty of Education in the Fall Term of the academic year of 2011-2012. The prospective teachers evaluated the projects according to the criteria of the project guide. The data obtained were analyzed with regression analysis and descriptive statistics.

The results of study revealed that the lowest mean scores of the domain of science fair rubric was the method domain ($\bar{X}$=1.35), and the highest mean scores of the domain of science fair rubric was the utility domain ($\bar{X}$=1.64) according to the results of the descriptive statistics. In addition, the model of the regression formula was that; Overall Scores of Science Fair Rubric= 1.165 (constant) +.251(Assimilation and Comprehension Domain) + .250(Conclusion and Clarity Domain) + .225(Originality and Creativity Domain) + .221(Applicability and Usefulness Domain) + .205(Utility for Economical and Social Domain) + .192(Used Scientific Method Domain) + .184(Consistency Domain). Surprisingly, the methods domain was one of the lowest predictors of overall scores of the science fair rubric. However, it is known that the method section is one of the important *sections of scientific studies. Besides, the scientific method section indicates whether scientific studies are understood by students or not. Therefore, teachers should pay more attention to fulfill scientific research methods in terms of serving the educational goals of the science fairs.*

Keywords: Science Fair, Judgment, Scientific Research Methods, Regression.

1. Introduction

1960s was a period when science education gained importance and when the policies of training scientists were on the agenda. It is seen that science programs changed in many developed and developing countries [1-4]. In that period, Turkey was also among those countries that were influenced by this change [5-6]. In addition, it was seen in that period that students learnt to behave like scientists and that project competitions (science fairs) which allowed students to act like a scientist were commonly applied. In Turkey, such attempts were made at high school level with the help of The Scientific and Technological Research Council of Turkey (STRCT) in 1968 [7]. Today, it is seen that a number of countries have revised their science programs to train individuals equipped with the 21st century skills. Turkey changed the elementary school curriculum of the science and technology course in line with the constructivist approach in 2005. The purpose of the new science program regarding was to train individuals who can research, interrogate, examine, associate science subjects with daily life and use scientific methods to solve the problems in every field of life and who know how to view the world from the perspective of a scientist [8]. In Turkey, the Secondary School Students' Project Competitions have been organized by STRCT and MNE (Ministry of National Education) for a long time. In addition, a similar competition named Science and Mathematics Project Work for Elementary School Students has also been conducted at elementary school level with the cooperation of STRCT and MNE since the academic year of 2005-2006 [9, 7]. Science fairs, which have become a tradition in developed countries, are exhibitions open to public in which students present their works. In general, in these science fairs, juries make evaluations, and students are awarded [10-12]. A science fair regarded as a celebration by Abernathy and Vineyard (2001) is defined as a place in which students share their studies with their friends, teachers, parents, scientists and other people in the society and make interpretations regarding their experiences. The primary purpose of science fairs is to help students understand and use scientific methods while designing and conducting experiments so that they can achieve their school program [12]. Besides such benefits of science fairs as teaching students new things, spending enjoyable time, developing their research skills and helping them think critically and develop positive attitudes towards science, these science fairs also cause students to feel worried and stressed at the end of the competition and increase their anxiety level [10-20]. In the competition of 'This is My Work' and in other similar project competitions, the purpose is to have young brains think and make observations, to encourage them to wonder and research and to help them reveal their potentials. In addition, it is an important result that the idea behind the project belongs totally to the student(s) [9,7]. The criteria for the evaluation of the works in these competitions are stated in competition guides. Although there seems to be much diversity in the evaluation of the works in provincial, regional and final exhibitions, it is generally stated by juries that the following criteria should be taken into consideration during evaluation: STRCT Evaluation Criteria 2009-2010 Project Guide, originality and creativity, the scientific method used, consistency and contribution, utility (economic, social academic, …), applicability or usefulness, literature review, conclusion and clarity, assimilation and mastery and obeying the safety warnings. There are a number of studies which emphasize the importance of the jury's evaluation in project competitions and which point out that the projects developed should belong to the students. These are quite important for the quality of the competitions and for students' development [21-23]. In this respect, the evaluation of projects is fairly important. Such questions as "according to which dimension of the evaluation criteria are some projects developed by students considered to be better than those developed by other students?" or "to which aspects of the projects do the juries evaluating them give more importance in the evaluation process?" occupy the minds of students participating in project competitions as well as of their supervisors. This study examined to what extent the criteria in the evaluation scale determined by STRCT in the Science and Mathematics Project Work for Elementary

© 2012 HSci. ISBN 978-989-98032-0-6

School Students also known as ‘This is My Work’ started in elementary school level in Turkey in the academic year of 2005-2006 predict the total score in the evaluation. For this purpose, the following research questions were directed:

- To what extent do the criteria in the evaluation scale in the project competition of ‘This is My Work’ predict the total score given in the evaluation process by the preservice teachers?
- What is the order of importance of the criteria in the evaluation scale in the project competition of ‘This is My Work’ according to the preservice teachers?

2. Method

This study was based on a correlation research design [24]. Relation of prospective teachers' perception of quality (high, medium, low) between primary school students’ scores of projects according to TUBITAK Rubrics. The dependent variable was the perception of quality (high, medium, low), and the independent variable was the score each prospective teachers gave for each project in each domain [25].

2.1. Procedure

In this study, thirty projects were determined for evaluation by prospective teachers. These projects were selected by judges in Isparta city for the Antalya District Exhibition of “Science and Mathematics Project Study for Primary School Students: This is My Work” Science Fair (web address: http://tegm.meb.gov.tr/bubenimeserim/) in the academic year of 2009-2010. Project Work Calendar as follows (See Table 1). The researcher was also a mentor this science fair. The science fair projects were evaluated by thirty prospective teachers who took the Projects Based Learning Applications course at Bülent Ecevit University Ereğli Faculty of Education in the Fall Term of the academic year of 2011-2012. The prospective teachers assessed the projects according to the criteria of the project guide [26]. The teacher candidates assigned such scores to the dimensions determined in the evaluation scale as 1 inefficient, 2 efficient and 3 very efficient. For the data obtained, regression analysis and descriptive statistics were applied.

3. Results

In the study conducted, 30 projects admitted to the regional exhibition were evaluated by 30 teacher candidates. In this evaluation, the criteria determined by STRCT were taken into consideration [26]. Among these criteria, “taking safety measures” and “giving reference” were not included in the analyses as all the 30 projects had common deficiencies in these dimensions. The results of the regression analysis regarding the prediction of the total scores in the project evaluation are presented in the Table 3 and Table 4.

When the paired and partial correlations between the predictive variables and the dependent variable (total score) were examined, it was seen that the highest relationship occurred between the Total Score and the Dimension of Consistency (r=.644); however, when the other variables were examined, the correlation between the two variables was found to be r=.525. The variables that had high level of relationship with the total score were Consistency (r=.644), Assimilation (r=.641), Applicability (r=,614), Conclusion (.607), utility (r=.576), Originality (r=.573) and Method (.502), respectively. The Project Evaluation Form, with its all the sub-dimensions, revealed a high level of significant relationship (R=,930, R^2=0929, p<.001). All the dimensions explained approximately 93% of the total variance in the total evaluation score. According to the standardized regression coefficient (β), the relative order of importance of the total evaluation score for the predictive variables was as follows: Assimilation (.263), Conclusion (.263), Applicability (.229), Originality (.220), Utility (.201), Consistency (.194) and Method (.187). When the results of the t-test regarding the significance of the regression coefficients were examined, all the dimensions were found to be significant predictors. Below is the mathematical model for the regression equation regarding the prediction of the total scores of the Project Evaluation Scale.

Project Evaluation Scale Score = 1.204 + .263[Assimilation] + .263[Conclusion] + .229[Applicability] + .220[Originality] + .201[Utility] + .194[Consistency] + .187[Method]

As can be seen, the least predictive dimension in the evaluation of the projects was the dimension of “Method”, and the most predictive dimensions

© 2012 HSci. ISBN 978-989-98032-0-6

were "Assimilation" and "Conclusion". In addition, further analysis was conducted with the stepwise method, one of regression analysis methods. The results obtained are presented in Table 2.

Table 1. *Project Work Calendar* [26]

Project Work Calendar for This is My Work	Date	Activities Conducted
Making applications to the Project	24 September, 2009 - 29 January, 2010	Students complete their projects between these dates and share their project information via the Internet.
Evaluation of the Projects by the Provincial Work Groups on Provincial Basis	01-19 February, 2010	Provincial Work Groups make preliminary evaluations of the project applications and conduct the approval process according to the criteria determined via the Internet.
Evaluation of the Projects on Regional Basis	22-26 February, 2010	Regional Work Groups evaluate the projects approved by the provincial work groups via the Internet.
Evaluation of the Projects by the Regional Science Committee	01-22 March, 2010	Regional Science Committees established in the regional centers by STRCT evaluate the projects taking the documents into consideration and determine the ones that will be admitted to the regional exhibition.
Organizing the Regional exhibitions and Determining the Projects for the Final Exhibition	13-14 April, 2010	The regional exhibitions are organized in the regional centers. During the exhibitions, the Regional Science Committee Members appointed by STRCT hold interviews with the students who have developed the projects and examine and evaluate the projects.
Organizing the Final Exhibition in Ankara	11-12 May, 2010	For the students' projects chosen from the regions to send to Ankara, a final exhibition is organized.
Award Ceremony	13 May, 2010	At the ceremony to be organized at the end of the final exhibition, students and their supervisor teachers are awarded and given a "certificate of achievement", and their schools are given a "plaquet".

Table 2. *Descriptive Statistics of Rubric*

	Mean	Std. Deviation	N
Total Score	13,2333	2,9431	900
Orginality	1,6089	,6331	900
Methods	1,3533	,4965	900
Consistency	1,4589	,5183	900
Utility	1,6489	,5976	900
Applicability	1,4844	,5668	900
Clearness	1,4656	,5459	900
Assimilation	1,4567	,5453	900

© 2012 HSci. ISBN 978-989-98032-0-6

Table 3. *Multiple Linear Regression Summary predicting Overall Quality (STRCT) with Domains*

	Unstandardized Coefficients		Standardized Coefficients			Correlations	
Model 1	B	Std. Error $_B$	β	t	sig	Zero Order r	Partial r
Constant	1,165	,124		9,359	,000		
Orginality	1,048	,050	,225	21,059	,000	,573	,576
Methods	1,137	,061	,192	18,622	,000	,502	,529
Consistency	1,046	,065	,184	16,167	,000	,644	,476
Utility	1,012	,055	,205	18,548	,000	,576	,528
Applicability	1,147	,058	,221	19,611	,000	,614	,549
Clearness	1,347	,061	,250	22,229	,000	,642	,597
Assimilation	1,355	,060	,251	22,621	,000	,641	,604
R=,919 R^2=0919 $F_{(7-892)}$=1454,178 p=,000							

Dependent Variable: Total Score
Predictors: (Constant), Originality, Methods, Consistency, Utility, Applicability, Clearness, Assimilation.

Table 4a. *Stepwise Regression Analysis*

Models		B	Std. Error $_B$	β	t	Sig.
Model[a]	Constant	7,895	,224		35,192	,000
	Consistency	3,659	,145	,644	25,252	,000
Model[b]	Constant	5,464	,213		25,693	,000
	Consistency	2,746	,124	,483	22,080	,000
	Assimilation	2,584	,118	,479	21,861	,000
Model[c]	Constant	4,010	,192		20,913	,000
	Consistency	2,064	,109	,363	18,908	,000
	Assimilation	2,296	,100	,425	23,066	,000
	Applicability	1,931	,097	,372	19,878	,000
Model[d]	Constant	3,264	,166		19,646	,000
	Consistency	1,772	,093	,312	19,016	,000
	Assimilation	1,831	,087	,339	20,971	,000
	Applicability	1,756	,082	,338	21,327	,000
	Clearness	1,430	,075	,307	19,190	,000
Model[e]	Constant	2,450	,143		17,114	,000
	Consistency	1,356	,080	,239	16,998	,000
	Assimilation	1,589	,073	,294	21,716	,000
	Applicability	1,587	,069	,306	23,136	,000
	Clearness	1,438	,062	,309	23,324	,000
	Orginality	1,250	,061	,269	20,342	,000
Model[f]	Constant	1,764	,133		13,227	,000
	Consistency	1,271	,071	,224	18,015	,000
	Assimilation	1,455	,065	,270	22,353	,000
	Applicability	1,566	,061	,302	25,865	,000
	Clearness	1,309	,055	,281	23,797	,000
	Orginality	1,099	,055	,236	19,969	,000
	Methods	1,085	,068	,183	15,981	,000
Model[g]	Constant	1,204	,116			,000
	Consistency	1,103	,060	,194	18,440	,000
	Assimilation	1,421	,055	,263	25,997	,000
	Applicability	1,190	,054	,229	21,894	,000
	Clearness	1,227	,046	,263	26,477	,000
	Originality	1,021	,046	,220	22,036	,000
	Methods	1,108	,057	,187	19,433	,000
	Utility	,988	,051	,201	19,408	,000

Table 4. *Explained Variance for Models*

Models	R	R^2
Model[a]	,644	,415
Model[b]	,786	,618
Model[c]	,857	,735
Model[d]	,901	,812
Model[e]	,934	,872
Model[f]	,949	,900
Model[g]	,964	,930

4. Discussion and Conclusion

In the study, the lowest mean scores of the domain of science fair rubric was *the Method domain* ($\bar{X}$=1.35), and the highest mean scores of the domain of the science fair rubric was *the Utility domain* ($\bar{X}$=1.64) according to the results of the descriptive statistics. In addition, the model of regression formula was that; Overall Scores of Science Fair Rubric= 1.165 (constant) +.251(Assimilation and Comprehension Domain) + .250(Conclusion and Clarity Domain) + .225(Originality and Creativity Domain) + .221(Applicability and Usefulness Domain) + .205(Utility for Economical and Social Domain) + .192(Used Scientific Method Domain) + .184(Consistency Domain). Surprisingly, *the Methods domain* was one of the lowest predictors of the overall scores of the science fair rubric.

However, Potter (2009) found out that “the students' mean scores in the domains of Method and Analysis did predict the students' mean Quality scores”. In this respect, the results obtained in the present study are parallel to those of the study carried out by Potter (2009). Potter (2009) reported that the dimensions of Method and Analysis were the best predictors for the project scale developed by the researcher. However, depending on this situation, the researcher stated that students and supervisor teachers in project competitions should not ignore the importance of the other dimensions of the scale. According to Potter (2009), juries evaluating the dimensions of Method and Analysis, which are the best predictors of the overall score, should focus on evaluating these dimensions due to their limited time. These findings obtained via the results of teacher candidates’ evaluations of the projects are quite striking. The “scientific method” that students used while preparing their projects least predicted the overall score. In fact, this indicates which features of projects teacher candidates take into consideration while evaluating the projects. The new science program (MNE; 2012) aims at helping students acquire the ability to conduct scientific research. Science teachers should train students who know the scientific methods necessary to conduct scientific research. It is important that project competitions serve this purpose. The necessary precautions should be taken to help teacher candidates to view projects and project competitions from this perspective.

5. References

[1] McGee, S. M., (1996). Submitted to The Graduate School in Partial Fulfillment of The Requirements. Northwestern University, İllinois, Unpublished Doctoral Dissertation.

[2] Breederman, T.,(1983). Effects of Activity-Based Elementary Science on Student Outcomes: a Quantitative Synthesis” .Review of Educational Research. 53,(4), 499-518.

[3] Kelly, M. P.,& Staver, J. R., (2005). A Case Study of One School System’s Adaptation and Implementation of an Elementary Science Program. Journal of Research in Science Teaching. 40(1), 25-52.

[4] DeBoer, G., (1991), A History of Ideas in Science Education. New York: Teachers College Press.

[5] Özinönü, K. (1969). Türkiye'de Bir Fen Müfredatı Geliştirme Denemesi. II. Bilim Kongresi. Ankara.

[6] Demirbaş, M & Yağbasan, R. (2005). Türkiye’de Etkili Fen Öğretimi İçin İlköğretim Kurumlarına Yönelik Olarak Gerçekleştirilen Program Geliştirme Çalışmalarının Analizi Ve Karşılaşılan

Problemlere Yönelik Çözüm Önerileri. *Gazi Üniversitesi Kırşehir Eğitim Fakültesi, 6(2), 53-67.*

[7] STRCT (2012). The Scientific and Technological Research Council of Turkey. (TÜBİTAK) Retrieved from: http://www.tubitak.gov.tr/

[8] Board of Education, (2005). Talim Terbiye Kurulu Başkanlığı.Retrieved from http://ttkb.meb.gov.tr/

[9] Research and Development of Education Department RDED, (2012). Eğitimi Araştırma Geliştirme Daire Başkanlığı.Retrieved from: http://egitek.meb.gov.tr/earged/index.html

[10] Grote, M., (1995). Teacher opinions concerning science projects and science fairs. *Ohio journal of science*. 95 (4): 274-277.

[11] Bunderson, E.D., & Anderson, T. (1996). Preservice elementary teachers' attitudes toward their past experiences with science fairs. School science & mathematics, 96(7), 371-378.

[12] Abernathy, T.V., & Vineyard, R.N. (2001). Academic competitions in science. *Clearing House*, 74(5), 269-277.

[13] Czerniak, C.M. (1996). Predictors of success in a district science fair competition: An exploratory study. *School science & mathematics*, 96(1), 21-28.

[14] Balas, A.,K., (1998). Science fairs in elementary school, ERIC clearinghouse for science mathematics and environmental education Columbus OH., 1-5, (ERIC document reproduction service No. ED 432444)

[15] Bellipanni, L.J. & Lilly, J.E. (1999). What have researchers been saying about science fairs? *Science and children*, May 99, 46-50.

[16] Wang, X.H., & Yang, B.Z. (2003). Why competition may discourage students from learning? A behavioral economic analysis. *Education economics*, 11(2), 117-128.

[17] Gomez, K. (2007). Negotiating discourses: sixth-grade students' use of multiple science discourses during a science fair presentation. *Linguistics and education*, 18, 41–64.

[18] Kankelborg, A., (2005). *Rural science fair competition: levelling the playing field.* Master thesis. Montana University, Montana. UMI: EP31005

[19] Yayla, Z., & Uzun, B., (2008). Fen ve teknoloji eğitiminde proje çalışmaları ve bilim şenlikleri. XVII. *Ulusal eğitim bilimleri kongresi*. 1-3 Eylül 2008. Sakarya.

[20] Fisanick, L. M. (2010). *A descriptive study of the middle school science teacher behavior for required student participation in science fair competitions*. Doctoral Thesis. Pennsylvania University. Indiana. UMI Number: 3403187

[21] Grobman, (1993). A fair proposition? *The Science Teacher. 60*(1), 40–41.

[22] Shore, B. M., Delcourt, M. A. B., Syre, C. A., & Shapiro, M. (2007). The phantom of the science fair. In B. M. Shore, M. W. Aulls, & M. A. B. Delcourt (Eds.), *Inquiry in education volume II: overcoming barriers to successful implementation*. Mahwah, NJ: Erlbaum.

[23] Czerniak, C.M., & Lumpe A.T. (1996). Predictors of science fair participation using the theory of planned behavior. *School science & mathematics,* 97(7), 335-362.

[24] Büyüköztürk, Ş., Çakmak, E.,K., Akgün, Ö.,E., Karadeniz, Ş. and Demirel, F. (2011). *Bilimsel araştırma yöntemleri,* PegemA yayıncılık, 8. baskı, Ankara.

[25] Potter, M.,C., (2009). *Analyzing the technical quality of a rubric used to assess science fair projects*. Doctoral Thesis. University of Oregon. Oregon. UMI: 3377391

[26] This is My Work Project Guide, (2009). Temel Eğitim Genel Müdürlüğü. Turkey.Retrieved from: http://tegm.meb.gov.tr/bubenimeserim/

© 2012 HSci. ISBN 978-989-98032-0-6

QUANTUM PHYSICS AT WORK IN CONDUCTIVE NANO ENHANCED POLYMERS: A HANDS-ON INQUIRY BASED EXPERIMENTAL PATH AT HIGH SCHOOL

A. Lisotti[1,2,3], V. De Renzi [1,2], G. Goldoni[1,2]
[1]University of Modena and Reggio E.- Via Campi 213/a, 41125 Modena, Italy
[2]CNR-Insitute for Nanoscience S3- Via Campi 213/a, 41125 Modena, Italy
[3]ISIS Cavazzi sez. Scientifica, v.le Matteotti 2/4, 41026 Pavullo (MO), Italy
annamaria.lisotti@unimore.it, guido.goldoni@unimore.it, valentina.derenzi@unimore.it

Abstract *Polymers with improved electro conductive properties achieved by nano fillers have increasingly wider application. Naturally linking to the curricular topic of electricity and charge transport they offer the opportunity to perform experiments in school labs within a natural IBSE setting and with low cost equipment.*
A recently designed material, QTC, appears particularly appealing owing to its quantum tunneling conduction mechanism.
The experimental path described in the paper is part of NanoLab, an educational project aimed at integrating in high school curricula nanoscience and nanotechnology. Such topics in fact offer a unique opportunity to engage pupils in cutting edge research and introduce modern Physics in an intrinsically interdisciplinary hands-on modality.

Keywords: conductive polymers, high school, IBSE, nanoscience and nanotechnology, quantum physics.

1. Introduction

Nanosciences and nanotechnologies are fast reaching huge proportions as a source of innovative technologies in almost every field of modern life. From an educational point of view they represents a unique opportunity to engage high school pupils in cutting edge research and introduce modern Physics in an intrinsically interdisciplinary hands-on modality.
Polymers are essential in electrical applications not only as long established insulating materials but also as conductive ones of equal importance with nowadays further improved properties achieved by nanofillers. They naturally link to the curricular topic of electricity and charge transport, enriching the traditional insulators to conductor's spectrum and can be used in school labs to design and perform exciting experiments linked to many actual applications with relatively little and low cost equipment.
A specific material, Quantum Tunneling Composite, has been picked for a more thorough investigation owing to its conduction mechanism based on quantum tunneling rather than the usual percolation.

2. Didactical module

In spite of a generally declining interest in the study of science, most young students are still fascinated with the technological outputs of latest research. To enhance pupils' interest and inspire them in further investigation it was therefore decided to introduce the topic through a video [4] on prosthetic hands for impaired people.
A major issue in artificial limbs both for humans and robotics has to do with controlling grip strength. Thanks to the feedback given by hand touch receptors when we pick objects up our brain is able to evaluate the necessary force to exert: objects should be held firmly but neither crushed nor squeezed!. This is not as immediate in artificial hands where sophisticated tactile sensors are needed. Such devices should likely be as thin as skin and still be reliable and extremely sensitive. Nanotechnology can be of help in this with a flourishing of new products already on the market ranging from paper thin force sensors to tunable electrically-conductive fabrics. Most of these rely on piezo resistive mechanisms and are based on conductive polymers.
A new material called QTC (Quantum Tunneling Composite) [8][3], has been tested on Nasa Robonaut [6] and is available in 3.5mm X 3.5mm. pill form [7]. QTC is not expensive, neither is the equipment needed for testing; in addition it exhibits amazing electrical properties owing to a quantum tunneling conduction mechanism. Such characteristics make it particularly suitable for use in school.
Firstly students are asked to investigate QTC resistance versus applied pressure and find the appropriate mathematical model. Since the material clearly shows an exponentially dropping resistance with increasing pressure, the task offers the opportunity to discuss an experimentally obtained exponential law comparing and contrasting it to the more usual linear one. A good occasion too to experience firsthand those most physical relationships in real life actually is not simply and purely linear!

© 2012 HSci. ISBN 978-989-98032-0-6

As a second step, after an initial enquiry on the characteristics of a good pressure sensor for either artificial skin or robotic hands, pupils have to discuss and test experimentally whether QTC would make a good material for such tactile sensors and compare it with other similar ones.

This ultimately leads also to revisiting the traditional rough partition among conductors and insulators for a much broader span of finely tunable materials.

Then, if students are already acknowledged with Ohm’s laws and conduction mechanisms in metals, by comparing and contrasting inquire is pushed further into QTC characteristic (potential (V)/ current(I)) curves and conductive internal mechanism. The unusual shape of such curves naturally calls for comparison with other piezoresistive materials and this most effectively leads the way to the introduction of quantum tunneling basics.

Finally an excursus on state of the art applications from printed electronics [5] to energy harvesting and the related frontier research is offered, followed by the request to devise possible new uses for conductive polymers and how test them on a proof of principle, small scale basis .

The proposed module was originally thought for use also with students (14-16 years old), who have not yet been systematically exposed to modern physics, the focus actually being on working style and developing experimental competences rather than specific content. However a few teachers working with older students (17-18 years old) suggested starting directly from QTC IV characteristic curves whose peculiarities compared to the more known IV plots in metals directly introduce to quantum tunneling phenomena.

Our opinion is that similarly to other NanoLab project modules (see paragraph 3.*NanoLab*), this one too can be tailored to suit different ages, needs and working styles and can be easily integrated in a number of different curricular themes ranging from conduction mechanisms (Ohm’s laws, resistance, insulators and conductors, ….) to quantum mechanics basics or used just for IBSE (Inquiry Based Science Education) implementation with an accent on designing, testing and application. A very interesting aspect of working with such modern materials as QTC in fact is that both students and teachers cannot always appeal to text-book ‘truth’ being therefore forced to focus on methodology rather than actual results. This makes it a perfect scenario for IBSE.

2.1. Theoretical background

Research leads to lighter, cheaper and more versatile new conductive materials which, are at the base of driving technology in touch screens, OLEDS , PV organic cells, just to cite a few applications.

Plastic in particular has been thought and classified as an insulator which actually is not always true. Black carbon or metal particles have been used as conduction inducing fillers in polymer composites with apparently very similar results far before QTC was produced. First studies date back to the ‘50s, however a fundamental difference in the mechanism can be spotted: traditional composites work mostly through percolation while QTC conduction is based on quantum tunneling.

For percolation to be successful reaching a concentration threshold is crucial. Below such threshold no conduction is possible, while beyond it as metal particles content increases the number of conductive paths building inside the matrix increases as well, till it reaches saturation. Tunneling of electrons can take place too in the chain gaps but it’s not preponderant. On compression conductivity usually increases while on traction it decreases: this is because in the first case the conductive paths get even more tightly packed, while in the second, gaps and cut offs are being created. As a consequence electrical resistance of such materials ranges typically from 10^3 to 10^2 Ohm and the resistance versus pressure relationship is usually linear.

In QTC, on the contrary, any mechanical deformation, either compression or traction, brings to a decrease in resistance which, with appropriate applied pressure, can range from 10^{14} Ohm to less than 1 Ohm, meaning that the material can be tuned from an almost perfect insulator to a very good conductor (very similar to metals). The causes can be searched for looking at the inner structure.

The micrometric nickel particles are mixed by hand into the elastomer. Such a delicate mingling has been proved fundamental for QTC typical response: the particles surface nanostructure results in fact undamaged, still exhibiting characteristic ultrathin spikes (less than 100 nm long and 10 nm in radius) which ensure electrostatic field enhancement and subsequent Fowler Nordheim assisted tunneling phenomena.

© 2012 HSci. ISBN 978-989-98032-0-6

The spikes presence is clearly revealed in TEM pictures while from SEM ones it's evident the extreme wetting of the two components with the elastomer completely coating and thus insulating single particles [1] [2]. Distances among particles greatly vary but many of them are less than 100 nm far. Such a strong concentration rate would produce many conductive paths owing to percolation if the polymeric coating didn't act as an insulator, continually interrupting the conductive paths. As a consequence electrical charges can't see away through conductive paths and settle on the spikes giving birth to extremely strong localize electrostatic fields increasing their values up to a 10^3 factor, thus favoring Fowler Nordheim assisted tunneling. Electrons can then tunnel through larger gaps than in traditional composites and this explains why resistance decreases also on traction.

Electrons' tunneling is a typical quantum effect and the base for many applications from transistors to STM. In such a phenomena electron dual nature clearly shows off. The electron acts as a wave and something happens that for a particle can't even be thought of ! Similarly to what happens to light crossing through a not too thick smoked glass, progressively losing the energy absorbed by the medium but still able to come out at last, there's a probability to find the electron beyond a barrier of nonconductive material which has been tunneled through by the electron wave.

2.2. Experimental setup and results

The experimental setup for the study of a QTC pill Resistance R versus Pressure P is shown in Fig. 1. a-c.

A clamp fixed to a vertical stand holds a perforated metal cylinder into which the leg stand of an aluminum disk plate used for mass loading is set. Thanks to the cylinder working as a guide, the disk can freely slide with very low friction still ensuring that the point exerts a normal force on the QTC pill. The whole set up is thought to minimize movement since resistance is very sensitive to the position of both sensor (the QTC pill) and load. Mass is initially increased by constant steps, say 100 gr., so that the point exerts an increasing pressure on the pill which is inserted in the circuit made out of two overlapping copper strips. Particular care is taken that the strips do not actually touch and current flows from one to the other only through the QTC Resistance R are directly measured with a multimeter in ohmmeter modality. The whole apparatus is quite cheap and except for the sample, it makes use of equipment you can easily find in a standard high school physics lab.

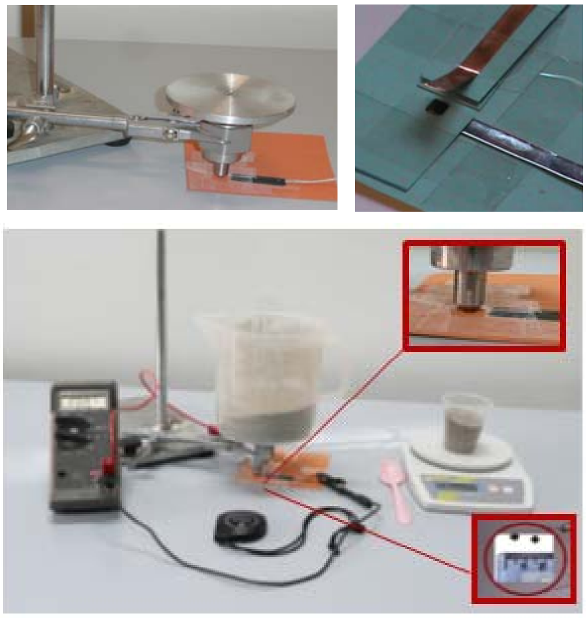
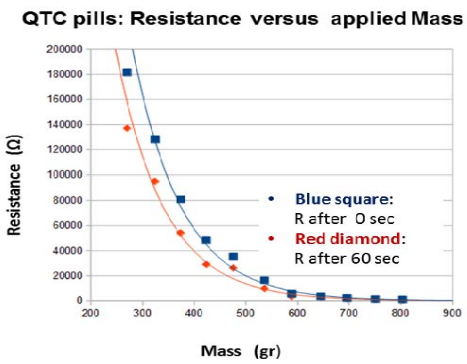


Figure 1. *a-c. Studying QTC pill resistance versus pressure: a. detail of the disk supporting the loads; b. detail of the QTC pill contact in the circuit; c. the*



complete experimental set up

Figure 2. *Readings of R at 0 and 60 sec.*

However simple the experiment is quite rich in discussion stimuli. For instance, because of the QTC pill crimping R varies a little according to the moment the measurement is taken so students have to decide when to take readings. However with appropriate testing they can prove that by fixing a time interval for readings after each reloading and sticking to it throughout the whole measurement process the model doesn't change:

it's still a decreasing exponential curve. See Fig.2.
Since for some students this may be one of the first approaches to an exponential curve in an experimental contest they may be led to appreciate some peculiarities of the model. For instance that in the steeper part of the curve data should be collected with a smaller step in masses. This leads to the use of sand for data fine tuning rather than the usual lab masses: a very convenient and cheaper alternative too since to produce resistances of just a few ohms almost 2,5 kg are needed.
As data are collected and stored in an electronic sheet pupils are asked to test different best fit curves on selected and restricted data ranges and introduced to the use of the logarithmic scale as an appropriate tool for similar contexts.
More questions are then asked and put to test such as why it is allowed to investigate R and mass when we actually are interested in R and pressure relationship and which are the hypothesis at the base of such a choice; if it is better to work in a continuum adding increasing loads or rather in a charge/discharge cycle; or whether the experiments are reproducible and to which extent.
Once QTC response to the exerted force is clear, pupils have to investigate whether it would make a good pressure sensor. They first have to discuss which are the characteristics that such a device should possess and how they can test that QTC really exhibits them all. Fast response, accuracy, reliability (same value or range of values for the same force exerted) are all concepts usually discussed very early in the curriculum when the first lab instruments are introduced, but here pupils have the possibility to revise and apply them in a much more operative and meaningful context.
Inspired by what has been done to measure R in conductive wires through Ohms law the following step consists in plotting QTC IV characteristic curve and compare it with the already well known ones in metals. Data are best obtained by online data acquisition (we used Vernier current (600 mA max) and voltage probes with Labpro interface and Logger pro software. A resistance of appropriate value was inserted in the circuit to prevent damage to the current probe owing to sudden peaks in current.
On experimenting it will soon be clear that the initial R produced by the applied pressure is a fundamental issue. In both regimes of high compression/very low R and almost null compression/ almost infinite R plots appear quite linear within an applied voltage range of a few Volts. While for a medium pressure (initial resistance in the range of 6- 10 Ohms) the IV curve aspect is quite unusual and hardly ohmic at all. A sudden peak in current intensity follows a previously not very smooth increasing trend, while on reducing voltage a hysteretic shape appears. See Fig.3. for a zoom on the first part of the curve

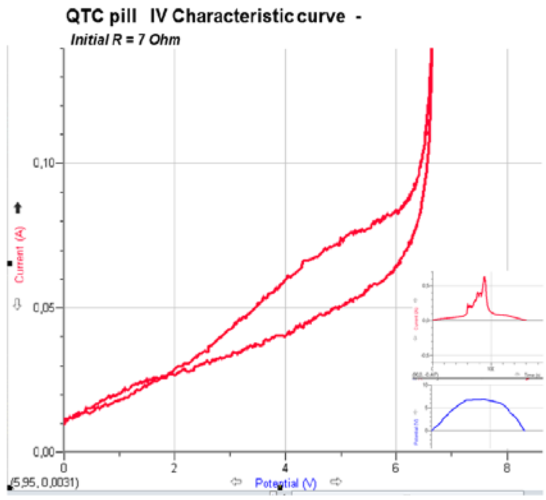


Figure 3. *QTC IV curve at an initial R of 7 Ohm. Zoom on the initial part. In the bottom right corner current and voltage plots vs time*

Discussion skillfully led by the teacher can easily exploit such anomalies to introduce some basics of quantum theory by observing how the previously obtained exponential dependence of R and the latest experimental details can be consistent with a conductive model dominated by quantum tunneling effect. With very low voltages applied electrons should not possess enough energy to tunnel through the elastomer insulator thick barrier in a significantly large number: therefore current intensity should be quite low and this is in fact what's observed experimentally. With an increase in V on the contrary probability that electrons successfully tunnel greatly increases as this appears clearly around 6 V . As tension is increased further current decreases with a negative R regime. Final R in low compression regime is lower than the initial one, while this is not observed at high compression : this appears clearly by plotting tangents to the curves in the origin. As charge flows it sometimes happens to incur in broken conductive paths where no flowing is possible

Therefore charge accumulates on the spot with consequent modification of the neighboring electrostatic field and sometime inhibiting tunneling in the nearby area too. The accumulated charge persists even when voltage is turned down. At the end the applied potential is no longer strong enough to maintain the stability of trapped charges configuration which is finally redistributed but not eliminated. Such redistribution shows off as current jumps and in the different final R of the sample. The accumulated charges create internal forces among the nickel particles resulting in a redistribution of the conductive paths as voltage is gradually changed Since the internal micro geometry has been modified the initial configuration will not exist anymore thus explaining both the hysteresis and the different R at the origin. With higher compression however conduction increases, charge accumulation is inhibited and the initial configuration is not substantially changed.

3. NANOLAB project website

The above experimental path is part of NanoLab (www.nanolab.unimore.it) an educational project of the Physics Department of Università di Modena e Reggio E., aimed at integrating nanoscience and nanotechnology in high school science curricula. Offered topics include nanoparticles, spectroscopy, smart materials, nanostructured surfaces.

The website offers free download of materials and resources, most of them editable under the Creative Commons Not Commercial Share Alike License. Each activity comes with background reading, correlated seminars held by researchers, students editable lab sheets , PPT and teacher guide with didactical notes and practical ones (building instructions, prices and addresses for buying samples and equipment) complemented by laboratory video guides which actually are of the main importance for distance training. At the moment the website is mainly in Italian but an English version is under construction too.

4. Acknowledgements

The authors thankfully acknowledge the interesting discussions with Giulio Annovi, Physics teacher at Liceo Allegretti sez . scient. Vignola (MO) and the skillful technical support by Stefano De Carlo of the Physics Department (MO).

5. References

[1] Bloor D., Donnelly K., Hands P.J., Laughlin P. , Lussey D. A metal-polymer composite with unusual properties, J. Phys. D: Appl. Phys. 2005; 38: 2851 .
[2] Bloor D., Graham A., Williams E.J., Laughlin P.J., Lussey D., Metal-polymer composite with nanostructured filler particles and amplified physical properties, Appl. Phys. Lett., 2006; 88: 102103 .
[3] Boohan R.: QTC A remarkable new material to control electricity. UK: SEP (Science Enhancement Program); 2005.
[4] “The magic touch“ video in the DVD “Nano Tv- Nanotechnology success stories from European Research “ . Available also on line at http://ec.europa.eu/research/industrial_technologies/dvds-videos-films02_en.html [08/22/2012]
[5] OE-A (organic electronics association) Organic and printed electronics brochure 4th edition 2011 at http://www.vdma.org/ [08/22/2012]
[6] NASA Robonaut project website http://robonaut.jsc.nasa.gov/ [08/22/2012]
[7] http://www.mindsetsonline.co.uk/ [08/22/2012]
[8] www.peratech.com/ [08/22/2012]

STUDENTS’ VIEWS ON THE EFFECTIVENESS OF THE MOBILE SCIENCE LABORATORY

M. Erol[1], U. Böyük[2], M. Uşak[3], R. Şahingöz[1]
[1]Bozok University, Department of Science Education, 66200, Yozgat, Turkey
[2]Erciyes University, Department of Science Education, 38039, Kayseri, Turkey
[3]Dumlupinar University, Department of Science Education,43100, Kütahya, Turkey
mustafa.erol@bozok.edu.tr, boyuk@erciyes.edu.tr, musaktr@gmail.com, recep.sahingoz@bozok.edu.tr

Especially in rural areas, the lack of laboratory facilities and opportunities for students to get experimental education are the major factors that cause fail in the science. The mobile science laboratories (MSL) allow students to learn science more willingly.

 ISBN 978-989-98032-0-6

The main goal of this study is to reach out to the students in a rural region of Turkey and to offer them an experimental science education with a MSL. Training via MSL is based on hands-on experimental activities. In the first day 'science is fun' type experiments have been demonstrated. In the other three days, physics, chemistry and biology experiments have been done. Questionnaires and interviews have been conducted with 324 students in Yozgat in order to identify their views on the effectiveness of the mobile science laboratory. The results show that the program is highly successful.

Keywords: Problem solving, preservice teachers, school courses.

AIMS OF PROBLEM SOLVING METHOD IN SCHOOL COURSES

E. Topbaş Tat, S. Bulut
Middle East Technical University,
Ankara, Turkey
etopbas@metu.edu.tr, sbulut@metu.edu.tr

Problem solving is a vital tool both in school curricula and in our daily life. Having competency on utilizing problem solving method in school courses and being aware of importance of this teaching method help teachers organize their lessons within this perspective. The purpose of this study is to investigate preservice teachers' opinions about aims of using the problem solving method in school courses. The participants of the study consisted of 55 preservice teachers enrolled in the undergraduate elective course- "Problem Solving in Mathematics". It covers mathematical problem solving strategies, history of mathematics and the assessment techniques on progress in problem solving. In this course problems are solved by using the steps: Understanding the problem, making a plan, carrying out the plan, check/look back, and extension. Preservice teachers' written explanations on the aims of using the problem solving method in their courses were used as data. These written explanations were coded by one PhD candidate and one teacher. Results of the study show that preservice teachers were aware of different aims of problem solving method. However, the main emphasis was on improving students' abilities to solve the problem.

Keywords: Problem solving, preservice teachers, school courses.

STUDENTS' EXPERIENCES WITH ALGEBRA WHILE SOLVING WORD PROBLEMS

E. Topbaş Tat
Middle East Technical University,
Ankara, Turkey
etopbas@metu.edu.tr

Purpose of this qualitative study is to investigate the middle school students' experiences with algebra while solving word problems. Two students from each grade level (6^{th} and 7^{th} grade) were selected from one elementary school. Firstly, these four students were asked five open ended word problems. After that, they were interviewed about their practices on word problems so as to learn their experiences with algebra. The interviews which were recorded by permission were transcribed and coded. After analyzing the data, five main themes were determined. These are strategies for solving word problems, algebra usage, understanding of symbols, reasons for preference of algebra and reasons for preference of arithmetic. Themes in this study may give us important information about students' algebra usage. By the help of students' explanations about algebra, we can develop some strategies to provide their transition from arithmetic thinking to algebraic thinking.

Keywords: Students' experiences, algebra, word problems.

 ISBN 978-989-98032-0-6

DESIGNING AND EVALUATING SCIENCE INSTRUCTIONAL PRACTICES

K.L. Adams[1], H.A. Pacheco[2]
[1]*University of Nebraska-Lincoln, 211B Henzlik Hall, Lincoln, NE 68588, USA*
[2]*Arizona State University, 620 E. McKellips E208, Tempe, AZ 85281, USA*
pacheco.heather@gmail.com, kadams12@unl.edu

Inquiry instruction has been seen as part of the classroom practices that makes an effective science teacher. Scientific inquiry, according to Lederman (2004), is based upon the systematic approaches used by scientists in an effort to answer their question of interest (p. 309)." However, few teachers have had experiences with scientific inquiry which is counter to what the NRC (2000) suggests. The NRC believes that teachers need to be well versed in inquiry and inquiry-based methods. As a result, they often have a difficult time providing authentic experiences for their students to engage in inquiry.
To counter this deficit, focus in recent reform based documents in the US has turned from focusing upon inquiry to the practices of science. This involves providing teachers with clear and concise descriptions of science skills that scientists use regularly. By providing a clear description of the practices, it helps teachers develop instruction that moves beyond a set of procedures towards developing an understanding of science through engagement with scientific practices. For example, instead of students only making observations the teachers would engage students to test observed phenomenon against current theories and explanations. In so doing, the students develop a deeper understanding of whether their observations prove or disprove theories. With a clear understanding of the practices, teachers are able to develop students' knowledge of science achieve their understanding of the world around them.
The aim of this workshop is to analyze classroom instructional activities against the USA's Next Generation Science Standards (NGSS) framework (2011). In doing so, the participants will determine how current instruction supports the science practices through the development of scientific literacy in students. In order to accomplish this, we have developed a user-friendly, teacher-oriented instrument to allow teachers and teacher educators to analyze hands-on activities. The laboratory analysis tool (LAT-itude) will use external parameters found within the NGSS Framework to position the instructional strategies in student learning. LAT-itude is based on upon the building science literacy for all through development of science practices and skills. In this 90-minute workshop, participants (maximum 40) will analyze laboratories activities to identify the science skills, the core crosscutting idea, and the level to which the representation supports the content standard(s).

Keywords: Laboratory, Analysis, Science.

TURKISH GIFTED STUDENTS' VIEWS OF NATURE OF SCIENCE AND SCIENTIFIC KNOWLEDGE

K. Bilen[1], M. Ozel[2]
[1]*KSU, Faculty of Education, Kahramanmaras, Turkey*
[2]*Nigde University, Faculty of Education, Nigde, Turkey*
mozeltr@gmail.com, kadirbilen@gmail.com

This study examined the conceptions of nature of science (NOS) and nature of science knowledge scale (NSKS) possessed by a group of gifted (4-8) grade students of Denizli, Turkey. The students were engaged in a 1-week science camp with emphasis on scientific inquiry NOS and NSKS. An originally version of a NOS questionnaire was developed, specifically addressing the context of Turkish culture, to assess students' views on the development of scientific knowledge. Pretest results indicated that the majority of participants had a basic understanding of the tentative, subjective, empirical, and socially and culturally embedded aspects of NOS. Some conflicting views and misconceptions held by the participants are discussed. There were no significant changes in students' views of NOS and NSKS after instruction, possibly due to time limitations and a ceiling effect. The relationship between students' cultural values and development of NOS conceptions and the impact of NOS knowledge on students' science learning are worth further investigation. Results indicated that students generally hold double-minded and unsatisfactory views on the nature of scientific knowledge.

Keywords: Outreach activities, science centers, science on stage, views about science.

THE EFFECT OF 'SCIENCE ON STAGE' SHOW ON ELEMENTARY AND HIGH SCHOOL STUDENTS' VIEWS ABOUT SCIENCE

E. Şentürk
Middle East Technical University (METU), Science and Society Centre (SSC)
esenturk@metu.edu.tr

Day by day, scientific and technological improvements have put science education in the lime light of all nations. However, many students find their science lessons boring and impractical due to the fact that science is generally presented as a corpus of knowledge to be mastered, memorized, and occasionally applied to the real world. One way of overcoming these situations is perhaps to support formal settings with informal (out-of-school) settings such as science museums/centers and their activities. The activities provided by science centers can be particularly important for developing and validating learners' positive science-specific interests, skills, emotions, and identities. In this respect, METU Science and Society Centre, in the spring of 2012, conducted a project entitled 'Let the Cradle of Science Swing You' supported by the Scientific and Technological Research Council of Turkey (TUBITAK). The purpose of the current study is to explore whether or not there is an effect of this project on changing elementary and high school students' views about science in a positive way. All voluntarily participated students (n=767) from the two cities Eskisehir (n=536) and Tekirdag (n=231) were implemented a 32-item attitude towards science measure before and immediately after the show. The paired-samples t-tests were conducted to evaluate the impact of science show on elementary and high school students' scores on views about science (VAS). The obtained data supported to conclude that there was an effect of the project on changing elementary and high school students' views about science in a positive way, and this effect was more pronounced for high school students.

EFFECT OF CONCEPT CARTOON WORKSHEETS ON STUDENTS' CONCEPTUAL UNDERSTANDING OF GEOMETRICAL OPTICS

E. Taşlidere
Mehmet Akif Ersoy Üniversity, Faculty of Education, Burdur, Turkey
etaslidere@mehmetakif.edu.tr

The purpose of this study was to investigate the effect of the use of concept cartoon worksheets developed according to the constructivist view of learning, gender and their interaction on science student teachers' conceptual understanding in geometrical optics. Four classes participated in the study which lasted three-week treatment period. Participants were 121 students from four intact classes. The intact classes were randomly assigned into one of the two treatment groups. A quasi-experimental design was used as a research methodology. The experimental group studied geometrical optics unit with the application of concept cartoon worksheets, while the control group studied the unit with the traditional instruction. Seven worksheets were developed keeping misconceptions of students in mind and all of them were enriched with the concept cartoons. To measure students' conceptual understanding of geometrical optics, a tree-tier misconception test was used as pre and post tests before and after instructions. The main effects of treatment, gender and their interactions on students' post-test scores were examined via ANCOVA with pre-test scores used as covariates. The analysis yielded a significant treatment effect but insignificant gender and gender*treatment effect on students' post-test performances. The results of the study showed that application of concept cartoon worksheets increased students' conceptual understanding significantly compared to traditional instruction. The finding also indicated that the use of concept cartoon worksheet is likely to be effective in decreasing students' misconceptions in geometrical optics for all students regardless of their gender.

Keywords: Concept cartoon worksheet, geometrical optics, conceptual understanding, misconception.

THE INFLUENCE OF INTEREST, MOTIVATION, PRIOR KNOWLEDGE AND EXPERIENCES ON THE NATURE OF INFORMAL SCIENCE LEARNING

E.Ö. Akar
Abant İzzet Baysal University Faculty of Education Department of Scondar Science and Mathmematics Education, Bolu, Turkey
akar_e@ibu.edu.tr, ebruoztrk@yahoo.com

The purpose of this study is to define the nature of learning in an informal science learning setting i.e. "Bilim Atölyesi®" (BA) and to identify the influence of interest, motivation, prior knowledge and experiences on the learning process. BA is a scientific activity program, for 9-12 years old primary students, organized by a Research and Development Company located in TechnoPark of Middle East Technical University, Ankara, Turkey. Consisted of fifteen activities under the general themes of genetic engineering, nanotechnology, and microbiology, BA intends to enhance participants' interest in science while they enjoy inquiry-informed science activities. Through a socio-cultural perspective (Leinhardt, Crowley & Knutson, 2002), this study focuses on the discourse of the participants during these activities i.e. the means by which meaning is mediated and by which understanding is constructed. (Osborne & Dillon, 2007). In addition to the participants' prior knowledge, experiences, interest and motivation, their interactions with the setting, peers and BA staff are assumed to influence participants' learning. Qualitative measures are used. Observations are made and structured and semi-structured interviews are conducted considering the age related developmental characteristics of the participants. BA staff's aims and perceptions of participants' interest that influence the selection of content and activity types are also explored. In order to draw conclusions about the nature of informal science learning and influential factors content analysis is going to be used. Researcher is limited with the characteristics of the setting i.e. little/no control over the environment and technical problems in capturing the data.

Keywords: informal science learning, discourse, socio-cultural perspective.

SOCIO-SPECTROMETRY: SPECTRAL ANALYSIS APPLIED IN MEASURING AND MODELING SOCIAL PHENOMENA

I.R. Chisleag Losada[1], R. Chisleag[2]
[1]National School of Political and Administrative Studies, Romania
[2]University"Politehnica, Bucharest, Romania
chisleag@gmail.com

"*Socio-spectrometry"*, defined as an inter-disciplinary science aiming to apply spectral analysis knowledge in measuring and modeling social phenomena, is a natural part of Socio-physics. This new interdisciplinary science, "*Socio-spectrometry*" is connected with *"Socio-optics"* both relying on the duality wave-particle which seems convenient to model relationships within society and its members using Physics models, which are powerful tools to be used by socially committed scientists to model social and economic phenomena, among them social inequalities.

A new class of models is introduced in the paper: "socio-spectra", the *spectra of social inequalities.* When the components of a social group (sub-groups or individuals) have unequal: background, education, wealth, social positions, rights, duties, chances and/or unequal evolution paths, this situation is, frequently, approached in *general*, as being an *inequality in the group.*

But, for a specific and detailed investigation and understanding of the relationships inside the group and of the group with the social and natural environments and for consequent, adapted social and political specific actions, there is important to know the *distributions* $\mathbf{y^s_i}$ of *each pertinent varying characteristic* **s,** for all **i** members *of the group,* distribution to be considered as a *socio-spectrum* $y^s_i = F(\mathbf{x_i})$ over the whole group. y^s_i is to be a well defined parameter (f.e., seats) depending of x (population, surface, budget, resources, specific wealth, time a. s. o.) depending of **i** (which values x_i are different for the different members **i** of the group). For all values $\mathbf{y^s_i}$ and respectively,

x_i the dimensional equations must be identical and their relative errors be spread over a short range, only. Not being only one unequally distributed characteristic (s>1), the group inequality is *multi-dimensional* (refers to *sets* of characteristics, of parameters) and to be measured, understood and managed, there are necessary *sets of socio-spectra* (of the same dimensional order).

Socio-spectrometry may offer strong tools in dealing with the tracing and the processing of the *spectra of social inequalities*, by offering a deeper understanding of the studied society and its components. If known, the multi-dimensional spectra (as generalized spectral surfaces) are useful in understanding the sources of inequality and of their relative contributions to inequality distributions.

The authors consider that some part of inequalities in the representation of social sub-groups in some bodies may originate in the relative power relationships or even corruption of the representatives of some sub-groups which have negotiated and granted the regulations for the structure, for the elections or have organized them (corruption within legislative and institutional frames).

The informational, mathematical and physical tools for processing Physics spectra are easy available for socio-spectra. The huge social information collected worldwide by Statistical Institutions (National, EUROSTAT a.s.o.) represents excellent data bases, at hand, for Socio-spectrometry.

The authors exemplify their approach by studying the *inequality of representation* of Europeans and EU members *in the European Council (of ministers),* by considering its seats and their distributions (per country, per million of citizens a.s.o.). They compare their results with the principles stated in EU Treaties, to draw some conclusions about the social inequalities in the representation in the EU institutions and make suggestions how to fight and prevent the generation of such inequalities.

There is eventually possible to estimate and quantify the contribution of each stated principle in the Treaties with the actual allocation of the votes in the Council. The social spectra chosen by a researcher or a politician to better introduce a social phenomenon are to be clearly explained and understood by the target audience.

There is mentioned the authors' expertise in stimulating s*ocio-spectrometric approach* by systematically asking students taken courses in Spectroscopy to find applications of the newly got by them spectroscopic knowledge, to model social and even everyday life phenomena, to find *spectra of social inequalities*, eventually engaging in such activities other possibly interested colleagues.

The authors consider that the term *"Socio-spectrometry"* may come to life.

Keywords: Socio-spectrometry; Socio-spectra; Spectra of inequalities of representation; Socio-optics; Socio-physics.

STUDY OF MACRO, SUBMICRO, AND SYMBOLIC REPRESENTATIONS IN CHILEAN SCIENCE SYLLABUS: THE CASE OF STRUCTURE OF MATTER

A. González, S. Contreras
University of Santiago de Chile, Avenue, Libertador Bernardo O´Higgins 3363, Central Station, Santiago, Chile
alexis.gonzalezdo@usach.cl, saul.contreras@usach.cl

In the process of teaching and learning chemistry is fundamental that learners are able to establish cognitive relationships between the macroscopic, microscopic, and symbolic levels. However, both chemistry curriculum and school textbooks lack a proper integration of these concepts. Moreover, the syllabuses that prescribe the contents to be learned during school life, present the same deficiency of quality, having a direct impact in the students' learning outcomes. Similarly, we have to consider that all these elements are used by teachers to plan the academic year.

With the aim of analyzing how this chemical triad is integrated in the Chilean chemistry curriculum, the selection, arrange, and organizational criteria in the natural sciences and chemistry programs were analyzed, specifically the content of matter and its structure. The analysis techniques used were analysis of the content, frequency, and maps of conceptual distribution.

The main results evidence the integration of the macroscopic concepts such as mixture, substance, solid and liquid at the onset of the academic years, whereas the microscopic and symbolic levels are included very late in the primary academic years. For instance,

 ISBN 978-989-98032-0-6

microscopic concepts related to atomic structure such as nucleus, atom, electron and chemical bond are included in the syllabus for the seventh grade of primary school; likewise, the symbolic concepts like chemical equations, formulas and symbols. Although contents are organized in the curriculum according to its complexity and abstract nature, concepts related to the microscopic and symbolic levels are introduced very late in the programs, being condensed, solely in the last years of primary school, therefore, not being assessed in previous levels.
Consequently, even though the syllabuses respond to the logic of the discipline, they do not consider the possibility of gradually introduce the macroscopic, microscopic and symbolic concepts in the academic curriculum. The above-mentioned exposes a deficient integration of the chemical triad, which may affect negatively the students' learning outcomes. By correcting these deficiencies when designing the academic curriculum, it could positively reorient the low results and interests that students manifest towards learning chemistry, as well as, to improve the teaching training process and to positively transform the discipline.

Keywords: levels of representation, chemistry, syllabus, curriculum.

SCIENCE IS A JOKE! CONCEPTUAL HUMOR AS A TOOL FOR INCREASING STUDENT ENGAGEMENT AND INTEREST IN SCIENCE

E. Westgate
University of Virginia, The Department of Psychology, 102 Gilmer Hall, PO BOX 400400, Charlottesville, VA 22904-4400, USA
rilelen@gmail.com, ecw4za@virginia.edu

The tendency of students to lose interest in the STEM (Science, Technology, Engineering, Mathematics) fields and slowly disengage over time has been dubbed the "leaky pipeline problem." As students proceed through the lower grades and experience loss of interest and perceived competence, they become less likely to seek out STEM fields and occupations when they are older. One potentially overlooked tool for preventing this loss of interest and engagement in science is the deliberate and systematic use of humor in classroom instruction and materials. Humor has been shown to reduce stress and increase coping in the health literature and may have positive effects on memory by drawing attention to key concepts. The current study provides support for the claim that humor may be particularly beneficial in science education. Sixty-two American college undergraduates viewed a humorous or non-humorous version of an online geology lecture on mineral properties in the lab, and completed measures of interest, recall, and recognition. Two weeks later, they completed an online follow-up with additional interest and performance measures. Overall, students who viewed one of the humorous versions of the lecture reported greater enjoyment of the lecture than those in the non-humorous condition. There were no differences in perceptions of understanding, difficulty, or informativeness. Although no overall differences in performance were found for participants as a whole, the forty-two students in non-STEM majors (i.e., not majoring in math or science) experienced improved performance at the two-week follow-up in the humorous vs. the non-humorous conditions. Likewise, the non-STEM majors who viewed a humorous version of the lecture also reported increased interest in geology immediately afterwards. These findings lend support to the idea that humor may be a potential effective tool in science education for students who may otherwise lack interest or engagement, by increasing interest and competence in science.

Keywords: Humor, Motivation, Interest, STEM, Psychology.

VIDEO PROJECTION IN SCIENCE LESSONS AT RURAL ADVANCED SECONDARY SCHOOLS IN TANZANIA

N. Setter[1,2], F. William[3], P. Mosha[3], M.G. Sahini[1], M. Mtebwa[1], S. Raghaven[1,4], E. Rwenyagila[1,5], K.M. O-Saki[3]
[1]*EPFL - Swiss Federal Institute of Technology, Lausanne 1015, Switzerland*
[2]*TALENT Foundation, Cully 1096, Switzerland*
[3]*University of Dodoma, Dodoma, Tanzania*
[5]*Current address: University of California at Santa Barbara, USA*
[6]*Current address: University of Dar es Salaam, Tanzania*
nava.setter@epfl.ch

The number of students taking PCM (Physics-Chemistry-Mathematics) final exams at the Advanced Secondary level in Tanzania in 2008 was ≈ 4'000, which is 0.4% of the corresponding age group. This is an excellent target population for initiatives in enhancing science learning. Moreover, recently Tanzania has started reform in secondary education; The number of students doing science at Ordinary level increasing in fast pace: The number of 'A' level students taking science is bound to grow too in the very near future. The infrastructure necessary for science studies in A-level public schools outside of central urban areas is yet lacking. There are few opportunities of organized continuous training for 'A' level science teachers.
We have combined a modern teaching approach and inexpensive technology and tested whether this could enhance A-level science learning in this realm, having in mind the A-level population of science learners of rural public schools in Tanzania, which is of approx 6'000 students (Form V and VI) in some 60 schools. We hypothesized that 'integrated learning' approach could be particularly suitable due to its attempt to draw personal experience and a practically oriented scientific inquiry. We installed in 10 schools technology packages, each made of a projector + loud speakers, a laptop computer, and, where needed, a solar-power unit.
The projector is used to project short videos, 3-4 minutes long, at the beginning of each lesson, showing the relevance of the studied material in science and technology activities at technologically developed environment: We leave 'kitchen science' to the 'O' level and expose the 'A' level students to the importance of the scientific concepts they are about to learn in modern technology. In addition the projector is used during the lessons to project videoed experiments, virtual experiments and animations, and to show relevant figures and photos. This is embedded in power-point presentation that is also used for displaying class-room work-sheets, describing class experiments to be performed by the students, etc..
We will present an overview of our approach, which has been in development and use since 3 years in Advanced Secondary chemistry, present examples of introductory videos, videos of experiments and a video developed by our researchers. We will inform about the reaction of students and teachers to the use of video and power-point projection in the classroom. Finally, we will summarize and discuss lessons learnt, and from this conclude on the way to continue.

Keywords: 'Integrated science' approach, video projections in science lessons, science education in rural schools, educators-engineers cooperation.

UPPER ELEMENTARY SCHOOL STUDENTS' UNDERSTANDİNG OF BASİC PHYSİCS CONCEPTS AND THE EFFECTS OF AN EXTRACURRİCULAR HANDS-ON SCİENCE PROGRAM

M. Bulunuz
Uludag University Education Faculty, A Blok, No:217, 16059 Nilufer,Bursa-Turkey
mbulunuz@gmail.com

The new Turkish National Science Curriculum is programmed in a helix way in which each year students study the same concept but at a higher level to develop their understanding by eliminating misconceptions. However, recent research studies in Turkey indicate that students still have difficulty understanding science concepts. The subjects in the current research were 347 7th and 8th grade students who had studied five basic physics concepts: *mass, weight, inertia, air resistance, and gravity.* Included were four public schools and one

 ISBN 978-989-98032-0-6

private school. This study had three purposes: (a) to determine how well students understood the physics concepts, (b) to determine whether public and private school students differed in their understanding, and (c) to evaluate the effect of real-life integrated extracurricular hands-on science activities on understanding of the concepts. In order to evaluate students' ability to explain and apply their knowledge after studying these five concepts from their science textbooks, a questionare was administered with 4 multiple choice and 4 open-ended questions. These questions measured students' comprehension and application of the science concepts to real-life phenomena. Findings indicated that students had poor conceptual knowledge/ application of the five physics concepts. Out of 100 possible points, students in the three public schools scored 24.9, 25.0, and 16.5. Students in the private school scored 33.7. Analysis of Variance indicated that the private school scored higher but still had low conceptual understanding. In one of the public schools, an extracurricular program was developed with activities adapted from science activity books by integrating real-life context. The pre-post data from this intervention are being analyzed and will be presented at the conference. The results suggest that academic activities just based on science textbooks are not enough for students to understand the basic physics concepts, and there is need to include a variety of hands-on science activities.

Keywords: Extracurricular hands-on science activities, real-life integrated teaching, science concepts.

THE CONVERGENCE OF MAYER'S MODEL AND CONSTRUCTIVIST MODEL TOWARDS PROBLEM SOLVING IN PHYSICS

R.G. Bautista
Natural Sciences Department, AMA International University - Bahrain

This study investigated the convergence of the Mayer's model and constructivist model towards problem solving in Physics. Twenty six students in Physics 1 (University Physics 1) enrolled in the Third Trimester, SY 2011 – 2012, were the subjects of the study. An analysis of the students' learning history in College Algebra and Trigonometry was conducted as basis of determining their mathematical abilities. A pre-test was conducted to determine the initial learning schema of the respondents. The examination used as pre-test was formulated by the author as his output in his dissertation and was field tested to a group of students majoring in Science at Quirino State College, Philippines. The Mayer's model was used a default procedure followed by the four-stage constructivist model in problem solving. Students were engaged in active learning through direct instruction using Mayer's model from the teacher, small group discussion, peer mentoring and follow-up session/s by the teacher vis-à-vis with the four-stage constructivist model in problem solving. Analysis of transcripts was done to determine the extent of learning of the respondents and the remediation to be implemented. After the execution of the lessons, the students were given a post-test. It was found out that the students who were exposed to the convergence of the Mayer's model with the constructivist model developed better attitudes and performance in problem solving. A significant effect and a moderately high impact model of variability on the attitude and academic performance of the students: 85.2 % on the students' attitude towards problem solving and 80.00 % on the students' academic performance.

Keywords: Constructivist Model for Teaching Word Problem; Learning Attitudes; Learning Ability; Mathematical Discourse; Mayer's Model.

PRINCIPAL FUNCTIONS OF SHOCKING EXHIBIT (EXHIBIT OF IMPACT) IN MOVING SCIENCE EXHIBITIONS

J.N. Teixeira[1], M. Muramatsu[2]
[1]Instituto Federal de Educação, Ciência e Tecnologia de São Paulo – Itapetininga, Brasil
[2]Instituto de Física da Universidade de São Paulo, Brazil

The shocking exhibits are, in general, present at science´s centers and museums, or in occasional scientific exhibitions, as itinerant projects in science fairs. These types of exhibits, in particular, play multiple roles in visited places, usually they increasing the quality of interactions, which may have different goals, depending of mission of each specified local. In case of itinerant exhibitions, the function of these exhibits range from increasing the curiosity and attention of visitors, going to increase the levels of scientific literacy, promoting options of scientific culture to visitors. However, one of most important function of these exhibits is the motivation of the visitor's interaction with the exhibition which can be helpful in learning of scientific concepts and in understanding of scientific phenomena modeling by this kind of experiments, or another present in the exhibition. The central aim of this work is to discuss this function that we consider one of the most important, looking for evidence of increased motivation of visitors, such increased interaction time with the exhibition, the effort and the persistence in some types of interaction, and sense of accomplishment or success, when the exhibit presents a challenge. As previous result, we identified important indicators of motivation in observed shocking exhibits, such as more time of interaction, indicating the persistence of visitors to interact with the exhibits. We also observed greater effort to solving the challenges proposed by exhibits and the free choice of another with lower levels of impact. In last ones, the visitors did more questions about their operations or form of interaction. Another group that was initially directed to exhibits with a lower level of impact presented lower curiosity with another experiments, often passing by some, without even asking the operation or exploring what the experiment shows. The results of this work may aid in the production of exhibits that surprise visitors, promoting an increase in the quality of interactions and hence increase of learning of scientific concepts and better understanding of the phenomena presented by the models in exhibition.

DEVELOPMENT OF CONTROL OF VARIABLE ABILITY ACROSS THREE GRADE LEVELS IN UAE SCHOOLS

H. Tairab
United Arab Emirates University Al Ain, UAE
tairab@uaeu.ac.ae

UAE policy makers often call for educators and teachers to pay particular attention to incorporation of scientific methods with its various aspects in teaching and learning processes to help learners become problem solvers and independent thinkers. One aspect of the scientific method that directly related to student ability to carry out scientific investigations is the ability to handle and control experimental variables commonly known as control of variable ability as a fundamental integrated science process skill which has been widely regarded as an important ability in scientific investigation. The present study was designed to assess one of the domain-general reasoning skill, the control of variable ability of selected sample of grade 8, 10, and 12 science students and to compare these students in relation to the development of this ability across grade levels. Using assessment framework similar to that used by American Association for the Advancement of Science (AAAS), 154 science students were tested on their understanding of key ideas related to control of variable as a fundamental integrated process skill. The findings suggested that there is much needed to improve student ability to handle and control experimental variables. The participants exhibited alternative conceptions of key ideas related to control of variable as a fundamental ability such as testing hypotheses, selecting the appropriate experimental setup, handling more than two variables, and providing valid explanations to the expected outcomes of an experimental setup. The findings were discussed in the context of UAE Curriculum and recent educational reforms that stress the need for better preparation of students to meet the challenges of

© 2012 HSci. ISBN 978-989-98032-0-6

today's changing societies. The findings have also highlighted that such a need for better preparation of students for the future requires new curricula and teaching approaches that focus not only on learning scientific content but also on acquiring advanced transferable abilities related to scientific investigations and logical reasoning skills that can be used to solve societal problems.

VIDEO RECORDED LESSONS AS A MEDIA DURING A SEMINAR FOR DEVELOPING PROSPECTIVE PHYSICS TEACHERS' PCK

V. Grigoriou, K. Papageorgiou, G. Kalkanis
University of Athens, Pedagogical Department P.E., Science Technology and Environment Section, Science Technology and Environment Laboratory
vgrigor@primedu.uoa.gr, nanpap06@gmail.com, kalkanis@primedu.uoa.gr
e_site: http://micro-kosmos.uoa.gr

Starting from the fact that teaching and learning are complex procedures where multiple approaches could be fruitful, reflection upon practices and reshaping past and current experiences appeals to encourage professional growth. Reflection becomes even more important when it concerns preservice Science teachers where opportunities for self-reflection and collaborative reflection upon teaching episodes could become a valuable media for fostering professional growth. This paper discusses the use of video-stimulated reflection as a means to promote awareness of student Physics teachers' among specific PCK aspects during a seminar concerning professional knowledge and instructional practices.

The research was carried out in the form of case studies with six student teachers participants who were at the second year of their master degree at Science Education. Students participated altogether in sessions where videotaped lessons of both pre-service and in-service Science teachers were displayed. After that, tutor was engaging them in a reflection procedure.

Research data were collected via a variety of research instruments, namely classroom observations and field notes, audio recordings of seminar sessions, interviews and video-stimulated reflection. Grounded theory was used for the qualitative analysis, i.e., the data were approached with relatively little preconception, as the researcher endeavored to identify categories of meaning from the data.

The analysis of the data shows that, student teachers spent a great deal of discussion time and collaborative reflection time, founding at the videotaped teaching episodes valuable elements for their professional development. They found effective opportunities to 'learn to notice' upon critical moments concerning instructional strategies, motivation for using technology, the role of experiment in an inquiry based learning sequence, the classroom context as a whole. These remarks might contribute to further discussion upon students' perceptions about teaching and learning and therefore to provide opportunities to develop aspects of their PCK.

Keywords: PCK, video, reflection.

HOW CAN WE TEACH MODERN PHYSICS EFFECTIVELY?

C. Eke
Akdeniz University, Faculty of Education, Turkey
ceke@akdeniz.edu.tr

Physics consists of classical physics and modern physics. Classical physics is convenient with everyday life. In daily life, many events are explained by classical physics. According to classical physics, modern physics is abstract. We do not see modern physics experiments daily life. Modern physics experiments can do special laboratory circumstances. Therefore modern physics is difficult, complex and unclear for students. The purpose of the present study is to investigate how students learn modern physics effectively. Especially, for this purpose the research on modern physics is examined with regard to effective learning methods and theirs results about modern physics. In the literature for effective teaching, researchers focused on experiments, demonstrations, new learning-teaching methods, students' ideas about modern physics issues.

In addition to the literature, for modern physics teaching, proverbs can use in modern physics course. In modern physics some of the events can associate with proverbs. After the determination of proverbs related to modern physics issues, students can make their own projects related to modern physics issues. Consequently, students should teach about modern physics issues with experiments, visual materials and project works. Experiments, analogies and visual materials play an important role in modern physics teaching.

Keywords: Modern Physics, Proverbs, Experiments, Teaching.

THE PROBLEM OF DEMARCATION: SUPERSTITIOUS AND PSEUDO-SCIENTIFIC BELIEFS OF PRESERVICE TEACHERS

B. Akcay
Istanbul University HAYEF Department of Science Education, Turkey
bbezir@gmail.com

One of the main goals of science education is to have scientifically literate society. Scientific literacy has been defined over a five decades in literature. One of the components of scientific literacy is to have an ability to distinguish science from non-science which is called problem of demarcation and understanding its limitations. To achieve this goal people should be understand the nature of science (NOS) which refers to epistemology of science, science as a way of knowing. However, today's society is increasingly exposed to pseudo-scientific and paranormal claims. To accomplish scientific literacy, teachers should aware of these New Age (pseudo-scientific) beliefs such as astrology, and homeopathy. Studies indicate that teachers' conceptions of science and scientific knowledge affect their instructional practices as well as their students' conceptions of science and scientific knowledge. Purpose of this study is to find out preservice teachers understanding of how to distinguish science from non-science and limitations of scientific knowledge. The sample consists of 120 preservice teachers including preservice elementary and preservice science teachers. Data collected during the 2011-2012 academic year. The questionnaire used to collect data. Its consist of 31 likert-type statements which are referred to common superstitions and pseudo-scientific beliefs and 5 open-ended questions including what the source of knowledge are, what science is, what the criteria to decide which knowledge is scientific and non-scientific. Results showed that preservice teachers believe in paranormal activities, astrology, and alternative medicine. Also they can't describe the criteria for demarcation to distinguish science from non-science. Their beliefs are mostly effective by their families, previous experiences and the media. Results revealed gender differences in superstition beliefs of preservice teachers. Females have more superstitious beliefs than males.

Keywords: Demarcation, pseudoscience, science, preservice teachers.

USING WRITING AS A MODE OF REFLECTION IN A CHEMISTRY LABORATORY

S. Kingir
Selcuk University, Graduate School of Applied Sciences, Konya, Turkey
sevgikingir@selcuk.edu.tr

This study investigated preservice teachers' written reflections in the physical chemistry laboratory. Data were collected through the administration of a reflection form to the 24 preservice chemistry teachers (9 female, 15 male) at the end of each laboratory session throughout a semester. The following questions were covered in the reflection form: How did you prepare for the laboratory? What did you learn? What were the effective factors in your learning? What difficulties did you face in your learning? How do you relate your learning with everyday life? How do you enhance your own learning? and How do you teach the concepts that you learned today to a high school student? Preservice teachers' written responses were coded and categorized into the following general themes: utilized sources, perceptions about learning, connection with daily life, and approach to teaching. The results showed that most of the participants read the experiment from their textbook just before they come to the laboratory. Preservice teachers mainly reiterated what they did in the laboratory rather than explaining the concepts that they learned. Most

of the participants had a difficulty in computing with data, and interpreting and visualizing the data. Many participants failed to connect laboratory experiences with daily life. All the preservice teachers adopted a teacher-centered approach in teaching the concepts that they learned to a high school student. They planned to use the strategies of lecturing, questioning, visualization, and exemplification. These findings suggest that appropriate learning environments should be created to encourage preservice teachers to adopt constructivist principles. Further studies can explore the effect of using reflective writing on students' conceptual understanding and metacognition in various content areas.

Keywords: Chemistry laboratory, Reflection, Writing.

EXAMINING OF PREDICTORS OF PROSPECTIVE TEACHERS' PERCEPTIONS OF THE QUALITY OF SCIENCE FAIR PROJECTS

H.S. Tortop
Bulent Ecevit University, Eregli Faculty of Education, Science Education Department, 67300, Zonguldak, Turkey
hasansaid@yahoo.com

The science fair where students present their projects generally evaluate or judge from judgment with certain criteria and then the best of projects is praised. Students conducted scientific research and they jolly passed time at science fairs. Quality of science fairs project assessment affect students some aspects. Teachers who they done mentorship, and of perspectives on project phenomenon, effect to reach the goals of the science fair. This study aimed to examine the predictors of quality of science fair projects in the light of prospective teachers' assessment of science fair rubric' domains.

In this study, thirty projects determined to evaluate by prospective teachers. These projects selected by judges in Isparta city for attending the Antalya District Exhibition of "Science and Mathematics Project Study for Primary School Students: This is My Work" (web address: http://tegm.meb.gov.tr/bubenimeserim/) at 2009-2010 academic years. Researcher was also a mentor this science fair. The science fair projects evaluated by thirty prospective teachers who taken Projects Based Learning Applications course, enrolled Bulent Ecevit University Eregli Faculty of Education at 2011-2012 autumn academic years. Prospective teachers taken into account for assessing the projects according to criteria of project guide. Obtained data conducted regression analysis and descriptive statistics.

At the results of study, the lowest mean scores of domain of science fair rubric, is method domain ($\bar{X}$=1.35), and the highest mean scores of domain of science fair rubric, is utility domain ($\bar{X}$=1.64) according to descriptive statistics. And model of regression formula is that; Overall Scores of Science Fair Rubric= 1.165 (constant) +.251(Assimilation and Comprehension Domain) + .250(Conclusion and Clarity Domain) + .225(Originality and Creativity Domain) + .221(Applicability and Usefulness Domain) + .205(Utility for Economical and Social Domain) + .192(Used Scientific Method Domain) + .184(Consistency Domain). Surprisingly, methods domain is one of the lowest predictors of overall scores of science fair rubric. However, it is known that method section is one of important section of scientific researches. Besides, scientific method section indicates whether or not to understanding of scientific researches by students. So, teachers should be given more attention to fulfill scientific research methods in terms of serving the educational goals of the science fairs.

Keywords: Science fair, Judgment, Scientific Research Methods, Regression.

 ISBN 978-989-98032-0-6

THE AVAILABILITY OF DRAMA AS A TEACHING METHOD IN PROVIDING AWARENESS REGARDING TECHNOLOGY-ENVIRONMENT INTERACTION IN SCIENCE AND TECHNOLOGY EDUCATION: AN EDUCATIONAL METHOD SUGGESTION

H. Bertiz
Abant İzzet Baysal University, The Faculty of Education, Elementary Education Department, Science Education Program, Gölköy-Bolu, Turkey
hbertiz@gmail.com

In this study, it was aimed to determine the availability of drama as a teaching method in providing awareness regarding technology-environment interaction via prospective science and technology educations teachers' views. A descriptive model was used in this study. The study was carried out with 33 prospective science and technology education teachers in a University situated in Ankara and completed in four weeks. At the end of the study, chosen randomly 9 pupils' views towards drama method were taken. For this, a semi-structured interview protocol was prepared by researcher before the interviews. For the qualitative data analyze, descriptive and content analyze techniques were used in the study. The prospective science and technology education teachers' meaningful expressions obtained interview protocol were described with frequency table in the study. According the observations and pupils' views, it was concluded that the drama as a teaching method is absolutely an effective method in providing technology-environment interaction. In the lights of findings, some suggestions offered.

Keywords: Drama, Availability of drama, Technology-Environment Interaction, Science and Technology Education.

STUDENTS' IDEAS ABOUT THE IMPLEMENTATION OF THE 5E LEARNING CYCLE MODEL IN THEIR CHEMISTRY COURSE

N. Aydemir[1], O. Geban[2], M. Aydemir[3]
[1]Ataturk University, Erzurum, Turkey
[2]Middle East Technical University, Ankara, Turkey
[3]Akdeniz University, Antalya, Turkey
nurdaneyazici@gmail.com, geban@metu.edu.tr, aydemirim@gmail.com

The purpose of this study is to elicit students' ideas about the implementation of 5E Learning cycle model (LCM) in their chemistry course. A total of 109 students from four 11th grade classes participated in the study. Classes were randomly assigned to control and experimental treatments. Experimental group (53 students) was instructed using the 5E learning cycle model whereas control group (56 students) was instructed with traditionally designed chemistry instruction. At the end of the instruction, semi-structured interviews were conducted with 6 volunteer students. A tape recorder was used during interview process in order to record the data. For the analyses of the interview data, first the audio recordings were transcribed in verbatim. Then, students' responses to the interview questions were coded and categorized into three dimensions namely, "comparison of the LCM and traditional classes", "changes in students", and "general ideas". The main differences between LCM and traditional approach based on students' views were daily life examples, student participation, experiments, and activities. In addition, the students expressed that LCM caused them some positive changes, such as increased attention to chemistry, learning better, more effort, talking much, and willing to learn. Moreover, most of the students preferred to have LCM classes rather than traditional classes.

Keywords: 5E Learning cycle model, Chemistry Education, Semi-Structured Interview.

 ISBN 978-989-98032-0-6

SCIENCE TEACHERS' KNOWLEDGE OF STUDENTS ABOUT GENETİC TOPİC

M. Aydemir[1], J. Çakiroğlu[2], C. Tekkaya[2]
[1]*Akdeniz University, Antalya, Turkey*
[2]*Middle East Technical University, Ankara, Turkey*
aydemirim@gmail.com, jaleus@metu.edu.tr, ceren@metu.edu.tr

This study investigated science teachers' knowledge of students about genetic topic. The study based on pedagogical content knowledge framework and one dimension of pedagogical content knowledge is students' knowledge. Teachers' knowledge was investigated about students on genetic topic with sub-dimension; students' requirements for genetic topic and students difficulties in genetic topic include misconception, learning difficulties etc. The dimension of students' knowledge determined with the help of model of pedagogical content knowledge of Magnusson, Krajcik, and Borko, 1999. Data were collected from five elementary science teachers having 12-30 years experiences. Data were collected by means of observation of teachers' genetic topic and interview. In the interview, students were asked on genetic topic about students' requirements for genetic topic and students difficulties in genetic topic. The observations of teachers were transcribed and related parts about student knowledge were determined and student knowledge parts were asked to teachers. Teacher responses were coded and categorized in the following themes; science knowledge, mathematical knowledge, maturity, skills for students requirements and genetic concepts, abstractness, constructing relationship, symbolic representation, students characteristics, science knowledge and mathematical knowledge for students difficulties. The results of the study revealed that genetic topic has abstract concept and students need to be in formal operation term for genetic topic to better understanding as requirements of students. Genetic topic is like top of the pyramid for biology topics because good understanding of genetic topic requires knowledge about cell, cell divisions, fertilization. Students generally are good at crossing. However, some of them did not understand what the meaning of crossing steps is and what the meaning of the results is.

Keywords: Science teacher, genetic, pedagogical content knowledge, knowledge of students.

FULL-SCIENCE: HAVE FUN WITH SCIENCE, LOVE SCIENCE, AND LIVE SCIENCE

B. Çavaş[1], Y. Özdem[1], B.Y. Yendi[1], U. Alper[2]
[1]*Faculty of Education, Department of Elementary Science Education, Turkey*
[2] *Atılım University, Science Entertaining Centre, Turkey*
bulentcavas@gmail.com, yozdem@metu.edu.tr, byılmaz@metu.edu.tr, ualper@atilim.edu.tr

The "FuLL-Science (have fun with science, love science, and live science)" project aims at ensuring the understanding of science and technology by the society offering innovative scientific and technological learning opportunities such as seminars, demonstrations, panels, competitions etc. from early childhood to adults. The FuLL-Science project is confident to reach this aim by promoting the following actions: The first approach (*Have fun with science)* is to help participants "have fun" with science. We plan to organize various activities, such as games, animations, entertainments, workshops, plays, theatres, music, dance, etc. that meet the participants in all ages with the amusement in science. We want to illustrate how science is enjoyable by a mix between science and art, theatre, and literature. The second approach (*Love science)* is to introduce the participants with the "love" part of the science, which we conceive as how scientists become productive in their respective fields and how scientists are ordinary people who are also have hobbies. That is, we would like to help the participants to recognize the scientists and their work by presenting them opportunities to meet with scientists and their studies. The third approach (*Live science)* is to assist the participants be acquainted with how they "live" science in their daily life. For example, we will present them opportunities to see how science is in our life, to experience the science in daily life by hands-on and minds-on activities, and to shape their view of science as a way of knowing. The participants will also realize the scientific developments in various fields by meeting and discussing with scientists. In the conference, we will introduce the project to interested researchers, present examples of hands-on science experiments that will take place during the night, and give information related to impact assessment of the night.

Keywords: Researcher's Night, Full-Science, Scientists.

SELF EFFICACY, PERCIVED PARENT AND TEACHER GOAL ORIENTATION AS PREDICTORS OF STUDENTS' GOAL ORIENTATION IN SCIENCE LEARNING

B. Çakır
Middle East Technical University Elementary Education, Ankara/Turkey
birgulmetu@gmail.com

Motivation is a critical research area to explain different response patterns in behavior and learning. Achievement goal orientation is one of important area in motivation which shed light on learners' reasons to engage in their academic work. One of the purposes of this study was to investigate the relationship between student achievement goal orientation and the variables named as students' self-efficacy, perceived parent goal orientation and perceived teacher goal orientation. The other purpose was to investigate how much variance in student goal orientation can be predicted by scores on student self-efficacy, perceived parent and perceived teacher goal orientation.

From three elementary schools in Antalya were selected for the study. Convenience sampling was used as a sampling method. 179 7th grade students participated to the study. Among these three schools, two 7th grade classes were selected randomly to represent their school. 92 (51.4%) of the participants were girls and 87 (48.6 %) were boys.

Two research questions were investigated:

1. What is the relationship between student goal orientation and students' self-efficacy, perceived parent goal orientation and perceived teacher goal orientation?
2. How much variance in student goal orientation can be predicted by scores on student self efficacy, perceived parent and perceived teacher goal orientation?

The results of 1st research question indicated that student mastery goal orientation and self-efficacy was strongly and positively correlated. In addition, perceived parent mastery goal orientation was moderately correlated with student mastery goal orientation. Perceived teacher mastery goal orientation was also moderately correlated with student mastery goal orientation. Secondly, students' performance goal orientation was moderately correlated with perceived parent performance goal orientation. It is interesting that student performance avoid goal orientation was moderately correlated with perceived parent performance and perceived teacher mastery goal orientation.

To answer 2nd research question multiple regression analysis was conducted. The results revealed that self-efficacy made the largest contribution to explain the variance in student mastery goal orientation. On the other hand, perceived parent performance goal orientation made the largest contribution to explain the variance in student performance goal orientation. In addition to this, perceived parent performance goal orientations also made the largest contribution to the variance in student performance avoid goal orientation.

Keywords: self-efficacy, achievement goal orientation, perceived parent & teacher goal orientation.

CREATIVE LITTLE SCIENTISTS

M.F.M. Costa[1], P. Varela[2]
[1] Centro de Física, Escola de Ciências, Universidade do Minho
Campus de Gualtar, 4710-057 Braga, Portugal
[2] CIEC, Instituto de Educação, Universidade do Minho
Campus de Gualtar, 4710-057 Braga, Portugal
mfcosta@fisica.uminho.pt, pibvarela@.uminho.pt

Science and Technology play a role of the utmost importance in our modern societies. An enlarged effective science math and technology education right from early childhood is a recognized

 ISBN 978-989-98032-0-6

priority. The complexity of today's society requires a great ability to think creatively and innovatively to meet the rapidly evolving development challenges, bringing creativity to school practice and to the teaching and learning of sciences and math in pre and early primary schools. The European FP7 project "Creativity Little Scientists – CLS" aims to positively contribute to this effort. The projects enrolls researchers from nine European countries (Belgium, Finland, France, Germany, Greece, Malta, Portugal, Romania, and the UK) representing a wide spectrum of educational, economic, social and cultural contexts. The Creative Little Scientists project constitutes a timely contribution to a better understanding, at the European level, of the potential available on the common ground that science and mathematics education in pre-school and early primary school can share with creativity. The project will provide a clear picture of current practices define challenges and proposes guidelines, curricula and exemplary materials for relevant teacher training in the various European contexts.

PRI-SCI-NET

M.F.M. Costa[1], A. Oguz-Unver[2]
[1] *Universidade do Minho, Centro de Física, Escola de Ciências, Portugal*
[2]*Faculty of Education, Dep. of Science Education,Mugla University, Turkey*
mfcosta@fisica.uminho.pt, ayseoguz@mu.edu.tr

PRI-SCI-NET is an EU funded FP7 Supporting and coordinating action (Call SiS-2010-2.2.1.1) on innovative methods in science education: teacher training on inquiry based teaching methods on a large scale in Europe. The project is coordinated by the Malta Council for Science and Technology (MCST) and has 17 partners from 14 countries (www.prisci.net). The project promotes Inquiry-based learning approach among primary teachers teaching science to young children in the age range of 3-11 years. The inquiry approach involves the active engagement of children in the learning process with emphasis on observations and achieved through authentic and problem based learning activities where there is no need to get the correct. Children draw conclusions on the evidence collected. It promotes student autonomy, involves discursive argumentation and communication with peers (talking science), self regulated learning, social interaction and collaboration.

This project is about setting up a Europe-wide network for professionals and academics in the area of Primary Science Education. The aim is to provide training and professional support to teachers to help them use Inquiry based learning in Science in schools. The platform at European level will network professionals as well as support the organization of training courses. It also recognizes teachers' and researchers' achievements in implementing Inquiry-based learning in science, as well as provides an opportunity for teachers and academics to share their experiences and successes. The project will concurrently also take small projects in primary science education, and promote them on a larger scale in order to provide examples of Inquiry Based teaching approaches to have an impact at European level. The project includes several previous projects, mainly: using an already developed theoretical pedagogical model for the teaching of science at primary level for developing teaching resources (developed as part of Comenius 1 and 2 projects); utilizing the European network for primary school teachers to provide training and professional development to primary science teacher trainers; as well as providing in-service training opportunities based on experience of partners in implementing ERASMUS intensive courses for primary school teachers on a national and international level. Pri-Sci-Net aims to establish a European community of primary science educators working within the Inquiry Based approach. The project Pri-Sci-Net will produce the following activities:

- Development and publication of 45 science teaching activities using IBSE in 15 different languages;
- Recognition of Excellence for teachers implementing IBSE at primary;
- Two International conferences to be held in Portugal and in Malta;
- Four 20-hour national training on IBSE at different levels for teachers and teacher-trainers in each of the 13partner countries;
- Three international teacher-training courses;

© 2012 HSci. ISBN 978-989-98032-0-6

- The creation of a virtual European network platform for teachers and researchers in primary science;
- An online newsletter and a research journal on IBSE in primary science;

The project is relevant to primary teachers interested in science as it will offer downloadable teaching material, training courses, online collaboration and networking, as well as opportunities to attend the international activities being organized by the project.

THE PROJECT "FISBRINK: LEARN PHYSICS PLAYING!": ITINERANT SCIENTIFIC EXHIBITIONS AND THE PROMOTION OF SCIENTIFIC LITERACY OF PEOPLE FROM THE CITY OF ITAPETININGA – SÃO PAULO, BRAZIL

J.N. Teixeira[1], M. Muramatsu[2]
[1]Instituto Federal de São Paulo – Campus Itaperininga, Brazil
[2]Instituto de Física da Universidade de São Paulo, Brazil
jonny@if.usp.br, mmuramat@if.usp.br

Students in the elementary and secondary education in Brazil today have shown low efficiency in the natural sciences, as shown by some international assessments such as PISA. One reason for this lower performance is, generally, the lack of teachers in public schools of Brazil and their inadequate formation, which influences the classes quality and, consequently, the scientific literacy of citizens that went through these levels of education.
In this context, the city of Itapetininga (São Paulo state, Brazil), presents some aggravating in this situation, because there are no science centers or science museums which are important tools to support formal education and to promote and increase the levels of scientific literacy and culture in a region. Thus, this itinerant project of scientific popularization was designed with the objective of stimulating the curiosity of local population through the "hands on" exhibits, aiming to increase the levels of scientific literacy and scientific culture of the people who pass through the exhibition which is performed in squares, streets and basic schools of the region.
In this project, Physics students from Federal Institute of Education, Science and Technology of São Paulo (IFSP) spread exhibits in tables, at places where people regularly pass through, inviting them to interact with the exhibit or to participate in workshops, to construct toys and experiments that use physics phenomena.
These types of project has many difficulties of implementation, such as the transport of exhibit or climatic conditions of visited places, they are mostly made in opened places, like squares, streets or public parks. However, one of the biggest difficulties of this project is to assess the impact on the visiting population, as they are sporadic visitors. Therefore, to evaluate the initial impact of the exhibition, we considered any eventual reaction of satisfaction, like a smile or characteristics facial or corporal expressions of each participant in the workshop or in the exhibition.
Through this parameter it was possible to know some important function of this kind of exhibition such as to whet the curiosity, to attract the attention of people, to encourage the temper for science and to motivate some people to think about science topics.

REVERSIBLE ACID HYDROLYSIS OF A CR-S BOND: A BIOINORGANIC/COORDINATION CHEMISTRY INTEGRATIVE EXPERIMENTAL APPROACH

T.M. Santos, J. Pedrosa de Jesus
Chemistry Department and CICECO, University of Aveiro, Aveiro, Portugal
teresa@ua.pt

Bioinorganic is a main target of Inorganic Chemistry Research. Any attempt for putting together Inorganic, Coordination and Bioinorganic in a single laboratory work provides students with a wide vision of today's′ world, as information/knowledge flows from different branches of science.
Beginning by analyzing the biological double role of chromium, distinction between oxidation state +3 (chromium - trace essential element, acting in carbohydrate and diabetes metabolism) and +6 (proved toxic and carcinogenic, although thoroughly used in industrial processes), an

 ISBN 978-989-98032-0-6

immediate consequence emerges through a discussion on this subject.

Conjugation of an essential element (chromium - transition metal) and a biological molecule (L-cysteine - natural amino acid), appears then an "ideal" combination.

In vivo, the anion Cr(VI) is well documented to easily cross cellular membranes (SO_4^{2-}/PO_4^{3-} specific channels). Once inside cells, is readily reduced to Cr(III), mainly by GSH - tri-peptide containing cysteine, ascorbic acid and L-cysteine, due to their high concentrations.

Studying a Cr(III)-cysteine complex, $Na[Cr^{III}(L\text{-}Cys)_2]$, as model for the formed intracellular Cr(III) species, and its behavior under a narrow biological fluids pH window, can easily lead students to extract general considerations about intracellular chromium-biological mechanisms.

The experimental work comprises the synthesis and characterization (UV/Vis and IR) of $Na[Cr^{III}(L\text{-}Cys)_2]$, followed by spectroscopic (Vis) characterization of the reversible acid hydrolysis of one of its Cr-S bonds (pH 7 - 5). Besides, the Cr-S bond opening-closing is not expectable, if based on the "traditional" inertness of Cr(III) complexes.

$$[Cr(L\text{-}cys)_2]^- + H^+ \rightleftarrows [Cr(L\text{-}cys)(L\text{-}cysSH)(H_2O)]$$

Reversible $[Cr(L\text{-}cys)_2]^-/[Cr(L\text{-}cys)(L\text{-}cysSH)(H_2O)]$ transformation is clearly detected in electronic spectra λ_{max} band shifting, and accompanied by solution color change (deep blue to violet and *vice-versa)*, permitting to follow the referred chemical reaction.

The described laboratory experiment is expected somehow to successful fill a "hole" on Secondary School Laboratorial work, combining different science disciplines.

Keywords: chromium; complexes; bioinorganic.

Acknowledgments: Chemistry Department (University of Aveiro), CICECO, FCT (Portugal).

BRINGING GREEN CHEMISTRY TO PRE-COLLEGE LEVEL STUDENTS

C. Nogueira[1], M.E. Santos[2], J. Oliveira[2]

[1]Vagos High School, 3840-404 Vagos, Portugal
[2]Department of Chemistry and CESAM, University of Aveiro, 3810-193 Aveiro, Portugal
candida.nogueira242@gmail.com, edsantos@ua.pt, jabpo@ua.pt

Since the publication of the famous book Silent Spring, which launched the Environmental Movement, the concerns about environmental pollution and human health have dramatically increased. This led to a new awareness towards to using renewable resources, and minimizing waste and energy, and to the emergence and development of the so called Green Chemistry. This new way of dealing with Chemistry, concerning not only industrial chemical processes but also research and academia were summarized in the so called Twelve Principals.

These guidelines should be introduced to the students, since early stages of learning chemistry until college level, which in Portugal spans from eight to twelve grades, to make them well prepared, better informed and environment alerted professionals. Among the possible topics that could be used to convey these problems and some of the proposed solutions Analytical Chemistry (AQ) was the chosen one. In fact, AQ seems to be an ideal way to "green" the Chemistry taught to the students. For them Chemistry is probably associated to the analysis, and working through the AQ steps it is possible to cover the majority of the fundamentals of Green Chemistry.

The implementation of the Twelve Principals, always according to the existing curricula, will be both from a theoretical as well as laboratorial point of view. In the first case when introducing new chemistry concepts they will be "tainted green". For instance when introducing the topic of chemical reaction, reagents and products the (first) principal that "It is better to prevent waste than to treat or clean up waste after it is formed". For the laboratorial work, a green chemistry metric was developed, and it will be applied to new lab sessions showing that they are "greener" than the ones already in use.

Keywords: Green Chemistry, Analytical Chemistry, Pre-college level.

Acknowledgments: The authors are grateful to CESAM for the financial support.

SCIENCE LEARNING AND ACESSIBILITITY: A CHALLENGE FOR KIDS AND TEACHERS

M.I. Nogueira[1], B. Milan Martins[1], S. Honda Takada[2]
[1]*Institute of Biomedical Sciences, University of São Paulo, Brazil*
[2]*Program of Neuroscience and Behavior IP-US[3], University of São Paulo, Brazil*
minog@usp.br, barbaramilan@usp.br, silviahonda@usp.br

Motor, Behavioral and Cognitive disturbs come from many sources; one important of them is the lack of oxygen in the neonatal period. Our laboratory studies this condition in an animal model (Takada et al. 2011) developed, validated and explored under many aspects, confirming the relevance of the sequelaes. In Brazil, aiming social inclusion educational authorities nowadays consider that all kids should be put together in the same class according to their age, in spite of special needs they might have. However, teachers are not well prepared to deal with the situation, from the understanding, psychological and instrumental aspects. Therefore, this workshop aims to promote conditions to experience some of those situations like blindness, deafness, mutism, and motor deficits to acquaint the professional with the conditions and also to discuss possible strategies to collaborate to a true inclusion and efficient teaching/learning process. The discussions will be oriented in how to overcome and potencialize the learning and inclusion of those kids through alternative materials and how can we validate these proposals.

Keywords: accessibility, social and educational inclusion, neonatal anoxia.

SCIENCE CENTERS AS ENRICHED EDUCATIONAL ENVIRONMENT

B.M. Martins[1], M.I. Nogueira[2]
[1]*Institute of Psychology, Universidade de São Paulo, Brazil*
[2]*Institute of Biomedical Sciences, Universidade de São Paulo, Brazil*

The neuroscience emphasizes the role of the environmental characteristics on the brain´s transformations due to its neural plasticity. Those conditions named enriched environment, according to the positive impact in learning and development they might provide. Therefore, this environmental concept was transported to science centers through interactive activities based in the "*learning by doing" (hands on, minds on, heats on*) principle. To evaluate their impact on children learning, workshops of scientific toys construction were offered to public schools in Santo Andre (São Paulo, Brazil). The objective is identifying the environmental factors that might favor or limit the performance and interactions of students in scientific toy´s building workshops.

The qualitative method Study of Cases Applied to Education was used to collect and analyze the data, it demands a continuous follow up by the researcher to assessing the interaction between students, mediators and teachers. The data were obtained by interviews, audio and video recording in daily field.

The fundamental structural element of the activity was a book containing the instructions to build the toys autonomously. Students that at school were classified with learning difficulties in the workshop performed like the ones considered normal. Mediators and teachers played essential role as enriched elements in this environment, where their conception of teaching and learning method exerts significant influence in the activity´s development. The workshops allowed different types of learning: how to do, how to express themselves, how to live together, teamwork, and the conceptual elements in the sciences.

This work showed that the conception of teaching and learning of the educator and the relationships between educator and student are fundamental to the creation of enriched educational environments. The learning environments in their design and implementation should be based on a comprehensive perspective, considering their physical, structural and human aspects.

Keywords: science museum, enriched educational environment, workshops, toy's construction.

INTRODUCING NATURE OF SCIENCE TO PROSPECTIVE TEACHERS: THE EFFECT OF USING DOCUMENTARY

O. Ağlarcı, F. Yazıcı
Marmara University, Atatürk Faculty of Education, İstanbul, Turkey
oya.aglarci@marmara.edu.tr, fatih.yazici@marmara.edu.tr

Raising scientifically literate people is one of the most important aims of science education. A scienfically literate person should understand what science and scientific procedures are and make decisions based on that knowledge. Understanding nature of science is one of the ways of raising scientifically literate people. Nature of science refers to epistemology of science as a way of knowing, or the values and beliefs inherent to the development of scientific knowledge (Lederman, 1992).
The researches have shown that teachers' and prospective teachers' understandings related to nature of science are inadequate and embedded with a range of alternative conceptions. Therefore, the aim of the study is to improve their understandings by using a documentary related to Einstein and the development of his famous equation ($E=mc^2$). Einstein and other scientists' (including Faraday, Lavoisier, Lise Meitner, Otto Hahn) scientific work as well as their personal lives were presented in this documentary. The study was constructed in the light of constructivist/interpretive paradigm and case study design was benefited. 20 prospective chemistry teachers (PCTs) were participated in the study. An open questionnaire designed by the authors was used and it was implemented after PCTs watched the documentary. The questionnaire involves questions related to difficulties that scientists come across, the gender role in science, scientists' characteristics, sociocultural perspective of science. Also, Views of Nature of Science Questionnaire (VNOS-C) (Lederman, Abd-El-Khalick, Bell and Schwartz, 2002) was selected as the second data- gathering instrument and was implemented as pre and post test.
After watching the documentary, the PCTs mentioned that they understood clearly the humanistic side of scientists and sociocultural side of science. They also recognized factors (such as gender, nationality, religion) that effect scientists and science as well. They emphasized the tentativeness and subjectivity play an important role in science. Their post test result scores showed that their understandings improved in comparison to the pretest scores.
It can be suggested that documentaries can be used as an alternative method when introducing nature of science to students and teachers.

A PRACTICAL WORK TO PROMOTE INTERDISCIPLINARITY BETWEEN ANALYTICAL AND INORGANIC CHEMISTRY

M.E. Santos[1,2], T.M. Santos[1,3]
[1]*Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal*
[2]*CESAM, University of Aveiro, 3810-193 Aveiro, Portugal*
[3]*CICECO, University of Aveiro, 3810-193 Aveiro, Portugal*
edsantos@ua.pt, teresa@ua.pt

The need for interdisciplinary in scientific research is well recognized nowadays, however poorly developed in the undergraduate levels of Chemistry learning. The courses at the University are usually organized in curricular units covering different areas of chemistry: organic, physical, inorganic and analytical.
Practical laboratory work is a fundamental support to motivate learning and understanding of theoretical concepts underlying the experiments, besides developing practical skills. It is also undoubtedly a very useful tool to promote a non-fragmented wider vision of chemistry. The existence of practical curricular units separated from theoretical classes is a good way to introduce interdisciplinary in laboratory works.
This work describes a laboratory experiment which can be carried out in such a curricular unit after or simultaneously with the 1st theoretical disciplines of Inorganic and Analytical

© 2012 HSci. ISBN 978-989-98032-0-6

Chemistry, where the students are supposed to learn, among other subjects, the chemistry of transition metals (Inorganic Chemistry) and oxidation/reduction titrations (Analytical Chemistry).
The laboratory work proposed combines the study of typical reactions of transition metal elements with quantitative analysis based on an oxidation/reduction titration. Four non-identified solids are provided to the students. They only know that three of them are three different coordination compounds containing a metal oxalate (in this case Al(III), Cr(III) and Fe(III) oxalate), and another is a simple metal salt (Fe(III) nitrate). Based on "typical" reactions of the different metal cations, and on the basic properties of oxalate the students perform the identification of each solid. Then, a solution of the iron oxalate is prepared and the content of oxalate is determined by titration with a standard solution of permanganate. The number of hydration water molecules and the molecular formula of the potassium trioxalatoferrate is then determined. The reactions involved are discussed and stoichiometric and equilibrium calculations are performed.

Keywords: Inorganic Chemistry, Analytical Chemistry, Practical Work.

ROMANIAN TEACHERS PERCEPTION ON INQUIRY – BASED SCIENCE EDUCATION

A. Sporea, D. Sporea
National Institute for Laser, Plasma and Radiation Physics
Str. Atomistilor 409, Magurele 077125, Romania
adelina.sporea@inflpr.ro; dan.sporea@inflpr.ro

The Center for Science Education and Training – CSET is a department of the National Institute for Laser, Plasma and Radiation Physics which supports and promotes science education at the pre-university level. CSET is one of the partners involved in the EU funded project "Little Creative Scientists – Enabling Creativity through Science and Mathematics in Preschool and First Years of Primary Education" contract no. 289081, and it coordinates the project in Romania. One of the project tasks is to make an analysis having as subjects preschool and primary school teachers. The analysis was done based on the questionnaire elaborated by the project team.
In Romania, the survey's participants count more than 250 teachers. The paper analyses teachers' perception on the inquiry-based science education - IBSE implementation in Romania, through the results of the survey.
The value of this investigation is highlighted by the following issues:

- IBSE method is known and applied in Romania at a less extent;
- Because of the large number of survey's participants, the paper can be considered a real radiography of IBSE implementation in the Romanian educational system.
- according to our knowledge, this study is a premiere in Romania

The authors tried to localize IBSE characteristics in Romanian teachers practice, in spite of the fact that IBSE method is not part of the curriculum.
The content of this communication is the sole responsibility of its authors and it does not necessarily represent the views of the European Commission or its services.

SCIENCE FAIRS. TEACHER TRAINING

Z. Esteves, M.F.M. Costa
Universidade do Minho, Centro de Física, Escola de Ciências, Portugal
zita.esteves@gmail.com, mfcosta@fisica.uminho.pt

Science fairs involving the development of science projects, is not a regular practice in Portuguese schools. Therefore three teacher training courses on the development of this type of IBSE projects in the context of Science Fairs were organized in recent years. Herein we will present the training strategies employed as well as the teacher's feedback on their professional experience in this subject and on the educational approach suggested by the authors.

© 2012 HSci. ISBN 978-989-98032-0-6

SCIENCE FAIRS

M.F.M. Costa, Z. Esteves
Universidade do Minho, Centro de Física, Escola de Ciências, Portugal
mfcosta@fisica.uminho.pt, zita.esteves@gmail.com

Science fairs are activities used out of the formal school context for longtime in different countries in different contexts and approaches. In thispresentation we will discuss the importance and pedagogical usefulness ofScience Fairs in both the acquisition of general work and inquiry skills besides, basic competencies in the learning of science, as well as concepts andknowledge directly related to the formal school curricula. Our approach andexperience on the implementation and use of this type of activity is going to be presented and discussed.

THE EFFECT OF MULTIPLE MODELS HANDS-ON PHYSICS ACTIVITIES ON DEVELOPMENT OF CHILDREN'S SCIENTIFIC PROCESS SKILLS

E. Çiğrik[1], M. Özkan[2]
[1]*Ministry of National Educational, Bursa, Turkey*
[2]*Elementary Education Department, Ulludağ University Bursa, Turkey*
ersen@bursabilimmerkezi.org, ersencigrik@gmail.com

Physics learning was one of the areas that have the most learning difficulties and misconceptions in elementary school. These difficulties were especially caused by fall through active learning experiences. Learning activities such as problem solving, experimentation, project developments were effective for the development of advanced scientific process skills. The development of students' who come to low socio-economic level schools; scientific process skills were determined during the hands-on physic camp in the study. 50 students who come from the boarding schools and state schools participated in the study. Scientific process skills (SPS) test were applied before the study. All the students participated in the activities related to physics topics during the seven-day camp in Bursa Science and Technology Center. The SPS test was applied after the study. In addition, the study examined the relationship between the development of science process skills and hands-on activity models.

Keywords: Hands-on Science, Science Learning, Physics.

"KASISH" MODEL FOR SCHOOL SCIENCE CLUBS AND SOCITIES FOR HANDS ON SCIENCE

P.C. Vyas, M.I. Nogueira
Council of Boards of School Education (COBSE), India
Institute of Bio- medical sciences, USP, Brazil

In last two decades, the importance of Quality of K1-12 science Education, Science literacy for all, application of scientific knowledge for improving the quality of life of people, right to education and right to scientific information for human development, protection and conservation of environment and World deceleration on Science for creation of endogenous scientific capacity for peaceful co-existence and sustainable development unleashed International movements like PCST, HSCI, Science Centers World Congress and ICSTME etc. Several governmental and voluntary, as well as, institutionalized professional efforts are being made for popularization of science and science communication all over the world to create societies with scientific temper. The net work of science clubs, centers and societies are being used as instruments for the above purpose. Since the integration of information and communication technology revolution in educational paradigm many knowledge net works promoting the activities under the clubs, centers and societies through print material and digital media has come into existence at macro level. In India, Vigyan Prasar is nodal institution for capacity building in science resources and Knowledge resources through Print material, Radio, television scientific experiments through computers, activity kits, Edusat interactive terminals, Vigyan Prasar information system (VIPRS) and Vigyan Prasar Net work science clubs (VIPNET).
The 'KASISH' model is based on K= Knowledge about these measures, A =Attitude

© 2012 HSci. ISBN 978-989-98032-0-6

formation through these activities, Skills required for the activities, innovations necessary to improve the existing methods for creation of society with scientific temper through human development i.e. education for life- long learning in science by different sectors and levels of society. The 21st century third mission of Education envisages continuing and extension education at schools, colleges and universities. The Improvement in quality of science teaching-learning is foremost important in first instance. The universities and colleges are fountain heads of research and innovation. All most all efforts made at international level, in developed and developing nations had interaction between schools, college , university and research institutions, However the role of society, its involvement and life-long education in accordance with objectives for science for all have not received significant attention of scientific community. The science has grown in isolation of society at large. It has brought popularization of science and science communication in focus in almost all countries of world. The capacity building among the scientists and teachers as effective science communicators has assumed significance recently. The school is required to become an instrument or nucleus of scientifically literate society. The kasish model is meant to empower all stakeholders such as scientists, teachers, researchers, students, youth and citizens at large in a culture of science for all.

The knowledge net works subject and specialty wise exists in all spheres of scientific activity at national and international level. Accordingly science clubs, centers and societies can be identified depending on their thrust areas. The activities in the field of science communication need blending with the cultural ethos of the society. The Indo- Brazil symposium organized under auspices of university of Sao Paulo of Brazil in the leadership of prof. Maria Ines Nogueira (Oct.17-21) brought together expertise in comprehensive science communication and culture. Experts from India and Brazil discussed several issues concerning identity, concepts and strategies, production of science and technology, role of communication, formal and in-formal education for museums and science centers, training of professionals, policies for social inclusion and accessibility, anthropological and cultural aspects.

The objectives of the network were exploring the structure, meanings, and implications of science communication in the contexts in which science communication is being conducted. Investigate the motivations of and constraints involved in producing information about science for non-professional audiences and analyze the functions of public communication of science and technology in contexts of language, culture, arts and media studies. Linking knowledge about the public communication of science and technology to research in communication methods more broadly, in order to develop new knowledge about science communication culture and Media. These aspects were used to construct Knowledge Net works effective at school level.

The knowledge net work based on Kasish model brought together teachers in schools, students and society, experts from college and universities for School science clubs and societies. The science centers are established at national, regional and area and under universities requires a much higher level academic expertise huge amount of resources .Hence the idea of School based Community Science Awareness Centers (CSASC); a permanent exhibition or mini-museum of achievements of school students in various activities, projects, hands-on experiments etc. in science clubs and societies through charts, posters, cartoons, photo-albums, collages, pictorials and digital resources was conceptualized. These mini-museums are developed by cooperative learning by students, teachers, experts of knowledge net works or organizers of clubs and societies and provide opportunity for the ownership of scientific efforts and help them to learn skills and motivation for innovation with locally available resources for experimentation.

Sustainable development is the priority area and it must have natural calamity proofing. Many states of India suffer from drought and floods, Natural calamities, landslides, cloud bursts etc. The climate change is considered as one of the factors affecting rainfall cycles enhancing the impact of these calamities aggravating the problems of environmental conservation. The Indian sub continent has become prone to earthquakes. The knowledge base of the above aspects is lacking in the country. These knowledge Net Works are effective at micro-level for a unit of maximum of 50 schools, 5 colleges and one university and help in integration of environmental education in general education. It is based on voluntarism in accordance with Gandhian principle of constructive social intervention. The programmes are selected based on research design information for every school and dynamic Charter developed by students, teachers, parents and experts. The subjects and themes and activities are planned by them also. Thus it is a need based programme for science based learning in out of lab and out of class learning environment. The presentation will focus on knowledge elements, pedagogic considerations, capacity building in school teachers and experts, Programme construction and selection, research designs and sharing of experiences for establishing knowledge Net Works and development of charter of activities for school science clubs, Community science awareness centers and school science societies.

SELF-EFFICACY BELIEFS OF PRE-SERVICE ELEMENTARY SCIENCE TEACHERS ON FIELDTRIPS

E.A. Köksal
Elementary Science Education Department, Nigde University, Turkey
eakoksal@nigde.edu.tr

This study intended to construct a self-efficacy scale on using field-trip in science education. The study also aimed to assess pre-service teachers on the self-efficacy constructs. Self-efficacy can be described as the perception of individual capacity. When the teacher candidates and teachers are considered, self-efficacy beliefs affect teachers' classroom practices and teachers with a high self-efficacy level are more passionate about teaching. Survey design was used in this study and the population was determined as all science education students at Nigde University. The sample consisted of all senior students in the same department. There are 265 students in the whole department while 33 of them in the last year. The data were gathered through a survey questionnaire by Öztürk (2008). The students' responses were analyzed in order to construct a self-efficacy scale. When item and scale analysis were done, it was found that the scale is multidimensional and consisted of teaching efficacy, taking responsibility, getting permission, analyzing profit-loss, and interacting socially factors.

References

Öztürk, Ç. (2008). Coğrafya öğretiminde gezi-gözlem tekniğini kullanabilme öz-yeterlilik inanç ölçeğinin geliştirilmesi [Developing a scale of self-efficacy belief about using fieldtrip method in teaching of geography]. *Ondokuz Mayıs Üniversitesi Eğitim Fakültesi Dergisi, 25*, 13-23.
http://www.pegem.net/dosyalar/dokuman/124565-20110819145941-25-13-cografya.pdf

THE UNIVERSE AS A LABORATORY

F. Gök
Akdeniz University, Faculty of Education, Antalya, 07058, Turkey
gok@akdeniz.edu.tr

The imagination of human being is limited by the size of the frame that he looks or sees the things. His perception, imagination and knowledge begin expanding as the size of the frame expands. Recently, in about 100 years, the limits of his frame have been increased greatly by flipping his eyes from earth to micro and macro universe. To look further away (deep in space), he has developed devices. To reach there, he has produced machines, computers and communication tools. To increase his knowledge about the astrophysical objects that are too far away, he developed telescopes and satellites. As he looked further away, he came across more astonishing objects than before whose physics are a mystery to him. He has tried to solve the mystery and understand their nature.
Supernova remnants (SNRs) are one of those objects located in deep space. We obtain information about elemental abundances of our universe by observing them in optical, radio, x-rays and infrared bands. We also obtain information about the formation of next generations of stars. As the number of SNRs observed increases, our knowledge about their nature increases as well. By observing these objects with Russian-Turkish 150cm Telescope (RTT150) in optical band we try to contribute to the knowledge about them.

© 2012 HSci. ISBN 978-989-98032-0-6

BOT'N ROLL ROBOTIC KIT AS A LEARNING TOOL FOR YOUNGSTERS

F. Ribeiro[1], G. Lopes[1], N. Pereira[1], J. Cruz[1], M.F.M. Costa[2]
[1]Departamento de Electrónica Industrial, Universidade do Minho, Portugal
[2]Centro de Física, Universidade do Minho, Portugal
fernando@dei.uminho.pt, mfcosta@fisica.uminho.pt

Activities involving robotics, projecting assembling and programming robots are in essence hands-on and inquiry-based activities leading to an effective learning of different aspects of science and technology among others. Different approaches have being used to introduce robotics in the education of young children. In this communication we will present an approach that in an inquiry based science education, IBSE, perspective, uses an informal environment to introduced robotics, as well as a range of other science and technology, concepts and competencies to young students.
Many youngsters are getting interested on general technology and the robotics field in particular. Even though their knowledge is very basic they are very enthusiastic and willing to learn quickly.
Most robotics events consist of competitions, and that means the youngsters still need guidance by professionals. RoboParty is a different educational robotics event that teaches the participants, with IBSE hands-on techniques, how to build a robot from scratch to program it and in the end they keep the robot they built for themselves for further exploration.
Such robot to be built by the young children for the first time needs to be very easy and with a friendly programming language. The Bot'n Roll robotics kit was developed specifically for the RoboParty event, and has since then been improved with more sensors and actuators, which are simple to built and easy to use. The Bot'n Roll robot family launched recently another more complex robot that uses omnidirectional wheels and that can be used on other robotic competitions like world known RoboCup. This paper describes also the Bot'n Roll robots and show how they are built, bearing in mind that these robots were developed for youngsters who never worked with robotics.

This communication was drawn in the frames of the activities of the PRI-SCI-NET project supported by the European Union Seventh Framework Programme (FP7/2007-2013, grant agreement no. 266647).

ENERGY AND ENERGY-RELATED DEVELOPMENT AND IMPLEMENTATİON OF A TEST FOR DETERMINATİON OF MISCONCEPTİONS

U. Töman, F. Özgür Karata, S. Odabaşi Çimer
Bayburt University, Turkey
utoman@bayburt.edu.tr

Sciences research in the literature a large number of science students about the concept of scientific ideas that they have not been accepted as the basis of these ideas and experiences gained in daily life often creates inconsistent reveals the prejudice and intuition. Before coming to class and students' misconceptions often encountered in their daily lives they create different types of events by analyzing the expression of these men are more adversely affect subsequent learning.
Primary and secondary education programs located in one of the basic and important concept is "Energy". Science is an interdisciplinary concept of energy in many different concepts are related directly or indirectly. Energy used by many branches of science are common across different disciplines and interdisciplinary aspects of an issue to be addressed. Students' misconceptions and reveal the different measurement tools have been used to describe them in detail. Thoughts about the concepts with a detailed clinical interview to determine the events and situations such as discussions about the testing methods are applied and known to be used with open-ended questions as well.
The one of the methods most commonly used to determine the multiple-choice tests. In this way it is difficult to determine why students chose that response. For this reason, testing is done with the interview after the application of pupils. Another way to investigate the causes of students' responses in the annotated-multiple-choice tests. Where the correct response to these tests along with the options questions are left blank for the students' descriptions of why they do this

 ISBN 978-989-98032-0-6

selection. Responses to multiple-choice section here with student-written answers in respect of relationship between the interpreted data. "Diagnostic test" is also referred to as one of the tools most often used to determine students' misconceptions. Test developed in this study to determine today's students think about what-why are believed to provide a significant contribution.
The purpose of this study the energy associated with the energy and energy conservation, energy sources and energy conversion concepts and misconceptions about the development of a test to determine the assessment of the applicability. Elementary Science Education Program is prepared to determine the reliability of the test were 80 students. Reliability of the test was found to be 0.92. Then, test 35 Elementary 2 the students' grade science teacher. The findings of the test the energy associated with teachers' energy and energy conservation, energy sources and energy conversion concepts and showed that a number of misconceptions.
The findings of the test implementation of the concepts associated with students' ideas about energy showed an extremely detailed. After each multiple-choice test the marks of the announcement of why you were asked as a result of the students considered that option. In parallel, a very descriptive options for students to find the options when creating test items written by students' responses to open-ended questions result from taking advantage of scanning a wide range of literature.
Showed no change and even the diversity of misconceptions is a known fact. This is taking into account the tests to determine students' thoughts about certain concepts need to develop a variety of intervals. Teachers' misconceptions in applying the test developed in this study, both thought to be determined and why they think this way. So much better than the results of learning activities drawn up.
Despite the description of the test to include portions of this research was the students explain their ideas enough. For this reason a more detailed manner to determine the students' thoughts on the concepts in two phases in line with the data obtained from multiple-choice tests and the test is thought to be conducting interviews.

MINI SYMPOSIUM

POST–GRADUATION PROGRAMS FOR SCI&TECH&CULTURE POPULARIZATION´S PROFESSIONALS

M.I. Nogueira[1], M.F.M Costa[2]
[1]*University of São Paulo, Brazil*
[2]*Universidade do Minho, Portugal*

1. IS THERE AN IDEAL CURRICULUM AND PROFILE FOR A SCI&TEC&CULTURE POPULARIZATION´S PROFESSIONAL?

M.I. Nogueira[1], C.A. Teixeira[1], P. Srivastava[2]
[1]*Universidade de São Paulo, Brazil*
[2]*Lucknow University3, India*
minog@usp.br, cteixeira@usp.br, pkscdri@gmail.com

The increasing amount and complexity of the Science, Technology and Culture knowledge in association with the demands of society to get acquainted and use them requires a continuous formal, informal and non formal education. It is necessary to go beyond the entertainment level to make people aware, stimulated to search for and understand principles of daily science, to use/comprehend news technologies and cultures that impact their lives. How to prepare the ones to mediate or manage this bulk of knowledge? Which is the best, if there is one, curricula? Which profile should this professional bear? Those questions are to be raised and discussed aiming to prepare a more suitable/prepared professional to reach out the layman, science centers visitors or for a better utilization of mass communication vehicles and social medias.

2. CONCEPTUAL MAP OF THE PROFILE OF A SCIENCE MEDIATOR/COMMUNICATOR

L.R. Batista, M. Muramatsu
Universidade de São Paul, Brazil
luisrobe@if.usp.br, mmuramat@if.usp.br

To stimulate the reflextion and the discussion on the challenging themes of taking science to children and look for strategies to boost their curiosity and interest for science since childhood is the goal of a Post-Graduation Program. We start from the belief that curiosity is an important characteristic of children. We firmly believe that the engagement of the student with an activity, his/hers motivation and the emotion they experience carrying on when accomplishing the task, constitute the elements that favors criativity, the imagination, the investigative attitutude and, consequently, the learning. We judge that the teacher/educator is the one Who has conditions to create situações to promote learning and evoke those children´s qualities. Therefore, to develop a course that might produce professionals with those qualities, The program should count with ecletic professionals with a profile encompassing all levels of scientific knowledge.

3. BUILDING EXHIBITS TO MOTIVATE VISITORS

J.N. Teixeira, M. Muramatsu
Universidade de São Paul, Brazil
jonny@if.usp.br, mmuramat@if.usp.br

One of the skils required in a person who deals with non formal education is creativity. To observe, acquire and transform a scientific/technological concept in an efficient, attracting and motivating experiment this skill is needed. Therefore, planning experiments that illustrate sicence phenomena one must consider an exhibit that attract visitors, by means of many factors, among them are the design of the device/exhibit, its interactive potential, the diaroms and the distribution of each experiment. This topic intends to discuss the advantages of building or developing impactant and interactive experiments, through which the visitor might interact with the exhibit, according to the layout of each one and the central goal of the exhibition.

4. SCIENCE FAIR TEACHER TRAINING

M.F.M. Costa, Z. Esteves
Universidade do Minho, Portugal
mfcosta@fisica.uminho.pt,
zita.esteves@gmail.com

Science fairs involving the development of science projects in Portuguese schools is not a regular practice. Therefore three teacher training courses on the development of this type of projects in the context of Science Fairs were organized in recent years. Herein we will present the training strategies employed as well as the teacher's feedback on their professional experience in this subject and on the educational approach suggested by the authors."

MINI SYMPOSIUM

TOWARDS EFFECTIVE SCIENCE LEARNING IN RURAL HIGH-SCHOOLS: EXPERIENCES IN SUB-SAHARAN AFRICA

N. Setter
EPFL Swiss Federal Institute of Technology,
1015 Lausanne, Switzerland
nava.setter@epfl.ch

1. FROM CONTENT-BASED INTO COMPETENCE-BASED APPROACH IN SCIENCE EDUCATION IN EAST-AFRICA

K.M. O-Saki
University of Dodoma

In training of future scientists, the movement from a behaviourist approach towards a constructivist model influenced educators the world over. The main focus in recent years has been to ensure that learners develop scientific concepts from the scientific cultural contextual experience and build cognitive, psychomotor and affective competencies in the process. In East Africa this movement is taking shape slowly in Kenya, Uganda, Tanzania and Rwanda by curriculum revisions that re-focus students to develop basic competencies as they study various science topics. The earlier reforms, through projects such as School Science project, African Primary Science program and School Mathematics project had some impact but their focus on open inquiry were not very successful in building the competencies needed in a modern science, technology, engineering and medical research and have later made teachers to revert to a heavy content based and chalk and talk approach.

We recently developed materials following a competency-based approach, which develop learner thinking from every day experiences and using class tasks, video materials and laboratory tasks. We shall describe the notion of

© 2012 HSci. ISBN 978-989-98032-0-6

competency embedded in our designed curriculum materials focusing on chemistry, which have been tested in several schools. We shall reflect on the implications of the competency approach to advanced level science education in East Africa and the challenges of scaling up this approach.

2. ENGINEERS-EDUCATORS PROJECT TO ENABLE SCIENCE LEARNING IN TANZANIAN RURAL HIGH SCHOOLS

N. Setter
EPFL Swiss Federal Institute of Technology

Ensuring sufficient number of engineers is among the major challenges faced by most countries. The solution to this problem necessitates appropriate high-school science education and requires infrastructure, which imposes extra difficulties in developing countries. Lack of in-service training of teachers risks to further impede provision of adequate science education.

Accessible modern technology: mobile communication, internet, on-line videos, virtual science experiments, etc. may help to alleviate some of the difficulties facing science educators in developing countries.

We report on a joint project between engineers and educators in which, to facilitate high-school science learning in rural areas in Tanzania, we developed infrastructure, prepared and implemented integrated science modules, and developed and tested a program for in-service training of high-school science teachers.

The infrastructure is composed of a ‘technology package’ containing solar-unit, beamer, and laptop. Typical integrated science module [ISM] counts several lessons and few practical sessions. Each lesson contains introductory video showing relevance of the studied subject in context of technology-rich environment, simple classroom experiments, and videos demonstrating the taught concepts. The methodology encourages enquiry-based learning. The in-service training unit introduces teachers to the ISMs. It could potentially expand into a nation wide distributed network of mini-centers for in-service training of high-school science teachers.

3. INTRODUCTION OF INTEGRATED CHEMISTRY MODULES (ICM) AT ADVANCED SECONDARY LEVEL: LESSONS FROM THREE YEARS CLASS-ROOM EXPERIENCE IN TANZANIA

F. William
University of Dodoma

We report on a research and curriculum development project focusing on the design, development and formative evaluation of an Integrated Chemistry Module (ICM) approach. ICM lessons focus on promoting classroom inquiry at “A” Level (17-19 year olds) secondary education in Tanzania where science at this level was originally taught in a disjointed, frontal approach. Our objectives were:

- Development of observational, recording, analytical, and co-operation competencies among chemistry students by including a variety of experiences in the classroom and encouragement of enquiry and participation in the class room.
- Assessment of practicality, effectiveness, and efficiency of the ICM approach in promoting scientific inquiry.

The study adopted a developmental research approach and used a quasi- experimental design, running in two schools where most of the prototypes were tested by the researcher in collaboration with the teachers.

Students and the teachers were highly interested and motivated. Students’ achievement test scores in the treatment group had a significantly better achievement in the post test compared to the students who learned through the conventional approach. These findings suggest that the ICM approach is a better way of implementing an inquiry in “A” Level Chemistry and in developing the scientific method among A level students.

© 2012 HSci. ISBN 978-989-98032-0-6

4. TEACHING SCIENCE USING INTEGRATED SCIENCE MODULES: EXPERIENCE AND REFLECTION ON TRAINING AND COACHING OF A-LEVEL SCIENCE TEACHERS

P.G. Mosha
University of Dodoma

Professional development of science teachers is a continuing process. In the case of A level chemistry teachers in Tanzania, no formal in-service training exists yet. In addition there is a serious problem of lack of textbooks and laboratories, and lack of practical skills in lab work.

12 months ago we established a small training center in a Tanzanian rural high school in possession of laboratories and initiated in-service training for A-level chemistry teachers of ten secondary schools. We used Integrated Chemistry Modules as the focus and ran two INSET (in-service training) workshops for the teachers. In the first INSET, the teachers were introduced to competency based teaching and learning, shown how to run selected modules, and did a micro-lesson task. The teachers tried the materials in their schools and were visited by us for first level coaching sessions. The INSET was improved and a second iteration was done after 6 months. After this we have followed the teachers up with intensive coaching and introduced also peer coaching. During coaching we found the need to improve content coverage and help teachers to use educational technology, do simple lab demonstrations, and run class sessions involving discussions of laboratory experiments and video demonstrations. Collaborative coaching has potential to raise professional competence in practical work and class management. Lessons learned on teacher development in A level chemistry will be discussed.

5. A-LEVEL SCIENCE: CAN A RURAL SCHOOL PROVIDE BETTER LEARNING CONDITIONS THAN ESTABLISHED URBAN SCHOOLS? REFLECTION BASED ON A HEADMASTER'S EXPERIENCE

E. Kisongo John
Kisimiri High School

The A level Science Program in Tanzanian Secondary Schools emphasizes advanced content, preparing students for higher education and leading roles in tomorrow's technology-supported society. Kisimiri High School [KHS] is an A-level public school in science and humanities operating since 2004. It is located on the slopes of Mount Meru at the scattered village of Kisimiri.

KHS ranking in science exams improved consistently since it first participated in the national exams in 2006. Last 2 years KHS occupied the first position in the region out of over 10 schools, and first-to-third position Nation wide out of >160 schools. The KHS outperforms better equipped urban schools with long tradition of excellence.

It is too early to comprehend conclusively the origin of this outstanding performance. However, comments on the school's specific conditions can be discussed in light of the school's success:

1. Located in a remote village, the school offers complete-insertion environment to both pupils and teachers.
2. Professional leadership, purposeful teaching, and progress monitoring are practiced.
3. Positive reinforcement, high expectations, shared vision and goals between pupils and teachers, and pupils' rights and responsibilities are all emphasized.
4. Science teaching and learning is carried using Integrated Science Modules that were developed during the Tanzanian-Swiss project ENSCIENCE is which KHS participates.

© 2012 HSci. ISBN 978-989-98032-0-6

MINI SYMPOSIUM

STRATEGIES OF SCIENCE&TECHNOLOGY POPULARIZATION IN NON FORMAL EDUCATIONAL CONTEXT

L.R. Batista, M.I. Nogueira
Universidade de São Paulo, Brazil
luisrobe@if.usp.br, minog@usp.br

1. ENRICHED EDUCATIONAL ENVIRONMENTS

B.Milan Martins, M.I. Nogueira
Universidade de São Paulo, Brazil
barbaramilan@usp.br, minog@usp.br

The use of non formal spaces for science education/learning has been increasing and their quality of exhibitions, interactions and strategies has becoming more sophisticated. Therefore they might be classified as enriched environments that are rich in opportunities to provide learning. In this context three different activities bearing the principle learning by doing, which encompasses hands-on, minds-on and hearts-on will be approached aiming to discuss the structural/ pedagogic elements as well as the used resource to improve the participants engagement: 1) Workshops to built toys to explore scientific concepts, 2) Scientific Gymkhanas and 3) Context of Environment to experience science

2. SCIENCE FAIRS

Z. Esteves, M.F.M. Costa
Universidade do Minho, Portugal
zita.esteves@gmail.com,
mfcosta@fisica.uminho.pt

Science fairs are activities used out of the formal school context for long time in different countries in different contexts and approaches. In this presentation we will discuss the importance and pedagogical usefulness of Science Fairs in both the acquisition of general work and inquiry skills besides, basic competencies in the learning of science, as well as concepts and knowledge directly related to the formal school curricula. Our approach and experience on the implementation and use of this type of activity is going to be presented and discussed.

3. POTENTIAL SPACES FOR SCIENCES LEARNING

J.N. Teixeira, M. Muramatsu
Universidade de São Paulo, Brazil
jonny@if.usp.br, mmuramat@if.usp.br

To provide suitable spaces and environment to improve the Science learning means to adapt and contextualize the environment making them functional in order to get significative learning. Centers and museums of science are not accessible to the majority of society since they are in general concentrated in large cities, with reasonable economic level or near a center of excellence. In this sense, itinerant projects for Science Communication as the Art & Science in the Park and the FISBRINK: Learn physics playing, are extremely important to develop the scientific literacy of people since these projects bring science and Technology to the public, transforming the public spaces in potential environment for learning concepts and scientific culture.

4. MODERN PHYSICS AND INFORMAL SCIENCE EDUCATION

M.C. Santarelli, H. Takai
Universidade de São Paulo, Brazil
mariaclara.amon2@gmail.com,
helio.takai@gmail.com

Modern physics spans the science from the late 19th century to today. It is rare that in an informal educational setting, e.g. science museums, the general public has the opportunity to learn much about modern physics. However, modern physics plays an important role in the Technological society. In this presentation we will share our ideas on how to bring subjects such as particle physics, nuclear physics and condense matter to a broad audience through interactive experiments. These hands on experiments can be implemented from inexpensive materials allowing for a large number of visitors to experience modern physics first hand. They can also be implemented in various degrees of sophistication depending on available funds.

© 2012 HSci. ISBN 978-989-98032-0-6

MINI SYMPOSIUM

THE FP7 EUROPEAN PROJECT PRI-SCI-NET

A. Oğuz Ünver
University of Muğla, Turkey

1. PRI SCI NET AND THE IMPORTANCE OF TEACHER QUESTIONS IN INQUIRY BASED SCIENCE

S. Dale Tunnicliffe
Institute of Education, University of London, PriSciNet partner
lady.tunnicliffe@sdtunnicliffe.demon.co.uk

The essence of the PRI SCI Net imitative is inquiry based. The project aims to promote the Inquiry-Based approach in Science Education (IBSE) with young children of ages 3-11 years across Europe. It aims to achieve this through providing educational material as well as professional development opportunities for teachers in various ways. The project aims to achieve these objectives by developing hands on science activities, networking teacher and academies across Europe and recognising and celebrating successful practice and research on IBSE with young children. Involving learners in the active instruction of their understanding was brought to the attention of science educators by Driver (1983) in her seminal book. Thus Inquiry based science is not new. In science primary teachers as well as secondary teachers use questions as part of their pedagogical tools. Moreover, when children learn science they not only construct meaning but also develop their understandings in a social context (Duit and Treagust, 1998). The learners are doing so in a socio cultural context, different for each locality. In teaching as Chin remarked, the use of questions by teachers is a technique frequently used . As such they can encourage learner's thinking and answers can provide the teacher with information feedback about the understanding of the respondents. However, such questioning does have an influence on the journey of that learner being questioned thought the activity that they are investigating. Chin identified 4 major are of ways of using questions to stimulate thinking in learners in science learning which is what we need in inquiry based science. These are Socratic, verbal jigsaw, semantic tapestry and framing. This paper looks at the transcript early years children carrying out an activity being trialled for the PRI_ SCI_NET project. An analysis of the questions generated by the teacher reveals whether a teacher believes in true IBSE or whether they se ether role as being in control and insisting the children obtain the right outcome according to the instructions given for the activity. Questions must not dictate learning; they must inspire learners through permitting freedom of thought. Thus the form of questioning used by the teacher is of the uttermost importance or IBSE because we want to encouraged the children to think for themselves using previous knowledge an, understanding and skills. We do not want questions to be used, which lead and influence the line of thought of the children who then follow a predetermined route. We want children to think for themselves.

2. INTRODUCING PROJECT PRI-SCI-NET: THE CASE OF PARTNER MUGLA

A. Oguz-Unver[1], K. Yurumezoglu[2]
[1]Mugla University, Turkey
[2]Dokuz Eylul University, Turkey
ayseoguz@mu.edu.tr;
kemal.yurumezoglu@deu.edu.tr

In today's world involving science learners in their own learning processes are indisputable fact. However, practical approach of this idea through the school system is needed some supports. Pri-Sci-Net which is EU funded FP7 is one of the projects that promotes Inquiry-based learning in science at primary level of education through developing activities for teachers to use as well as setting up a Europe-wide network for professionals and academics in the area of Primary Science Education. The project is coordinated by the Malta Council for Science and Technology (MCST) and has 17 partners from 14 countries. A virtual platform set up at European level will network professionals as well as support the organization of training courses. The project will also recognize teachers' and researchers' achievements in implementing Inquiry-based learning in science at primary level, as well as provide an opportunity for teachers and academics across Europe to share their experiences and successes. The project is relevant to primary teachers interested in science as it will offer downloadable teaching material, training courses, online collaboration and networking, as well as opportunities to attend the

© 2012 HSci. ISBN 978-989-98032-0-6

international activities being organized by the project (http://www.prisci.net/). Therefore, the aim of this paper is to introduce the project through the case of partner Mugla, to encourage teachers involving to Europe-wide Pri-Sci-Net project's network for sharing their experiences and successes and to provide examples of inquiry based teaching activities from national training courses. We believe that the promotion of this project for the conference attendees is handy for their professional development.

3. USING INQUIRY BASED LEARNING DURING HANDS ON SCIENCE-PROJECTS IN FINNISH PRIMARY SCHOOLS

T. Asunta
University of Jyväskylä,
tuula.a.asunta@jyu.fi

During many years I have carried out several primary science-projects with both my primary and secondary student teachers based on the idea of inquiry based learning. Experiences of both student teachers and primary class teachers and their pupils concerning this type of learning will be introduced and discussed. Several examples of activities used in these projects will also be presented and discussed. Pupils' feedback on different cases will also be discussed. The connection of activities used in Pri-Sci-Net EU-project will also be described.

4. PROBLEM BASED LEARNING IN SCIENCE AND TECHNOLOGY TEACHING IN THE DEPARTMENT OF PRIMARY TEACHERS EDUCATION OF THE UNIVERSITY OF CRETE

P. G. Michaelides
University of Crete, Rethymno-Crete, Greece
michail@edc.uoc.gr

Critical and creative thinking is considered as an objective of education, especially in modern 'knowledge based societies'. Inquiry Based Learning has been proposed as an appropriate approach towards this objective. Consequently, teaching skills of Inquiry Based Learning should be a qualification of effective teachers, especially teachers of the compulsory education. Teaching approaches of Inquiry Based Learning require, apart from the necessary knowledge to be applied, and a firm 'way of conduct' from the teacher. This 'way of conduct' as an emotional skill is developed better by paradigms than by formal teaching. We have used Inquiry Based Learning at the Department for Primary Teachers education of The University of Crete in three distinctive courses, a/Laboratory of Educational Robotics, b/Everyday observations in Science Teaching, c/Science Teaching experiments with self made equipment. Although the main objectives of these courses were different, we have found indications that the teaching approach we adopted has inspired our students a positive attitude towards Inquiry Based Learning and we present our data in this work.

© 2012 HSci. ISBN 978-989-98032-0-6

DIFFERENT USABILITY OF HANDS-ON PHYSICS EXPERIMENTS

B.V. Dorrío[1], M.F.M. Costa[2]
[1]*Universidade de Vigo, Vigo, Spain*
[2]*Universidade do Minho, Braga, Portugal*
bvazquez@uvigo.es, mfcosta@fisica.uminho.pt

There is a growing perception that conventional teaching in Physics does not lead to the desired results. Although many different strategies can be employed for making knowledge of Physics and its learning more attractive, Hands-on Physics Experiments (HPEs) allow students to be able to perform scientific experiments and thus construct their knowledge bearing in consideration the way in which people learn (Figure 1).

Figure 1. *Learning methodologies [1]*

An effective understanding of concepts is carried out via direct observation inquiry and experimentation (Figure 2). HPEs activities will promote student's active participation and engagement and can often be found at science museums, but also increasingly in learning centers. In this work, an updated view of HPEs resources (books, journals, events, projects, associations, mass media, companies, museums...) [2] is presented, as well as effective clues for an efficient implementation in practical situations. Finally, different strategies for using this kind of experiments inside the classroom will be presented: in-class demonstrations [3]; interactive demonstrations [4], problem-based learning (PBL) mini-projects [5], collective HPEs/science weeks [6], corridor HPEs and HPEs competitions [7].

Figure 2. *Several examples of HPEs*

Figure 3. *Some examples of HPE applications*

This work was drawn in the frames of the activities of the PRI-SCI-NET project supported by the European Union Seventh Framework Programme (FP7/2007-2013, grant agreement no. 266647).

References

[1] http://www.ntl.org/
[2] Dorrío B V, Rúa A, Soto R and Arias J (2004) Hands-on Physics Bibliography, in Proc. of the 1 Conference on Hands-on Science. Teaching y Learning in the XXI Century, Divjak S (Ed.), 119-124, Ljubljana, Slovenia
[3] Carpenter D R and Minnix R B (1981) The lecture demonstration: try it, they´ll like it, The Physics Teacher 19, 391-392
[4] Sokoloff DR and Thornton RK (1997) Using iterative lecture demonstrations to create an active learning environment, The Physics Teacher 35, 340-347
[5] Edelson D C, Gordin D N and Pea R D (1999) Addressing the challenges of inquiry based learning through technology and curriculum design, Journal of Learning Sciences 8, 391-450
[6] Esteves Z, Cabral A and Costa M F M (2008) Informal Learning in Basic Schools. Science Fairs. International Journal of Hands-on Science 1 (2), 23-27
[7] Pinkerton K D (1991) Interactive hallway physics for elementary schools, The Physics Teacher 29, 166-168

© 2012 HSci. ISBN 978-989-98032-0-6

USE OF TECHNOLOGY

© 2012 HSci. ISBN 978-989-98032-0-6

WEB SUPPORT OF EXPERIMENTS

J. Trna, J. Krejci
Masaryk University, Brno, Czech Republic, EU
trna@ped.muni.cz, jkrejci@ped.muni.cz

Abstract. *Rapid development of ICT makes it possible to support education. The big advantage is the dissemination of materials in a web environment. Application of experiments has three integral components: explanation of a science phenomenon, technique of the use of equipment, and didactics implementation of an experiment into teaching/learning. The objective of this study is the development of multimedia support application for experimentation: "Web Support of Experiments", which is composed as a multimedia educational instrument suitable for the three components of experimentation. The practical part is published on the Internet in a form of webpage containing the experiments and the methodology.*

Keywords: Experiment, ICT, multimedia, science education.

1. Introduction

Science education has sought innovations for several decades. There are a few reasons for innovations. They include a large amount of new information that is not possible to pass to students in a complex form of "small science". Today students are primarily interested in the meaningfulness of their education and particularly in the benefit for their personal success and successful future life. The postmodern concept of present time has led to the rejection of the concept of rational knowledge, which is typical for science. Another important factor is rapid technological development, particularly in the area of ICT.

An underappreciated factor that significantly influences science education is a radical change in students' recognition of the current world. We are talking about a new student generation, the so-called "Net generation". D. Oblinger and J. Oblinger [3] describe significant differences of the Net generation features which affect their education and the change of their learning style. Among the most important characteristics that influence the educational process most belong:

- Net generation takes the use of ICT for granted component of everyday life.
- Net generation uses ICT as well as other devices intuitively, without instructions manual.
- Net generation is visually more literate, its reading literacy is less developed.
- Net generation performs more activities at the same time and they prefer speed to precision.
- Net generation prefers practical activities to theoretical studies.
- Net generation prefers learning and working in teams.

With respect to the life style when the members of the Net generation are constantly connected by means of different ICT, the system of information sharing is quite natural for them. Teachers should realise the different features of today's students in preparing and implementing the teaching and should react to them. The utilisation of computers, data projectors, interactive boards, power point presentations, animations, and other ICT means may significantly influence the relation of students towards teaching and subsequently make the results of the educational process more efficient [6]. That's how the important ideas of constructivism can be accomplished practically.

2. ICT and experiment

The experiment is a basic scientific educational tool and a basis of many teaching methods and techniques [4]. But it would be naive to assume that the current Net generation of students would react to experiments in the same way earlier generations did. It is necessary to search and develop innovative educational methods based on experiments with the use of ICT. It is logical that "ICT-experiments" should be implemented in pre-service and in-service teacher training.

Experiments have to be organically included in teaching/learning. This application of experiments has three integral components:

(1) Description and explanation of a science phenomenon by use of an experiment

(2) Technique of the use of school science experiments equipment

(3) Didactics implementation of a school science experiment into teaching/learning

The third component is insufficient in both school practice and teacher training. The second mistake is to separate the individual components. We have tried to eliminate these errors. The objective of this study is the development of a multimedia support application for experimentation "Web Support of Experiments"(hereinafter WSE), which is composed as a multimedia educational instrument suitable for the three components of experimentation. Design-based research has been used as a basic research method.

2.1. Multimedia processing of experiments

Today the use of computers and the Internet has become an integral part of everyday life, and thus education. Students receive information in the form of multimedia including a significant element - interactivity. They are not satisfied with a passive role in lessons and feel the need to participate actively. School science experiment has to accept this tendency. Therefore, it is necessary to upgrade the implementation of experiments in a multimedia format [5]. It is undeniable that a real experiment, where students are the active agents, has the highest efficiency. Nevertheless, there are a number of situations where multimedia-processed experiments replace or supplement a real experiment.

2.2. Web presentations of experiments

Multimedia-processed science experiment should reach students and teachers. The easiest way is to use the Internet as the most effective ICT environment. Of course, there are many complications we have to face. They include language barriers, access to the Internet, software equipment, etc. However, these problems can be solved and they will become less serious as the ICT development progresses.

3. Web support of experiments

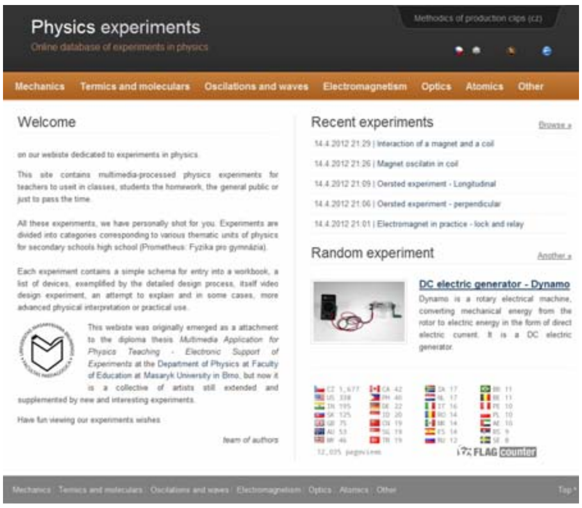


Figure 1. *Homepage of WSE*

The basic idea of WSE [2] is that there would be a number of multimedia-processed physics experiments in one place, accessible to the general public. It is designed to train trainee teachers, teachers in instruction, students doing homework, the general public or just for fun. Surely it can be applicable in various science clubs or science groups (see Figure 1).

It brings an innovative element of complexity: video of the experiment, list of tools, experiment scheme suitable for entry into the workbook, explanation of the phenomenon, pictorial scheme how to perform the experiment, classification according to the curriculum, types of the experiment, possible learning tasks and additional questions. Experiments are categorized in groups corresponding to curricular units of secondary school physics. Currently there is the first set of experiments.

3.1. WSE requirements

Considering intended use and expected complexity of experiments, WSE requires:

- Availability online
- The concept of data storage with the appropriate technical background of the server
- Selection of technology enabling to depict experiments visually in the form of static pictures or a dynamic solution of videos
- Achievement of e-learning specifications, i.e. reusability and, of course, at least partial integrability into learning management systems (LMS)
- Possibility of language mutations
- Quality and simple presentation of mathematical notations
- The administrator should be able to edit materials
- The basic use should not require additional software installation
- Timeless design - technical design should not be obsolete or even unusable within a few years
- Expandability - the teacher or administrator must have authenticated access to manage the content and users
- Intuitive control - elimination of redundant instructions and suitability for younger students
- Simple presentation on interactive whiteboards or data projectors
- Good aesthetic value

The aim of these requirements is to ensure up-to-date, user-friendly, sustainable and didactically comprehensible teaching materials to support experiments. Without some of the above mentioned requirements it would not be possible to implement WSE into the current form, and while creating WSE, none of the above mentioned requirements was minimized, on the contrary, requirements increased due to the use of the design-based research.

3.2. Selection of technologies

It is necessary to choose such technologies to meet the above mentioned requirements fully. These requirements can be met in several ways; our aim was to choose the best solution. Due to the requirement for online availability, WSE is conceived through dynamic web pages. Due to the presence of a database and dynamic elements such as video, it is necessary to use one of the scripting languages on the server that will manage all operations over the database, display dynamic content and carry out its storage and editing in the admin interface. For this purpose, we selected one of the most widely used languages for creating dynamic web sites PHP. This language gives us full control of content creation, both of technical and graphical content. This solution is suitable because of the requirement for the data storage. In this case all the data will be stored on the server along with the websites. The most widely used database server MySQL was selected. Videos are saved in a F4V format, because its properties allow smooth replaying on the web. To play videos on the website a flash movie player JW FLW Player was chosen, because it is a part of WSE and does not require any additional installation of support software. A major problem, however, was displaying mathematical equations. One possibility was typesetting in TeX or writing in MS Word and then converting into a picture, but this method would be very uncomfortable and hardly editable. Therefore, we used JSMath Javascript library that allowed us to insert a mathematical notation using TeX commands and subsequent real-time transfer of the picture. Pages are coded in XHTML, using CSS. Availability of WSE is provided by any computer with Adobe Flash Player plug-in and allowed JavaScript. Compared to offline distribution there is the advantage of saving distributed data and unnecessity to install client's or support software.

3.3. Description of WSE use in instruction

The great advantage of multimedia physics experiments in instruction is the possibility of interference with the course of the experiment, which allows not only to determine the pace of instruction or the number of repetition according to the individual educational needs of students, but also the choice of teaching methods or time of instruction. Multimedia through clarity and "popularity" enable more efficient achievement of the teaching objective and shortening of the instruction length. It is appropriate to combine video recordings with real experiments or other students' activities. An important task of multimedia physics experiments is to develop students' activity, independence and creativity. Integration of multimedia physics experiments in instruction should make students active, they are not just passive participants. Suitable applications of multimedia physics experiments in instruction can increase the popularity of the subject and to make the teaching process more effective.

WSE can be used in all stages of instruction. Individual stages of instruction are suitable for different experiment implementations. Possible experiments in different stages:

- Motivation - paradoxical or surprising experiments
- Exposition - experiments combined with exploration, simulation and illustration
- Fixation - experiment in detail and slow motion
- Application - an alternative experiment demonstrating a physical phenomenon in practice, problem solving and projects
- Diagnostics - experiment without sound accompanied by students' comments; experiment is stopped in a certain part and students draw conclusions

WSE allows students to download videos in full quality, so it is possible to store experiments in their own data carrier and also present in the classroom without the Internet connection.

4. A sample experiment of WSE

As an example, we present an experiment "a glass of water upside down" demonstrating the effect of atmospheric pressure [1]. This experiment includes all parts of the above mentioned complexity (see Figure 2).

5. Conclusions

A complex database of multimedia-processed experiments is a necessary tool for students and teachers. However, it is necessary to ensure that it is scientifically correct, technically feasible and mainly didactically properly created. The team of authors should be made up of scientists, science educators and of experienced teachers. WSE should be verified in practice. The system of multimedia experiments should be open to any possible supplements and improvement.

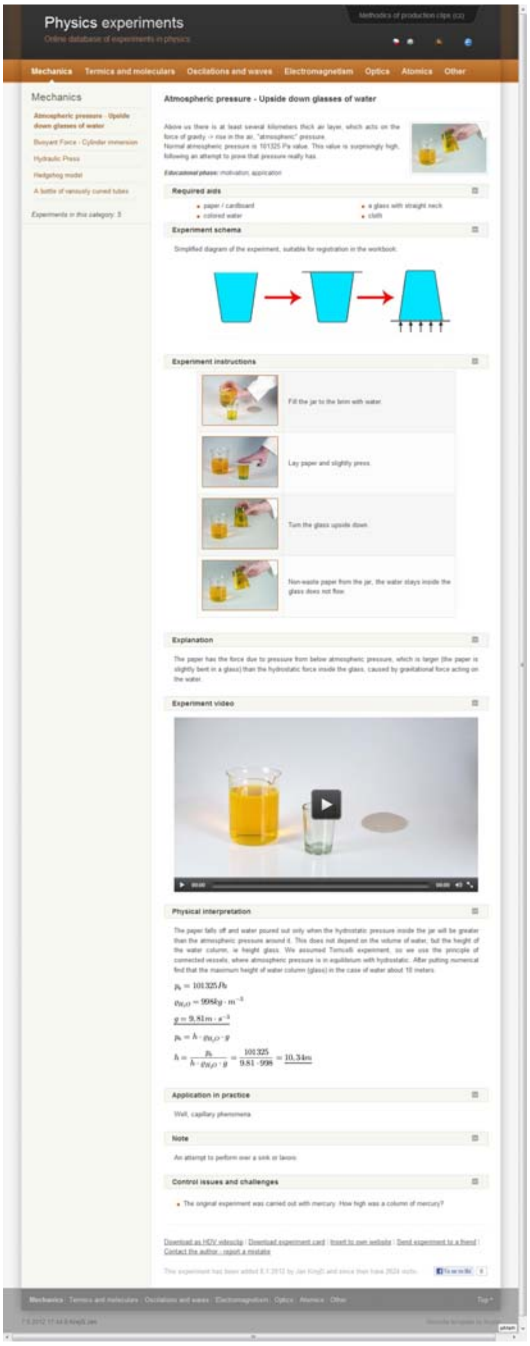


Figure 2. *Experiment on WSE*

6. Acknowledgements

The study initiated within the project “PROFILES: Professional Reflection-Oriented Focus on Inquiry-based Learning and Education though Science“(FP7-SCIENCE-IN-SOCIETY-2010-1, 266589).

7. References

[1] Krejci J. Atmospheric pressure - Upside down glasses of water. Physics experiments; 2010. http://fyzikalni-experimenty.cz/en/mechanics/atmospheric-pressure-upside-down-glasses-of-water/ [15/08/2012]

[2] Krejci J. Online database of experiments in physics. Physics experiments; 2010. http://fyzikalni-experimenty.cz/en/ [14/08/2012]

[3] Oblinger D, Oblinger J. Educating the Net Generation. 2005. EDUCAUSE. http://www.educause.edu/educatingthenetgen/ [14/08/2012]

[4] Trna J. Motivation and Hands-on Experiments. In: Selected Papers on Hands-on Science. Braga, Portugal: Associacio Hands-on Science Network, Vila Verde, Portugal; 2008. p. 221-230.

[5] Trna J, Novak P. The educational roles of video programs with experiments. In: Multimedia in Physics Teaching and Learning. Udine, Italy: University of Udine; 2009.

[6] Trnova E. Vliv informačních a komunikačních technologií na chemické vzdělávání. Media4u Magazine 2011; 8(3): p. 112-115.

COLLABORATIVE LEARNING USING ICT AND TWINSPACE

E. Vladescu
National Vocational College "Nicolae Titulescu", Aleea Rozelor, nr. 5, Slatina, Romania
elenavladescu@yahoo.com

Abstract. *In 2010, I was the coordinator of an eTwinning project named "ICT, You and Me". Schools involved were from Romania, Poland, Spain, Greece and Latvia. This project won the second place in the European eTwinning Prizes 2012 competition, 12-15 age category. This project aimed to improve pupils' skills in Information and Communication Technologies, Science, Maths and foreign languages. In this paper I will present modern technologies used in this eTwinning project which made the lessons more attractive to everyone.*

Keywords: collaboration, eTwinning, ICT.

1. Introduction

My first eTwinning project was a winning one. This project aimed to improve pupils' skills in Information and Communication Technologies, Maths and foreign languages. Through creating films, presentations, videos and surveys, collating data about themselves with the help of on line statistical tools, pupils learned about cultural differences and similarities of their partner schools in other countries in an enjoyable way. The subjects involved were ICT, Mathematics, English, Science and Art. The students' age group was 8-14.

Duration: 1 school year.

2. Project's main objectives

- To teach pupils to use and/or improve their communication skills using ICT;
- To become familiar with basic norms and etiquette for virtual communication to be able to collaborate appropriately in a virtual community;
- To encourage pupils to learn to know each other, have a better understanding of their partner pupils, school and country and finally become friends;
- To learn to evaluate information based on exact data. This will help avoid prejudice and will enhance a scientific approach to working;
- To help pupils develop an understanding of nutrition and encourage them to lead a healthy lifestyle.

3. Pedagogical innovation and creativity

In the begining of our project, pupils created personalized speaking avatars using Voki(Fig 1), uploaded their photos and avatars, then pupils of the partner schools tried to match every photo to the correct avatar writing their guesses in the comments to the avatars.

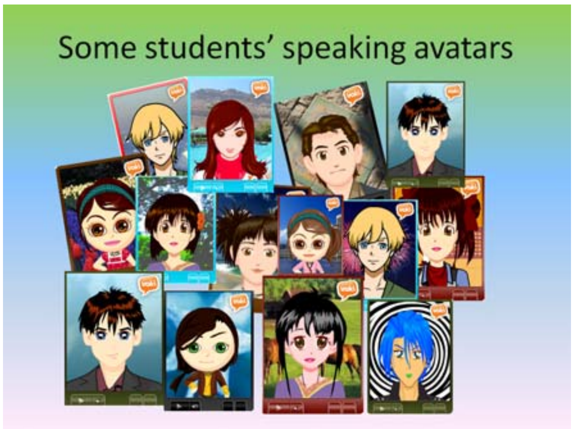


Figure 1. *Some students' speaking avatars*

Each country collected names from the partner school and created a word cloud using ImageChef, WordItOut Wordle, Tagul or Tagxedo.
Modern technologies used in the project made the lessons more attractive to everyone. The goal, which was to create a model of the average project participant, encouraged the pupils to get familiar with statistical tools and improved their mathematical knowledge(Fig 2).

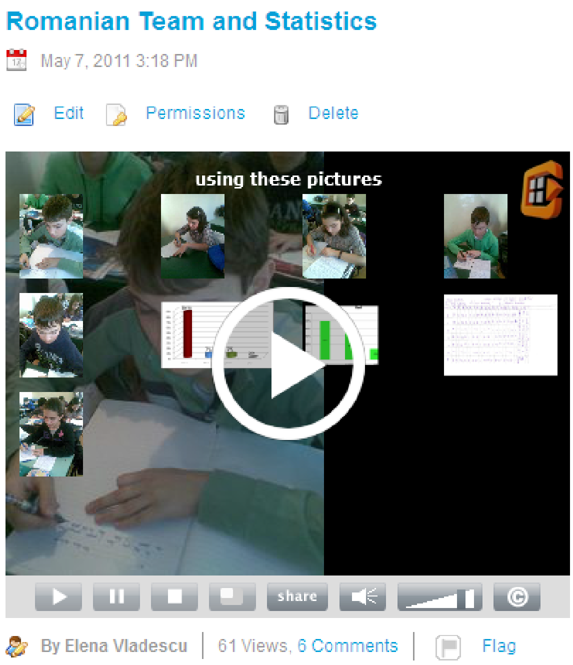


Figure 2. *Romanian Team and Statistics*

A new form of cooperation with the use of VoiceThread site resulted in a better understanding and a mutual discussion about ways of spending free time and healthy lifestyles, which made the English lessons more appealing. The participation in online 'brainstorms' allowed us to share opinions with our foreign colleagues and encouraged the pupils to express themselves in English. Interactive forms of writing exercises increased the degree in which pupils were involved with the project. Games and quizzes created by the participants were also an interesting way to gain, consolidate and test the acquired knowledge and skills. The pupils proved to be very creative while taking photos, creating videos and slideshows as well as presenting the following subjects: the project participants, the schools and the towns. The pupils also improved their creativity by designing a project logo, common online drawings and interactive holiday greetings.

4. Curricular integration

During Maths classes, the pupils gathered information about themselves and their project partners. Using online tools they interpreted the acquired data in forms of diagrams and created a model of the statistical project participant. They also created quizzes and mathematical problems concerning partnership countries.
During Science classes and form periods they learnt the rules of a healthy lifestyle and shared their opinions on the issue with their foreign peers via VoiceThread site.
Mind maps, quizzes, presentations and surveys were created to summarize the topic of pro-health and ecological behaviours. During Healthy Week the pupils analyzed and rated their own diets.
During English classes they presented the results of their observations in a form of glogs. Those classes were also used for discussions with our partners via VoiceThread regarding following topics: ways of spending free time and tourist attractions of our countries. A number of other glogs were created on the subject of favourite singers, music bands and sports disciplines. Furthermore, we engaged in producing videos and creating and solving quizzes.
During extracurricular classes we discovered the secrets of Internet sites, created games and designed a project logo.

5. Collaboration between partner schools

The project participants maintained contact using electronic mail, TwinSpace forums and Facebook. We communicated at least once a week, or sometimes even more frequently in cases of ICT issues. The partners cooperated during gathering data, creating a statistical model of the project participant and took part in discussions by means of VoiceThread and Skype. Using the service Colorillo, the pupils created common pictures while chatting online. Each school was responsible for a different type of surveys and quizzes. The AnswerGarden web was used to conduct brainstorms (picking the name of the statistical participant, choosing the favourite dish, singer, sportsman and evaluating the project). The partners also declared their desire to create and conduct surveys on chosen topics, picked their ideal spot for vacation and the Christmas gift of their dreams, using Nota tool. Lino and Wallwisher webs allowed the pupils to collect question proposals, photographs of interesting spots in partnership cities along with the corresponding information, which was later used for quizzes, surveys, games and discussions on VoiceThread. Interactive maps were collectively created using Tripline and GoogleMaps.

6. Creative use of ICT

We decided to introduce the pupils to some of the newest sites, which are still not popular in our countries. Their variety was highly appreciated by the participants of the project.

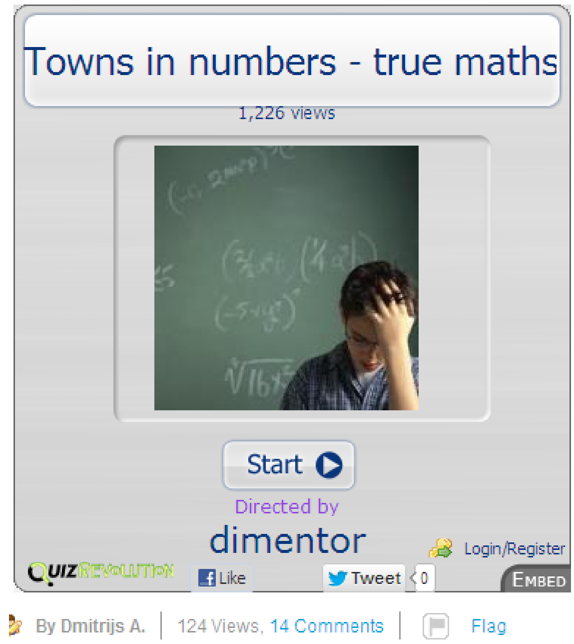


Figure 3. *A quiz created by a Polish student*

Depending on our needs we used: Voki (matching the right avatars with participants' photos, greetings, Maths problems, evaluation), ImageChef (word cloud consisting of participants' names, project logo, greetings), Animoto, Slideshow, Smilebox, Flixtime, PictureTrail (videos about: school, town, presenting the project logo), VoiceThread (discussions), Glogster (healthy lifestyle and hobbies), Lino, Nota, Wallwisher, AnswerGarden (cooperation, collecting question suggestions, brainstorming), QuizRevolution, Quizz.biz, ProProfs Brain Games (creating quizzes and games)(Fig 3), Blabberize (hobbies), Morpheus, SantaBot (discussions with bots), survey services (collecting data, evaluation), Photovisi (collages), Google map, Tripline (journey routes, interesting places, journey diary), - Mixbook (Maths problems), Prezi (presenting the statistical data and a video about the creation of the statistical project participant's model), GoAnimate (evaluation), Colorillo (online drawing).

7. Results and benefits

Thanks to the project our pupils broadened their knowledge in areas such as Mathematics, English and Computer Science. They familiarized themselves with the newest Internet sites, and perfected their teamwork and self-presentation skills, particularly important for shy pupils. They are now more likely to make use of the newest technologies, which help to save their time, paper and allow for more creativity. The teachers behind the project not only vastly perfected improved their ICT skills but also developed their teaching techniques. They organised meetings for their colleagues promoting the ongoing project as well as eTwinning programme so as to encourage them to benefit from the newest technologies applicable for everyday use in class. The project met with significant recognition from the head teachers, the parents and other teachers. This project won several awards: the second place in the European eTwinning Prizes 2012 competition(Fig 4), 12-15 age category, National and European Quality Labels for Poland, Latvia, Spain, Greece, Romania, 1st prize in Maths and Science category of Polish National eTwinning Awards competition, Finalist of Latvian National eTwinning Awards competition (among Top 6 Best Projects), the Best Project Diary of March in the Polish competition, 1st prize in a Romanian competition for eTwinning beginners.

Figure 4. *Our project won the 2nd place in the European eTwinning Prizes 2012 competition*

8. References

[1] ICT, You and Me. URL: http://new-twinspace.etwinning.net/web/p33516 [06/25/2012]

EDUCATING THE CREATIVITY OF CHILDREN BY LOGO PROGRAMME

R. Nemanienė
IT teacher, Šiauliai Romuva Progymnasium
Dainų st. 13, Šiauliai, Lithuania
romuvos.pm@siauliai.lt

The contemporary society has faced the necessity to have educated and creative people, able to discuss and doubt, think critically and free, able to adapt to the constantly changing world. Lithuanian schools have been distinguishing the Creativity Education within the general comprehensive programme as one of the main aims of education. The aim of Information Technologies as the comprehensive subject in the school of comprehensive education is to educate informational and technological competencies of children. It is important for children to gain knowledge and experience within the sphere of informational and communicational technologies which would contribute to their simple adaptation in contemporary society.

According to provisions of general comprehensive programmes, planning of activity during lessons of information technologies requires high amount of attention towards interdisciplinary integration as well as towards the education of creativity, general competences and everyday life skills.

Aim of the presentation is to review possibilities of educating the creativity of children during learning of the chapter "Construction by Aids of Computer" in the 6th grade (age of children – 11-12 years old), by applying Image Logo (further – Logo) system. Analysis of the chapter "Construction by Aids of Computer" evidences that educational content is the most sufficiently revealed by applying creativity, imagery, jocosity. Topics of programming are difficult for children if no graphical aids are used. These aids are rather effectively implemented by Logo.

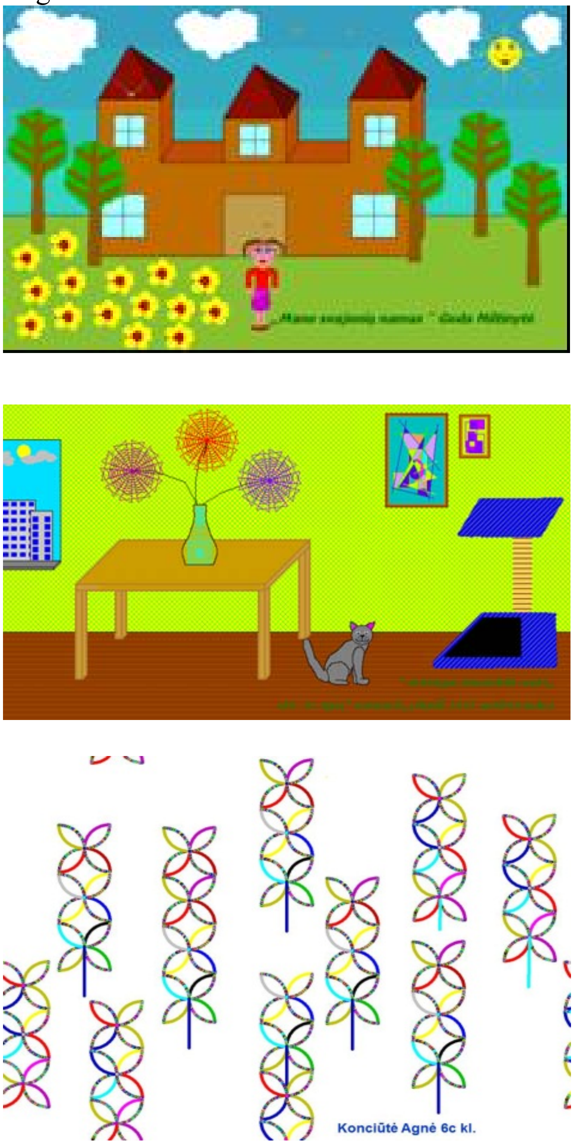


Figure 1. *Several examples of static projects, created by children: My Dream House, My Pet, Flowers*

Logo system is the software, applied for learning and teaching of children. The main actor of the system is the turtle, "living" in the computer and performing various commands. Children, together with the turtle, draw, construct, model and create animated movies, games and other projects.

From the first lessons children are acquainted with the main commands and later they analyse more complicated structures, algorithms, procedures; when preparing tasks I seek to include children into the creative activity, to encourage their creativity, as well as skills of critical thinking and problem solving.

The task of the presentation is to share the gathered experience by analysing projects of children. Teaching can be divided into two stages: creation of static and animated projects.

Creation of animated projects is initiated from the creation of animated masks. Later children form the tale on the base of the developed sketch. The tale can be composed either on the freely selected topic or according to the offered beginning; the creation of the new tale by using characters from various tales is also possible. This is their final work in the chapter "Construction by Aids of Computer".

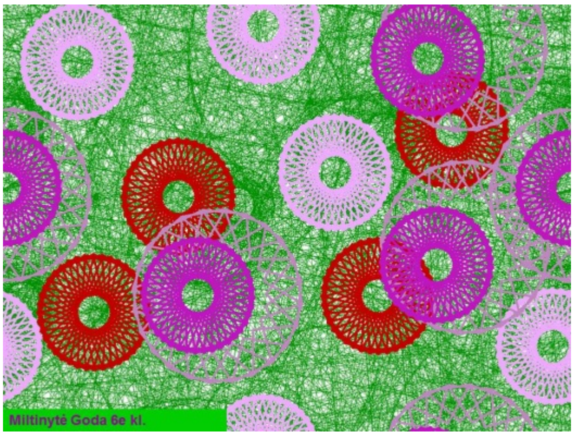


Figure 2. *The picture has been created by applying the main commands, masks of the turtle.*

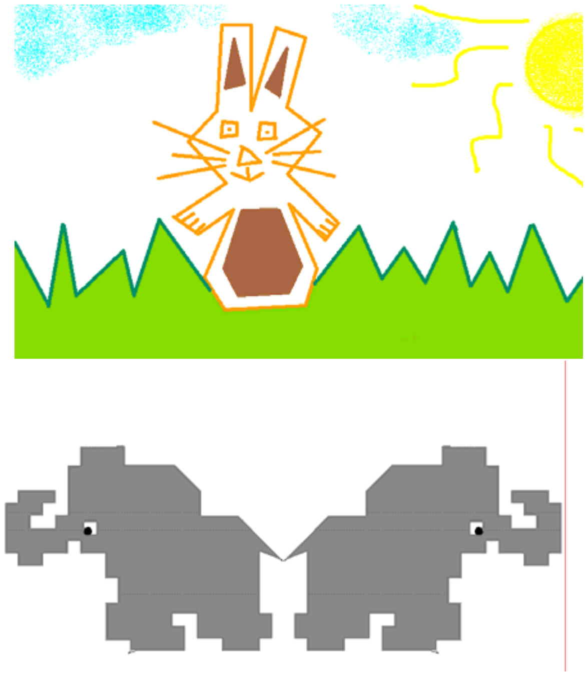


Figure 3. *During the integrated project "From the Dot to the Form" of IT and Mathematics X and Y axis were used*

Conclusions and recommendations.

Tasks and strategies for the development of creativity must be selected according to the age of children. As far as the age of 11-12 years old is the transitional period between the childhood and adolescence, it is important to encourage the creative self-expression of children and to form premises for them to experience the joy of using the imagination and improvisation game; it is also very important to prepare children for the transition from the creativity as the game into the creativity as the work, the result of which must be complete and ready for the presentation to others. According to the own experience, I can state that encouragement of the creativity of children helps to realise own ideas and the developed projects give the joy of creation for children as well as self-confidence; they educate the critical thinking and skills to apply the knowledge within processes of learning other subjects.

References

1. http://www.smm.lt/svietimo_bukle/docs/pr_analize/kurybiskumo%20ugdymas.pdf
2. Pradinio ir pagrindinio ugdymo bendrosios programos. Vilnius, 2008.
3. Metodinė veikla mokytojo ir mokinio kompetencijos ugdyti. Vilnius,2007
4. Inovatyvių mokymo metodų ir IKT taikymas. Vilnius, 2007.

IAC, E-LEARNING ŞI TEACHING TECHNOLOGY

E. Costrachevici
The National College Of Computer Science Piatra Neamț, Romania

IAC and e-learning can offer students and teachers a flexible support and a wide access to materials and resources, evaluation of knowledge and of means of communication. The role of the teacher in an online teaching environment changes:

- teachers become experts in asking questions, not only in providing correct answers;
- the teacher offers only the initial model of activity for the students, allowing them to orientate however they may choose;
- teachers present the subjects from multiple perspectives, outlining the important directions of study.

The role of the student in an online teaching environment changes:

- -students become complex problem solvers;
- -students work as members of study groups;
- -students use the same instruments that professionals use.

Methods of teaching specific to online education:

- lessons have the following functions: the transfer of information, the explanation of principles, the illustrative presentation of certain skills, fitting certain concepts in a certain context, motivating students and dividing their work in stages, sharing the program by using the explicative module;
- face to face debates for further developing understanding, students being stimulated to explain to each other notions and concepts, to argument their explanations without the help of a teacher;
- conference sessions through the computer can create tutorials which do not require immediate completion.

The analysis of the content includes the collecting of material resources which are in the form of three categories:

- information and resources relevant to the subjects;
- information and resources relevant for the development of teaching and teaching processes;
- information and resources relevant for the system of transfer of the lecture content, including calculating equipment and related programs.

Students and teachers can have more roles and/or functions at once in the teaching system. The infrastructure of the teaching system can, also, undertake multiple tasks. Globalization is a process of great significance in the contemporary moment but its implications for education are still being explored. Today's teachers of science are confronted with an almost overwhelming volume of materials purporting to provide information which will enable the student to understand science. Information technology resources – e-mail, the Internet and the World Wide Web(WWW), and multimedia – are increasingly common components of the instructional experience for students. In this sense, Getting online is seen as essential for getting on.

One issue facing learners and lecturers in higher education is having to learn and teach more in less time. This can result in an overstuffed curriculum in which courses have too much content and a reliance on student 'busy work' to comply with assessment demands. The overstuffed curriculum leaves little opportunity for learners to acquire a deep understanding of the subject, or to develop learning to learn skills and 'generic' lifelong skills such as critical thinking, problem-solving, communication and interpersonal skills.

Most students, especially first year students, need help to become effective learners. Such help is most useful when is offered in the context of subject learning. Unfortunately, teachers often assert that there is no room in the curriculum for learning to learn and lifelong skills because discipline content must take precedence.

Although in universities mainframe computers had been in use since the sixties, schools generally had had no previous experience with computer technology until the early eighties with the introduction of free-standing or stand-alone personal computers, usually referred to as PC's. In investigating what appeared to be a problem about the application of technology in schools, it was seen on closer analysis to be also a problem about people, change and ideas in education. A major component of multimedia systems nowadays is computer based training. Understanding this concept is about identifying the strongest elements of multimedia learning technologies:

- The high efficiency of this type of learning is given by a technology that allows communication by image, sound, text and video, all at once;
- The information search and find process that implies using the calculus technique and that accesses , directly or by ODBC (Object Data Base Connectivity) , complex data bases, allows integration of data in the dynamic process of learning or can initiate searches depending on the studying subject;
- Freedom of navigation is very large, hypermedia systems allowing simultaneous usage of multiple structural and navigational criteria. Reading an e-book utilizes the hot word automatic commutation. This concept is associated with the learning individualization concept, so hard to accomplish in the case of classic learning;
- The multimedia system for learning assures the perception of a process in its dynamic, its phases being in their logical succession, with characteristic length and synchronization;
- The existence if learning mechanisms, checking and evaluation already implemented through widgets allows the composing of what, inside the creational multimedia products is designated by the CBT (Computer Based Training) module. By mechanisms specific to object-oriented technology, objects are generically identified and auto contained, thus, by simply copying them, they adapt to the new context;
- Real time presenting, such as teleconferences, supplies a level of abstractisation if multimedia products and offers support for remote learning and for creating specialized instructing centers.

The propagation of multimedia technologies must be supported by a support that can help information reach the target and users to obtain multimedia information of some results in real time. The introduction of eLearning elements in school environments mark a first necessary step on the basis of which construction of an authentic society dedicated to knowledge and understanding can take place.

The multimedia interactive educational content and its integrated platforms for a computer assisted education can answer to the question: How do we form adaptive thinking?. An eLearning project must consider five fundamental components:

- A digital curriculum;
- Professional development;
- Connectivity;
- Technology;
- The development of teaching methods.

These components implicitly define the didactic scale of a project such as eLearning on the three directions – from individual study to focusing on the student, from the reproduction of knowledge to the creation of knowledge and from artificial to natural. The notion of distributed and collective competences will gain additional importance in the context of changing the systems of education and development. Informational programs encourage teachers, school managers and technical staff to focus upon the fundaments of the new methods and teaching techniques: philosophies and new approaches (constructivism, styles of teaching, and multiple intelligences), the design of schooling, of support materials, more efficient strategies for obtaining the goals of learning etc.

The challenges of building a society based on knowledge, in the perspective of using new technologies, have, in their turn, a direct impact on education and human development systems, determining specific evolutions – of transformation, correlation, adaptation or correction – of legislative or management nature, curriculum and learning structure. On another hand, the implementation of informational and communicational technology in education is an appropriate answer to social demand – an effect of the growth in level of accountability and hiring of individuals in a democratic society.

An important aspect of national politics in the direction of forming new generations is the use of the computer as support for learning. Thus the impact of informational and communicational technology (ICT) must be provided and oriented on teaching by meeting expectations.ICT must not be considered as just an element of education, but also as a means of teaching (integrated in the teaching of diverse disciplines), with an important role in upgrading the quality of teaching and improving the instructional-educational process. There will be developed skills of creation, handling, obtaining, selection and retrieval of information, also creativity and the capacity of structured thinking will be improved. But introducing ICT is not only to familiarize students with the processing of information, but also with gaining new processes of learning much less passive and more autonomous. Also, new individual and group learning environments shall be created. Another possible effect would be that of converting the pattern of interaction between educator-student into a triangle type pattern educator-computer-student.

Education done in a traditional fashion, as well as the one done with assistance from a computer offers some specific opportunities, which cannot be transferred. The extensions of using the technological environment for training, still insufficiently explored and exploited, refer to:

- Focusing on the one who is learning;
- Distributed resources;
- Fluidity of roles.

Informational and communicational technology (ICT) has the power to change destinies offering opportunities which, some years ago, seemed inaccessible. The development of the internet, of technology, in general, favors the growth of new ideas in people, as well as access to knowledge in the class room, even through long distances. These pieces of knowledge and innovations are essential for continual development and the progress of nations in the entire world. In the end, we can say that today's students are the leaders, teachers or workers of tomorrow. The investment in training and preparing them is necessary and valuable for the future. In any case, this world of opportunities, which gives strength and inspires students and teachers everywhere, is not without challenges. Access to technology and instruments which give people the possibility to realize their full potential is not automatically available to anyone, anywhere.

Using proper technology, teachers from all over the world can lend to other teachers their valuable experience and they can determine the growth in the standards of global education. Teachers gain abilities which help them obtain as much as possible from the technologies existent in their schools, by adopting new practical applications of the informational and communicational technology (ICT). In approximately the same way by using appropriate technology every student must have the possibility of achieving their full potential in their class activities as well as in day to day life. Technology has an especially important role in transforming this vision into a reality, doable, in particular, through the donation of computers to schools from certain organizations that can provide such equipment.

It is with great certainty that technologies for information and communication will become valued instruments in Romanian school as well as any other school, but with this a certain need to develop a specific attitude and a new way of thinking arises.

Every educator will be required to gain a certain basis in the field of ICT, the ultimate goal being the development of a informed culture understood not only as knowledge and professional skill, but also as a new orientation towards reality. This implies a series of objectives:

- the development of a bigger picture view on the scale and importance of the applications of the new technologies and their social effects as well as the economical impact on the individual and community;
- learning the common principles that govern the application of information, knowing nature, the proprieties and structures of

information, in the context of the new technologies;

- the development of the capacity of using instruments and applications specific to the new technologies in activities such as searching, working with and storing information, surveillance and control over information, communication through e-mail and the internet;
- giving shape to the capacity to indentify the situations where the use of the new technologies is advisable and the designing of solutions for diverse situations.

In the context of computerization strategies in the Romanian school system, lectures on electronic support become a day to day instrument of the teacher who wishes to give a boost of quality to the process of teaching-learning. This implies: the ability to select multimedia materials and electronic lessons in accordance with the objectives of studying; the capacity to evaluate the relevance of a certain material in electronic format for a educational situation.

The role of the new technologies in the school systems, and the one of the educational software in particular, varies from giving access to information and knowledge to facilitate the understanding of phenomena, individual training etc. To utilize effectively the different applications in electronic format for educational activity, alongside the technological initiation in using the computer, teachers need a educational initiation appropriate to the new demands: integrating ICT in their classes; the elaboration of lecture plans starting from the objectives of teaching; the elaboration of didactic strategy which should include learning objects in electronic format.

Until the full use of all innovative aspects which give a plus in value the teaching process, special attention should be given to an appropriate integration in education of the ICT component and the appropriate education of teacher, in a long run reforming process.

To train new generations in such a way that they would be capable to deal with the problems that present themselves in our modern world, those changes are necessary in the paradigm of teaching which favors a transition from disciplinary, atomized teaching to one orientated to developing a new way of thinking integrated in the complex social and cultural present a way of thinking which is autonomous, creative and open to new information. The process of teaching transcends formal education and it depends on interactions made by a multitude of external sources located in close proximity to individual development and in the horizon of personal motivation. Humans and the world interact continuously, reality is seen from multiple perspectives, information reaches us through different channels, in such a way that to have an appropriate answer, new knowledge must be produced and not reproduced.

The change in learning paradigm and specifically the transition from acquiring knowledge to development of skills, values and attitudes impose a focalization on training on activities dominated by active and willing participation of students according to their needs, interests and profiles of learning. The differentiation of training and contextualizing it presents itself as invaluable support in using the class computer.

The new tendencies in the educational environment highlight the necessity of an instrument of teaching which can implicate the two actors of the training process: teacher and student.

HANDS-ON SYMMETRY WITH AUGMENTED REALITY ON PAPER

Q. Bonnard, A. Legge, F. Kaplan, P. Dillenbourg
CRAFT, École Polytechnique Fédérale de Lausanne, Station 20, 1015 Lausanne, Switzerland
quentin.bonnard@epfl.ch

Abstract. *Computers have been trying to make their way into education, because they can allow learners to manipulate abstract notions and explore problem spaces easily. However, even with the tremendous potential of computers in education, their integration into formal learning has had limited success. This may be due to the fact that computer interfaces completely rupture the existing tools and curricula. We propose paper interfaces as a solution. Paper interfaces can be manipulated and annotated yet still maintain the processing power and dynamic displays of computers. We focus on geometry, which allows us to fully harness these two interaction modalities: for example, cutting a complex paper shape into simpler forms shows how to compute an area.*
We use a camera-projector system to project information on pieces of paper detected with a 2D barcode. We developed and experimented with several activities based on this system for geometry learning, however, we focus our presentation on one activity addressing symmetry. This activity is based on a sheet where a part of its content is scanned, and then reprojected according to one or more symmetry axes. Such a sheet is used to illustrate, in real time, how a symmetric drawing is constructed. Anything in the input area can be reflected: ink paper shapes, or physical objects.
We show how the augmented sheets provide an easy solution for teachers to develop their own augmented reality activities by reporting on the collaboration with three teachers. These teachers successfully used the activities in their classes, integrating them in the normal course of their teaching. We also relate how paper interfaces let pupils express their creativity while working on geometry.

Keywords: Paper Interfaces, Augmented Reality, Symmetry, Primary School, Geometry.

1. Introduction

On one hand, paper is already fully present and deeply integrated in the classroom and in the curriculum. It is cheap to produce, yet persistent and malleable enough to adapt to the dynamic constraints of the classroom. On the other hand, computers, with their ability to display multimedia content or assist in the exploration of problems with otherwise time-consuming computations, could bring a lot to education.

Paper interfaces combine the best aspects of these two worlds: paper becomes a dynamic display, which is able to compute and process data. More importantly, paper interfaces do not disrupt the existing practices in schools, where paper is omnipresent.

In this paper, we explore how paper can be used to transfer the task of designing in Technology Enhanced Learning (TEL) from computer programmers with extensive technical backgrounds to teachers with extensive experience. We go beyond participatory design by implementing generic components that can be easily transformed into customized pedagogical activities without technical assistance.

We first review the work related to paper interfaces in education and the paper-based authoring of interfaces. We then describe our system and, more specifically, the basic component given to the teacher: the symmetry sheet, which, when placed under our camera-projector device, displays the symmetric transformation of one part of the sheet along predefined axes. Next, we report on the design process involving three teachers who create their own activities from these symmetry sheets. We discuss how this system fully supports the full usage of the teachers' expertise. Finally, we present another activity based on these sheets that fosters the creativity of pupils in the creation of symmetric cut-outs.

2. Related Work

Paper interfaces find their roots in the seminal paper of Wellner [8], who proposed a desk augmented by a camera and a projector, which allows for the manipulation of content using printed paper and fingers. Earlier, however, Perlman [6] proposed programming in Logo by ordering cards in rows, which represent commands in sequences, rather than typing with a keyboard.

Various technologies support the use of paper interfaces. A popular one consists of printing a microscopic pattern on paper, which allows a small camera embedded in a pen to detect its position, effectively digitalizing the annotations by the pen. Malacria et al. [3] used such a technology to synchronize the notes taken with digital content, showing that it helps reproduce the context in which the notes were taken.

Augmented Reality approaches (see [1]) typically use cameras and markers printed on paper, for example to augment a regular textbook with multimedia content [4]. Yeh et al. [9] show how to make this approach mobile, by using smartphones to augment paper on biology field trips.

However, Oviatt et al. [5] compare how students work on geometrical problems using pen and paper versus other interfaces which approximate pen and

paper with less and less exactitude: a smart pen using the microscopic pattern and a graphical tablet. They demonstrate that the closer to the familiar work practice the tool is (i.e. pen and paper), the better the performance.
These technologies have been employed to let users define their own interface or application. For example, Piper et al. [7] propose a toolkit based on smart pens to design language activities collaboratively. Lee et al. [2] describe an augmented reality application, which allows users to develop other activities within the augmented reality environment.
Zufferey [10] proposes an interface that combines tangible and paper elements to teach logistics. With this interface, he can combine the pedagogical activities and the associated interface on regular sheets of paper. We aim to advance this approach by transforming the co-design into design sessions, where the teachers are independent of the developer of the technology.

3. A Paper Interface for Learning Symmetry

Our paper interface is based on the Metroscope, a tabletop environment developed at our lab (see Figure 1). The Metroscope incorporates a camera and a projector directed at the tabletop surface via mirror. The augmented surface has a dimension of 70x40 cm. The camera and projector are connected to an embedded computer, so that the interaction with the hardware is minimal for the end user: switch on or off. It only requires an electric outlet.
We use 2D barcodes to identify and precisely track the various elements of the interface. Since the display is projected from the top, it is possible to draw information on the interface elements. We print markers on sheets and cards, but we can stick them on tangible objects, and also use these in combination with regular geometry tools, such as a ruler and a protractor.
We have already developed pedagogical activities making use of this system [11]. The research objective of this symmetry activity is to explore how teachers can participate in the design process. To allow for this, we have created a generic component made up of sheets printed with one or several axes and 2D barcodes. When the Metroscope detects these barcodes, the camera captures the image on one side of the axis, and projects its symmetrical images (see Figure 2).

Figure 1. *Our camera-projector on a table, along with various types of objects which can be augmented: sheets, cards, tools, and wooden blocks*

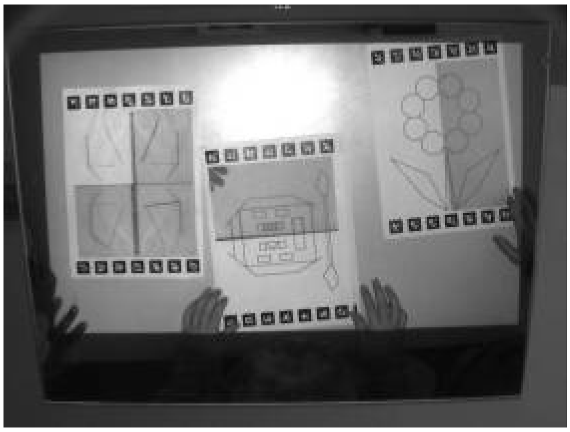


Figure 2. *A view from the top of the symmetric sheets. The greyer sides of the sheets are actually the projection of the other side of the axes. Note that anything is reprojected, such as fingers, not just the ink on the paper*

In order to illustrate how these sheets could be used, we prepared a sample activity, with three exercises. The first exercise consisted of drawing directly under the lamp to illustrate the symmetric movements of the pen. The exercise included drawing over a watermark on one side of the axis and observing what happens on the other side. The second exercise consisted of drawing the symmetric image of a pre-printed figure and confirming the answer by placing the sheet under the Metroscope. The third exercise consisted of freely drawing one side of a symmetric figure and tracing the other side with the help of the Metroscope.

4. Appropriation of the Design of the Activity by the Teachers

We showed this sample activity to three teachers from two schools. The first teacher had a 5th grade class (10-11 year old pupils), the two others had a 4th grade class and a mixed 3rd and 5th grade class. We intended for them to customize the activity and use it as part of their teaching.

4.1. First Design

We invited the teacher of the 5th grade class to our laboratory to demonstrate the sample activity. The original idea was to illustrate the possibilities of the Metroscope for symmetries, and co-design an activity to be used in her class. To this end, we wanted to produce a draft of the paper interface, beginning with a blank sheet, by drawing figures and writing the instructions developed by the teacher. Instead, the teacher asked whether it would be possible to obtain the digital versions of the blank sheets. Since she is a computer enthusiast, she preferred producing the digital versions of the augmented sheets herself.
We planned to try the activity with the pupils three weeks later when the teacher was introducing symmetry to her class. Two weeks after the meeting, she sent us the digital versions of the symmetry sheets so that we could print them out and test them. The only change we made to her design was changing the colour of the grid from blue to light yellow. We thought that a lighter colour would prevent the Metroscope from detecting preprints and show the symmetric images that the pupils drew without the grid lines. It turned out to be a bad decision: the colour was too light for the pupils too, and they had trouble seeing the pre-printed figures.

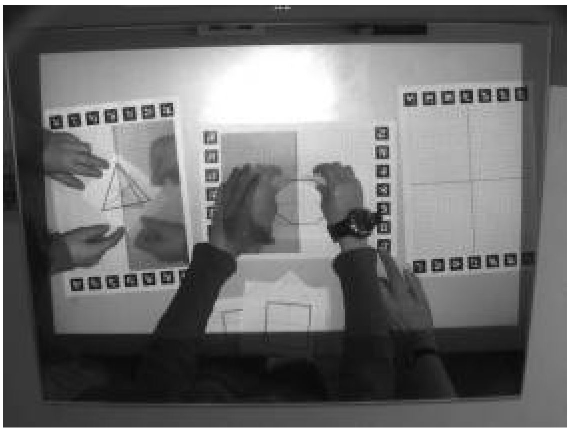


Figure 3. *An overview of pupils manipulating outlines placed on paper cut-outs. They align the symmetry axis they find on the outlines with the symmetry axis of the symmetry sheets. If the projection of the outline matches their outline, their axis is correct*

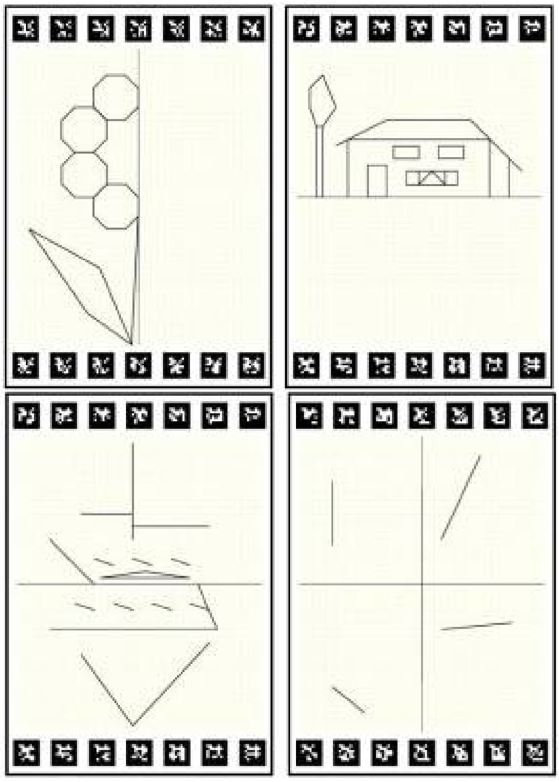


Figure 4. *Figures to complete by reflecting the outlines across the axes. The Metroscope projects the symmetric projections of the preprinted figure and the pupil's answer*

The teacher not only designed the pieces of paper but also the course of the activity, in three steps. First, the pupils would cut out outlines of figures and classify them according to the number of axes of symmetry (no axis, one axis, or multiple). They would then use the Metroscope to check their classification by manipulating the outlines on a blank sheet; if the axis was correct and matched the one on the sheet, the outlines would overlap (see Figure 3). Second, the pupils would be given one side of a symmetric figure (a flower or a house reflected in water, see Figure 4, left.) and asked to draw the other side. They could check their answer by putting the sheet under the Metroscope to see if the symmetric projection matched their drawing. Third, the pupils would complete a figure whose strokes were scattered on each side of the axes (see Figure 4, right.).
On the date agreed, the Metroscope was placed on a table in the back of the classroom. The teacher managed the class and the use of the Metroscope by herself; the experimenter only observed. The detailed report on the experiments is out of the scope of this paper.

4.2. Second Design

For practical reasons, a video demonstration of the sample activity was shown to the two other teachers rather than a live demonstration with the Metroscope. They were immediately enthusiastic about the fact that the pupils could use the Metroscope to instantly see the effect of symmetry on their drawing.

After 10 minutes, we started the design of the activities for the three levels of pupils (3rd, 4th, and 5th grade). The first author strived not to intervene with the design process, asking only for clarifications about the activity from the two teachers, e.g. whether the axis they were talking about was horizontal or vertical. It took an hour and a half to define the three activities, i.e. plan the exercises, write the instructions, and draft the figures.

To fit the space restriction of this paper, we detail hereafter only the instructions given to the 4th graders:

1. Draw something freely on a symmetric sheet under the Metroscope and observe what happens.

2. Return to your desk and write down your observations. Share them with the class.

3. Draw a geometric shape in one quadrant of a symmetric sheet with two perpendicular axes. Add details to build a mandala that will later be printed out and given to you to colour. (A mandala is a circular pattern often consisting of the repetition of one or more simpler patterns.)

3. Draw the other side of the butterfly at your desk, and check your answer under the Metroscope.

4. Draw the reflection of the castle on a lake at your desk and check your answer under the Metroscope.

The 3rd and 5th graders had the same first two steps as the 4th graders. The 3rd graders, however, finished the activity by drawing one side of a figure, observing what happens, and drawing the other side at their desk. The 5th graders skipped step 3, but had more complicated shapes to construct with a ruler instead.

Each teacher requested one additional feature: the mandala should be printed (i.e. the drawn quadrant be extracted and replicated according to the symmetry axes) and an animation showing the construction of the symmetry of a shape should be added.

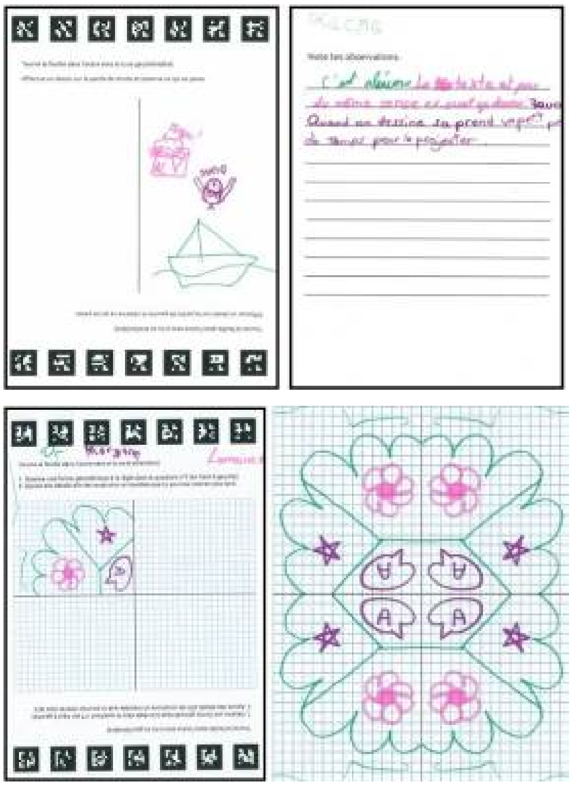


Figure 5. *From left to right: the output of one group of 4th graders for steps 1, 2, and 3, and the resulting mandala rendered from a scan of the third sheet*

The first class used the Metroscope during two periods of 45 minutes each in the morning; the second class did the same but in the afternoon. Because these teachers planned activities with live symmetric feedback, pupils were split into groups of three to work with the Metroscope while the rest of the class was assigned autonomous activities. The teacher of the 4th graders focused on the first three steps of the activity (see Figure 5 for a sample of the output), while the other teacher maintained a more intense rhythm to finish the whole activity.

The teachers seemed frustrated with the short time spent with the Metroscope. The experimenter proposed leaving the Metroscope at the school and the teachers accepted the offer with enthusiasm. They asked to keep the unused sheets for the 4th graders, and requested blank symmetric sheets for other activities. This follow-up is out of scope of this paper.

4.3. Discussion

These two collaborations with teachers are already enough to highlight the idiosyncrasies that would be lost if a TEL design excluded the teachers. The two design sessions resulted in many different activities. For example, the first teacher preferred using the Metroscope only to check the answers ("For me, the Metroscope will allow them to control what they have done... But I can't see what they could do directly under the Metroscope."), while the two other teachers were immediately enthusiastic about the live symmetric feedback ("With this... Can you imagine? They'll understand in a sec!"). This is probably linked to how the teachers planned the activity: all pupils doing the same activity in the first case, versus a small group using the Metroscope while the remainder of the class worked on something else autonomously. Surprisingly, however, the first teacher preferred oral instructions ("I think [a blank sheet] will do... It allows me to explain things."), while the two others used a written text ("it's good if they have instructions to read"), even though the teacher was always with the pupils.

Regarding the content of the activities, the first teacher reused official content from the curriculum (e.g. the flower pattern), while the other activity was reinvented. Each of the three teachers imagined a new feature: using outlines on paper cut outs to be moved manually rather than just by drawing, printing mandalas, and animating the construction of the symmetry.

We do not intend to over-analyse these examples, trying to conclude which alternative is better. Our message is that the classroom is an environment too complex to be modelled by a researcher. Instead, it seems only reasonable to ask experts in the domain, i.e. teachers, to address this issue. Researchers in TEL should then focus on implementing modular and customizable components, instead of replacing teachers in their designs or performance.

5. Appropriation by the Pupils

Finally, we used the symmetric sheets to explore the creativity of the pupils. After the previous controlled study, we ran a small, informal activity during two periods of 45 minutes. We gave the pupils a sheet with a vertical axis, a sheet with a vertical and a horizontal axis, and a sheet with vertical, horizontal, and two diagonal axes. They used them to prototype a partial outline with a pencil in the input area of the symmetric sheet (see Figure 6). Then, they used the Metroscope to have a preview of the full outline, composed by the partial outline and its symmetric projections. They could adjust the outline, and when they were satisfied with it, the pupils cut along the outline (see Figure 7).

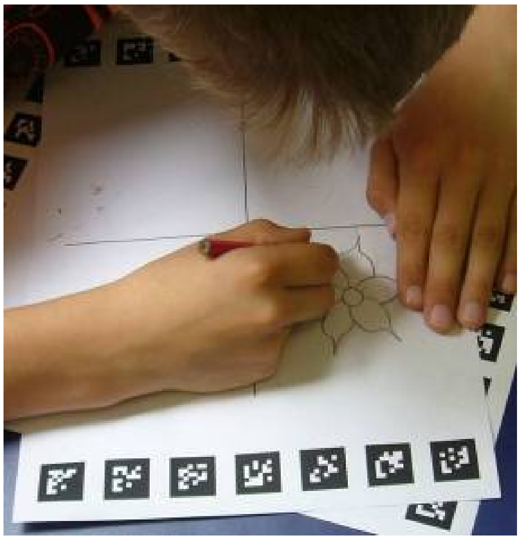


Figure 6. *Prototyping the outline*

Figure 7. *From left to right: Resulting cut-out on two, four and one axes*

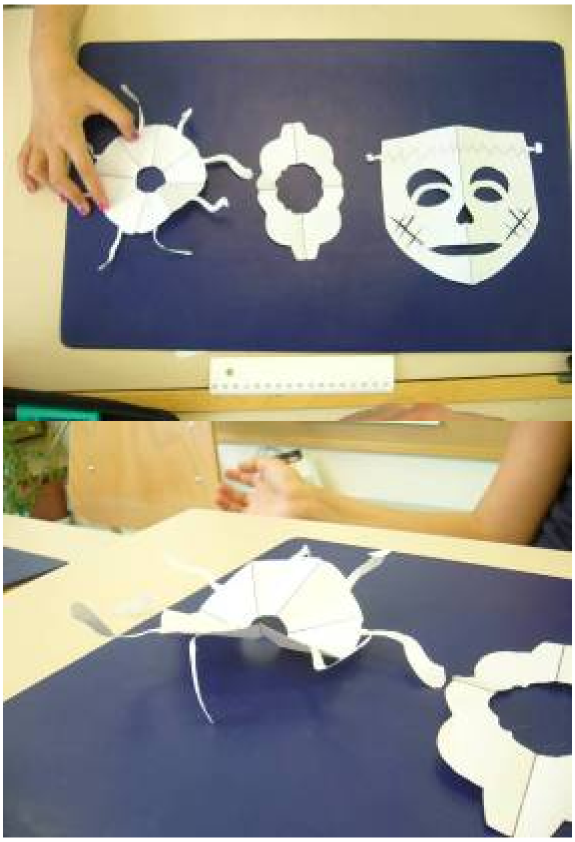


Figure 8. A cut-out in volume, top, and side view.

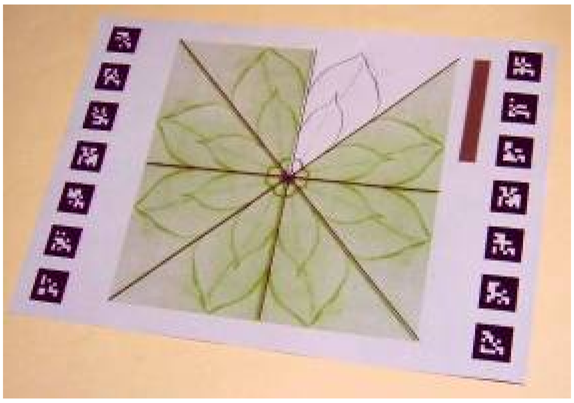


Figure 9. *A symmetric sheet limited by time. The augmentation disappears when the bar (on the right) is empty*

We were impressed by the variety of the creations of the pupils. Some of them were simple drawings not meant to be cut, but only automatically reflected. The vast majority, however, took advantage of the exercise to actually design cut-outs. A lot of the designs included inner holes, allowing more complex shapes. The most impressive example of appropriation is shown in Figure 8: a pupil designed her cut-out as an object in space rather than a flat object.
We expected this activity to provoke congestion around the Metroscope, because of the engagement that could happen. For this reason, we limited the time that each sheet could be augmented: a bar was projected on the sheet, and decreased linearly (See Figure 9). When the bar was empty, the Metroscope would stop projecting the symmetric image of the input area, rendering the symmetrics sheet a regular sheet of paper.
We computed the expiration time of each sheet as a fair repartition of the whole period, assuming that two pupils would be constantly using the Metroscope at the same time (this worked as long as the axes on the two sheets were different). As it turned out, only one pupil reached the expiration of a sheet: she was drawing a very detailed horse head. Otherwise, it is another example of how the persistence of a paper interface allows an efficient repartition of a system.

6. Conclusion

We briefly presented paper interfaces, showing how they can be used to implement the basis of an activity designed by teachers. We reported on two cases where the whole pedagogical design has been done by the teachers. In one case the teacher did everything involving the creation of the material. In the other case, we simply digitally authored the content they specified, but they could have easily done it on blank sheets with a regular pen and copy-machine. In fact, when we left the Metroscope with them, they asked for the digital versions of the blank sheets to print. We find this to be a very encouraging step toward the adoption of paper interfaces supported by a catalogue of generic augmented paper components that can be adapted to the teachers' needs, independently from the technological developer. Finally, we showed how this technology can be as easily adopted by pupils.
In our future work, we would like to investigate another difference among teachers: not all of them can spend the energy and time necessary to fully design activities. We think, however, that further advantages of paper interfaces can be used for the transfer of TEL designs from teacher to teacher: it is easy to distribute digital versions of the interface and reproduce their physical counterparts (by simply printing them). This reproduction can be done with further adaptations and customizations, in either a digital (word processors and graphical programs) or physical way (pen/scissors/glue and copy machine).

7. Acknowledgements

The authors wish to sincerely thank the teachers and their pupils who supported and gave a meaning to this work.

8. References

[1] Billinghurst, M. Augmented reality in education. New Horizons for Learning 12 (2002).
[2] Lee, G., Nelles, C., Billinghurst, M., and Kim, G. Immersive authoring of tangible augmented reality applications. In Proc. of the 3rd IEEE/ACM ISMAR (2004), 172181. http://home.postech.ac.kr/˜endovert/iatar/.
[3] Malacria, S., Pietrzak, T., Tabard, A., and Lecolinet, E. U-note: capture the class and access it everywhere. Human-Computer Interaction INTERACT 2011 (2011), 643660.
[4] Martin-Gutirrez, J., Luis Saorin, J., Contero, M., M. Alcaniz, Prez-Lpez, D., and Ortega, M. Design and validation of an augmented book for spatial abilities development in engineering students. Computers & Graphics 34, 1 (2010), 7791.
[5] Oviatt, S., Arthur, A., Brock, Y., and Cohen, J. Expressive pen-based interfaces for math education. In Proc. of the 8th international conference on CSCL (2007), 573582.
[6] Perlman, R. Using computer technology to provide a creative learning environment for preschool children. Tech. rep., M.I.T., 1976.
[7] Piper, A. M., Weibel, N., and Hollan, J. D. A

Pen-based toolkit for authoring collaborative language activities. In Proc. of the ACM 2012 conference on CSCW '12, ACM (New York, NY, USA, 2012), 269270.
[8] Wellner, P. Interacting with paper on the DigitalDesk. Communications of the ACM 36, 7 (1993), 8796.
[9] Yeh, R., Liao, C., Klemmer, S., Guimbretire, F., Lee, B., Kakaradov, B., Stamberger, J., and Paepcke, A. ButterflyNet: a mobile capture and access system for field biology research. In Proc. of the SIGCHI conf. on Human Factors in computing systems, CHI '06, ACM, 2006.
[10] Zufferey, G. The Complementarity of Tangible and Paper Interfaces in Tabletop Environments for Collaborative Learning. PhD thesis, 2010.
[11] Bonnard Q., Verma H., Kaplan F. and Dillenbourg P. Paper Interfaces for Learning Geometry. 7th European Conference on Technology Enhanced Learning, Saarbrücken, Germany, 2012.

HOME-MADE SCIENCE SOCIAL NETWORK

D.Ü. Şaylan, K. Bora
Sabancı University, Orhanlı, Tuzla, İstanbul 34956 Turkey
ducer@sabanciuniv.edu, kerembora@sabanciuniv.edu

Abstract. *Expensive laboratory equipment is not needed for experiment and observation; on the contrary, there are unlimited resources in our everyday lives. Home-made science includes any hands-on science application; such as science demonstrations, experiments, games and toys made from cheap, accessible materials. They promote self learning. The home-made science network aims not only to serve as a reliable resource for such applications but also to bring teachers, students, enthusiasts together on a web platform where they can share valuable experience.*

Keywords: Hands-on science, simple and cheap materials, self-learning.

1. Introduction

Preschool children continuously observe their environments and draw conclusions from their experiences. They are curious and they are eager to explore their environments by experiment and observation. Children also tend to seek consistency, they check the newly gathered knowledge with previous experiences and continuously ask questions. This is critical in building a big picture of the material world as a whole.

Until children start any systematic school education, their knowledge is mostly through observation and experiment. At school however, the situation is usually different. In class, science knowledge is given to them in prepared packages. The link of this knowledge to the real world is usually not clear.

In such classroom environment children may lose their curiosity and even their motivation to explore and start accepting what is given to them as unquestionable facts. To prevent this, we must use every opportunity to supply them with tools with which they can observe and experiment with their surroundings. Expensive laboratory equipment are useful in making accurate measurements, but they take away the creative activity and convert the experiment to a demonstration where students do not really understand the apparatus. "What is controlled in the experiment or under what conditions the experiment is performed in" is generally not clear. A Sophisticated apparatus is usually a black box which puts some distance between the natural phenomena and the child [1]. Furthermore, such sophisticated laboratory equipment are not available to most students especially in public schools.

Home-made science gives students the opportunity to build, modify, observe. Home made science applications include science demonstrations, experiments, games and toys made from cheap and accessible materials. They are not only fun but also easy to construct, easily modified, safe applications of science.

As science educators, our aim is to teach our students "a way" to look at the world around them. We would like them to perceive their surroundings with observation, not with hear-say and we would like them to build a systematic view of the material world as a whole.

We believe that home-made science can give children handy opportunities to observe the nature and have fun in the process.

2. The curriculum

In the Turkish education system there has been radical changes in the last year. The first 12 years are mandatory. 4 years of primary school, 4 years of middle school and 4 years of high-school. There is no mandatory preschool. Children start primary school as early as 60 months of age. Starting at 3rd grade, students start to take required science and technology classes. Starting at 9th grade, science classes are divided into physics, biology and chemistry. In the four years of high-school education, the topics covered from the 3rd grade to 8th grade are taught in more detail.

There has been an effort to change the curriculum aiming to make all primary school graduates to be science and technology literate. There is no doubt that this is only possible through hands-on science education. However, especially in public schools the laboratory facilities are quite limited. Even in schools where there are science laboratories, the equipment is not sufficient to allow all students to have an extensive hands-on experience. This is why it is very important to integrate applications of science with simple materials to the curriculum. A lot is expected from teachers and there is a growing demand from the school administrations, parents and students. The teachers are encouraged to include hands-on science applications in their classes. However there is not enough guidance. Textbooks suggest applications with very limited information. Many teachers are trying to meet these expectations with a lot of creativity and effort. But a lot of them keep on teaching science classes conventionally.

In the last few years, we have been developing/adapting home-made science applications at Sabanci University [2]. Our students develop these applications as a part of a project course. We have been sharing these applications with teachers via workshops and internet.

During these workshops, we observed that there are two groups of teachers. First group is very active and creative. They already know most of the applications we share, they already use them and many more in the classroom environment in parallel with the curriculum. These teachers usually have many great ideas to improve the applications as well. Other group of teachers are quite impressed with what they see, they would like to use these applications in their classes however they think that they do not have enough resources to start. Most importantly, they do not know where they can use a specific application in parallel with the curriculum.

The need to bring these teachers together where they can share their experiences is apparent and workshops are a great platform for such collaboration. However, it is also crucial that there are easily accessible resources available for them when they are alone in the field.

Many resources are already available. One can get ideas from the internet. There are also a number of books written on home-made science applications and they are all very useful, see for example [3,4,5]. The problems with the available resources are language barrier, reliability, safety and practicality:

- Resources are mostly in English (language barrier)
- Some applications/experiments seem to work on paper but in practice there are tricks to be taken into account (reliability)
- Safety of the applications may be questionable (safety)
- The relation of the applications with the present curriculum is not clear (practicality)

3. Home-made science website

In the recent years, especially after social media has been embraced, the internet has become more interactive especially with user generated content. We aim to utilize the power of social media, to reach a larger number of people, and to generate more content for the Home Made Science Network.

EV YAPIMI BİLİM

Home made science network website is under construction right now. The network website aims

- To share reliable applications of home-made science with children, teachers, enthusiasts
- To give people a chance to share their home-made science experiences
- To provide a platform where new applications can be developed or the existing applications can be improved
- To guide teachers on how the applications can be used in parallel with the curriculum

The home-made science website (www.evyapimibilim.net) is going to have the following features:

- Anybody can be a member of the network.
- Members of the network
    - Can share applications
    - Can rate existing applications
    - Can put comments on applications
    - Tag experiments with relevant keywords
- Experiments can be searched by topic, keywords, materials
- All applications will be uploaded to the system with a full list of materials, details of steps to

take, brief scientific explanations, suggestions for the place in curriculum, the estimated cost.
- All applications must be tested by the member before they are uploaded in the system. This is a requirement for reliability. The user must share pictures of the apparatus, materials etc. Video uploads will be highly recommended. Safety of the experiment must be confirmed as well.
- There will be volunteering editors who will check the uploaded material for reliability and safety before they become visible.
- The experiments can be shared through social media (facebook, twitter).
- The experiments will be rated by the users
- The experiments difficulty level will be shared by users

Initially about 30 experiments will be uploaded to the system with clear instructions and videos before the website is launched in October 2012.

4. Future

After the launch of the website, we are going to work in collaboration with an Advisory Board of volunteering teachers to ensure the reliability of the shared material and to improve the effectiveness of the website.
We are also going to use the existing opportunities at Sabanci University and work with our students systematically. We believe our students can have an important role in the sustainability of this project.
Civic Involvement Projects (CIP) is a one year course which is mandatory for every Sabancı University student. Through CIP, students take active roles in civil society in cooperation with national and international non-governmental organizations and state institutions [6].
CIP has a wide range of projects; about child development, human rights, environment, consumer responsibility and handicapped people. Child development projects are a big part of CIP and they are organized in cooperation with the Ministry of National Education and local primary schools. In these projects, Sabanci University students visit certain underprivileged schools for a year and perform activities with the children. These activities are aimed to be fun and educational.
Starting in the 2012-2013 academic year, we will launch a *home-made science* project as a part of CIP. A number of applications is chosen for 5th grade students and a three week program is prepared. This program is going to be applied to several schools during the 2012-2013 academic year.

Another useful platform at Sabanci University will be the Project 102 course offered to freshman students. We will keep on offering home made science projects to students as a part of Project 102 course where students are going to be supplying content as well as systematically testing content which is already presented at the website.

5. Conclusions

Self-built, hands-on applications of science is critical in science education and there are limitless resources of such activities in our everyday lives. Cheap, easily obtainable materials, easy to make experiments give children self-confidence because they have a chance to observe, question, modify and test the natural phenomena, as they are directly involved in the learning process.
Home-made science network website may serve as a growing platform where teachers, children and enthusiasts come together to built a reliable resource guiding to the world of home-made science.

6. Acknowledgements

Authors would like to thank all the Sabancı University students who chose to design course modules during their Project 102, Ersin Göğüş,
Ali Alpar, Ünal Ertan, Emrah Kalemci, Yuki Kaneko, Alimet Sema Özen, volunteering teachers of the Advisory Board and the CIP coordinators for their valuable contributions. Authors would also like to thank to Institute of Complex and Adaptive Matter (ICAM) for supporting this work.

7. References

[1] Michaelides PG, Miltiadis T, Science Teaching with Self made apparatus. Paper presented at the 1st International Conference on Hands on Science Hsci2004 – Teaching and
Learning Science in the XX1 Century, 5-9 July 2004, Ljubljana, Slovenia, Proceedings pp.47-52
http://www.hsci.info/hsci2004/PROCEEDINGS/FinalPapers/040530.pdf (Retrieved 27/08/2012)

[2] Saylan DU, Gogus E, Alpar MA, Home-made Science in parallel with the curriculum, Proceedings of the 4th International Conference on Hands-on Science HSCI 2007, http://www.hsci.info/hsci2007/PROCEEDINGS/FULLTEXTp.pdf (Retrieved 27/08/2012)

[3] Churchill ER, Loeschnig LV, Mandell M, 365 Simple Science Experiments with Everyday Materials, New York, Black Dog & Leventhal Publishers, 1997.

[4] Valadores EC, Physics Fun and Beyond, New Jersey, Prentice Hall, 2005.

[5] Compiled by Unesco, 700 Science Experiments for Everyone, New York, A Doubleday Book for Young Readers, 1956.
[6] Civic Involvement Projects: 2005, http://cip.sabanciuniv.edu/eng/ (Retrieved 27/08/2012).

GALILEO TEACHERS NETWORK IN TURKEY

D.Ü. Şaylan, K. Bora, M.A. Alpar
Sabancı University, Orhanlı, Tuzla, İstanbul 34956 Turkey
ducer@sabanciuniv.edu,
kerembora@sabanciuniv.edu,
alpar@sabanciuniv.edu

Abstract. *Gallileo Teachers Network of Turkey and its interactive website is connecting and supporting the members of the network and is an effective tool for volunteers who would like to participate in the effort of sharing the excitement of astronomy with others.*

Keywords: Galileo Teachers, Astronomy, Science education, Hands-on science.

1. Introduction

Galileo Teacher Training Program (GTTP) was launched as one of the Cornerstone Projects of DAY 2009 by International Astronomical Union. Turkey is a part of the training program since 2008. The main aim of the program is the observation of the night sky consisting of the stars, constellations, moon, sun and the planets; to watch the night sky and note the changes, think about the reasons. Also, it is to talk about the role of Galileo Galilei in Scientific Revolution. There are lectures, sky observations and workshops in which the participants get introduced to some hands-on activities related to astronomy. Another important aim of the program is that the participants share what they have learned in the program with their students, parents and the rest of the public. If the participants use the activities in their classes or they organize sky observations they are named "Galileo Teachers". If the Galileo Teachers organize a GTTP for a group of educators they become "Galileo Ambassadors". Program aims to create 3,000 to 6,000 certified Galileo Teachers around the world by 2012.

Galileo Teacher Training Program is an example of a well established global science education program. The program aims to share how Galileo's systematic observations of the sky changed the world, to show how anybody can observe the same things on their own and how much one can discover by just looking up at the night sky. Also the program aims to give the teachers hands-on and observational tools which can directly be applied in the classroom. The project has an active global website [1] and a facebook platform to connect parties all over the world.

2. GTTP in Turkey

Today one can find anything on the internet, this is correct for science education resources as well. One can find lecture notes or videos, hands-on activities and immense amount of information. In order the information on the internet to be used effectively in the classroom, resources must be understood clearly and incorporated adequately into scientific curricula by the educators.

Although some teachers show extraordinary effort and are very creative in incorporating this information in their classrooms, most teachers require sincere and reliable support of an active community in this process [2].

Galileo Teachers Network of Turkey and its dynamic website which is connecting the members of the network, has been launched in 2012 and it has proven to be an effective platform for teachers since then.

About 300 educators, astronomy enthusiasts, volunteers, teachers participated in training programs since 2008 in Turkey, however only 25 of them have been entitled as Galileo Teachers [3]. Through these sessions, we noticed that most of the participants were having trouble to use GTTP resources effectively. It is also problematic to keep an active communication with the participants. A need of a platform where participants could share activities as well as experiences was apparent.

Although we are following the main principles of GTTP, some differences have been implemented in the administration of the project to deal with these problems. Our GTTP Network Website has been the key in this process. After a volunteer participates in one of the trainings, they are asked to become a member of the website. The participants can share information about themselves in their profiles, and they can share the activities they organize not only in their classroom, but also with public in their neighborhood. Participants who share activities through the website automatically become Galileo Teachers.

We are forcing the training programs to have at least three night sky observations, naked eye and with simple telescopes. As the last part of the GTTP sessions, we are organizing public observations

where most participants have their first experience on sharing the night sky with students and general public. Organizers are also strongly recommended to have workshops where teachers discuss how these resources can be used in parallel with the curriculum.
GTTP targets a learning-from-each-other type active community where anybody can become a Galileo Ambassador.

2. Website

Powered by Drupal free content management system, our website is an easily administrable dynamic and interactive platform. Anyone can become a member of the network and so can be informed about the upcoming GTTP sessions, activities of Galileo Teachers and also astronomy related news. When they become GTTP participants, they have permission to add their activities to the website. When they do so, they become Galileo teachers.
It is easy to upload activities, just by entering some information about the activity and by attaching some photos. Uploaded activities can be viewed in the upcoming/last activities blocks and can be searched by cities or keywords and also appear on our activity map (Figure 1).
Our website is also a reference for trainings and activities of Galileo Teachers. This is critical to preserve the knowledge in these practices and to set examples for members intending to organize events of their own. We have presentations and lecture videos, tips for planning a night-sky observation and hands-on classroom activities as supporting resources for the members of the community.

Figure 1. *Activity map of Galileo Teachers in Turkey by August 2012. Darker circles indicate greater number of activities*

We are working on social media to promote our website as well. We have a facebook group for the announcements and any activity shared in the network website can also be easily shared through facebook.

It is also aimed to share current astronomical events through the website and facebook in order to encourage the members of the network to organize new events.

Figure 2. *An image obtained from Stellarium [4] software in order to announce an activity to the members (Perseid Meteor Shower Peaks: August 12, 2012)*

3. Conclusions

GTTP Turkey has been a delightful experience for us in many ways. Powered by a dynamic website, this active science education community set a good example for similar projects. This project also gives an opportunity to establish strong relations between the astronomy community at the universities and amateur astronomer educators. The project aims to establish a non-hierarchical community of people who construct and spread the good practices together. It should be noted that, top-to-bottom structure of our national education system is completely in contrast with the philosophy underlying this kind of community.

4. Acknowledgements

Authors would like to thank Rosa Doran of the global task force for her support and Galileo Teachers of Turkey for their contributions.

5. References

[1] http://www.galileoteachers.org/ (Retrieved 27/08/2012)
[2] Ben-Peretz M, The Teacher-Curriculum Encounter: Freeing Teachers from the Tyranny of Texts, SUNY Press, 1990.
[3] http://www.galileo-ogretmenleri.net/ (Retrieved 27/08/2012)
[4] Stellarium, www.stellarium.org (Retrieved 27/08/2012)

THE NEW TECHNOLOGIES AND MATHEMATICS

L.C. Vladescu
The school with I-VIII classes Schitu, Olt, Romania
lucconstvl@yahoo

Abstract. *The evolution of our world from an industrial society into an information society, placed a mark on all of its subsystems, imposed throw its new technological support. In this frame, the education system must rethink everything, from methods, contents to structures. This step needed the introduction of Informatics and ICT in the school curriculum for teaching different disciplines. This way, teachers are using the computer, not only as a didactic material but more as a complementary system in the teaching-learning-evaluation process. In this paper I will present some methods for teaching and learning Mathematics using the new technologies.*

Keywords: Mathematics, new technologies.

1. Introduction

What we understand today by new technologies? If we look for a definition, we can say that new technologies are those technical innovations with great impact on our daily life. Smaller and smaller PCs, tablets or mobile phones create both opportunities and challenges for teachers and schools. All these new teachnologies dramatically reshaped the way teaching process is carried out.

Preparing the new generation and the societies in crisis situation is the teacher's mission. We have not to forget that we have a past who generated a huge inherited culture, and we have the moral obligation to transmit it. This is a very interesting thing that the computer and the new technologies became the indispensable support for the education update[1].

Mathematics is everywhere and is very important for our life. In the same time, mathematics is seen as a very difficult and boring topic. A good teacher succed to attract the students if he or she is very well prepared and up to date with all these new teachnologies.

2. Milestones in the implementation process of the new technologies in education

We have to have in mind three levels:
a) the planning and financing level;
b) the organization level;
c) the curriculum level.

At the first level, it has to be planned the total computerisation of all education institutions from a country, then to assure the necessary budget for the education system and, in the same time, to encourage the sponsors in the education field in order to accelerate the computerisation process.

At the organisation level, compulsory education to cover all kids aged 7 to 15 or 16, to increase the number of highschools with Informatics profile or oriented on new technologies, to create an adult education system based on the new technologies, to increase the role of non-formal and in-formal education by strengthening the relationship between the worlds of education and work.

At the third level:

- introduction in the compulsory education curricula of the new educations based on ICT and new technologies;
- developing appropriate programs and textbooks;
- encouraging the use of ICT in all other subjects.

3. Hardware tools

The hardware tools needed for the instruction procces can be:

- Presentation equipment: video monitors, multimedia projectors, interactive whiteboards. Provides visual or/and audible, passive and interactive perception of digital data for individual or group audience.
- Storage devices: magnetic, optical, mixed. The increasing storage capacity is accompanied by compacting sizes, increase portability and data security.
- Specialized equipment for the acquisition of images, video sequences and sound. The use of scanners allowed the exponential expansion of the amount of digital information and served as an impetus for development of multimedia formats.

4. Software tools

Software tools are different types of digital resources:

- passive resources - documents, images, sound or video clips;
- standardized learning objects - interactive objects, which allow the intervention of the trained person to conduct practical activities, exercises and tests in accordance with international standards in the field, the set of standards known as SCORM (Sharable Content Object Reference Model);
- simulation applications - applications that model real phenomena and events through a set of mathematical formulas. Dominant feature of such applications is the user's ability to observe and to model a phenomenon or action without

real involvement in them. In this category affiliate also the educational games;

- applications for assessment - local or online software that allow to create ongoing evaluation tests, intermediate or final, and analysis, storage and transmission of results to the evaluator or learning management system;
- learning management systems (Learning Management System) - software that integrated database containing data on progress, learning efficiency, instructional content and data on their use by those trained in digital format;
- Content Management Systems (Learning Content Management System) - software for management development and subsequent publication of educational resources (content) through LMS.

5. Communication Tools

Communication Tools are software and hardware tools used to organize the communication, both synchronous and asynchronous as well. Synchronous communication tools of universal individual or group, the most common are: Skype, Google talk, Yahoo messenger, specialized systems and videoconferencing etc. videodifuzare. The number and variety is growing continuously. Of asynchronous communication tools most commonly used are: email, forums, blogs, discussion groups, RSS, repositories for images, text and video (Slideshare, Google albums, YouTube etc). Specific communicative tools software is able to transmit information in real time and store it virtually unrestricted volume.

6. Virtual Learning Environments

A Virtual Learning Environment(VLE) is a set of teaching and learning tools designed to extend the learning experience of students by using ICT tools. There are several commercial VLE, including Blackboard, WebCT, AEL, Lotus LearningSpace VLE but also the free distribution VLE. The same features are encompassed by the Learning Support Systems (LSS), the Managed Learning Environment (MLE) and e-learning platforms.

7. Examples from Mathematics

In the educational software, can be promoted: problem solving, experimental research / documentation, demonstration, simulation, brainstorming, discussion, teaching games, applications / practical tasks etc..
An example from mathematics is shown in Fig 1, AEL educational materials, Mathematics – 8-th grade, “Shapes representation”.

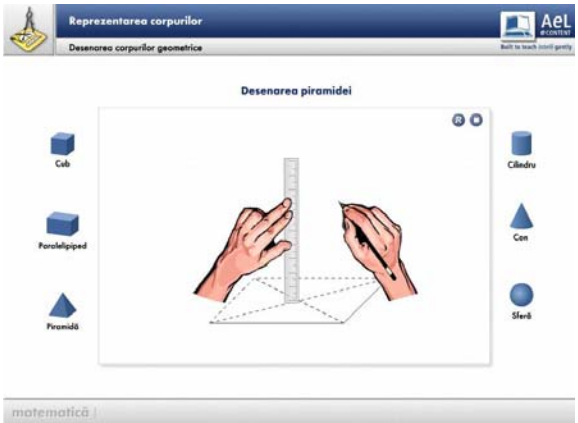


Figure 1. *AEL, “Shapes representation”*

Some examples of sites that contain materials that can be used in the elaboration of teaching materials:
http://www.mathsisfun.com/
Math explained in easy language, plus puzzles, games, quizzes, worksheets and a forum. For K-12 kids, teachers and parents[3];
www.encyclopediaofmath.org/index.php/Main_Page is Creative Commons Attribution-Sharealike 3.0 Unported License (CC-BY-SA) and the GNU Free Documentation License (GFDL)[4];
www.doe.virginia.gov/testing/sol/practice_items/index.shtml include examples of new technology-enhanced items for grades 3-8 mathematics, Algebra I, Geometry and Algebra II. Practice items in science and English also are provided as examples of items being field tested in spring 2012[5];
http://math4children.com/Videos/graphs/index.html is a math video lesson on representing information on graphs. Parents and teachers can use this to help kids learn how to represent information on graphs.Click on the PLAY button to start the video lesson and pause at will to let kids fully understand.)[6].

8. Conclusion

New technologies relying on visualizations, interactions, and kinesthetic experiences can make the key ideas of Mathematics more widely accessible. Besides, a part of schools, colleges and universities are using computers for various utilities viz. pay rolls, time-tables etc. In our country, two students share a school computer only in the ICT lab and only one from five students have computers at home. In the rural area, the situation is much worst. The available computers sometimes do not work and too often lack a full suite of software. This low and unreliable access to technology means that students do not get enough experience to master complex software tools and teachers cannot assign homework that assumes ready computer availability.

Important, technology-rich curricula materials are rarely implemented, if at all, because there is insufficient access to technology and schools are unable to rearrange the curriculum to exploit the advantages of these materials. In this environment, the potential of information technologies on Mathematics education cannot be realized.

9. References

[1] Amend, J.R., Larsen, R. & Furstenau, R.P. (1990) Drawing relationships from experimental data: Computers can change the way we teach science, in J. of Comps in Math. & Sc. Teaching 10(1) 101-111.

[2] Beichner, Robert J. (1994) Testing student interpretation of kinematics graphs, in Am. Journal of Physics, 62, 750-762.

[3] Pierce, Rod. "Math is Fun - Maths Resources" Math Is Fun. Ed. Rod Pierce. 3 May 2012. http://www.mathsisfun.com/index.htm [06/23/2012]

[4] Encyclopedia of Mathematics. URL: http://www.encyclopediaofmath.org/index.php?title=About&oldid=20414 [06/24/2012]

[5] Virginia Department of Education. Testing & Standards of Learning (SOL). Mathematics Practice Items. http://www.doe.virginia.gov/testing/sol/practice_items/index.shtml [06/24/2012]

[6] Math4Children. http://www.math4children.com/index.html [06/24/2012]

WHAT THE SCIENCE EXPERIMENTAL TEACHERS THINK ABOUT THE USE THE TECHNOLOGY (ICT) IN TEACHING? COMPARATIVE STUDY OF THE RELATIONSHIP BETWEEN THINKING AND PRACTICE

S. Contreras

University of Santiago de Chile, Avenue, Libertador Bernardo O´Higgins 3363, Central Station, Santiago, Chile

saul.contreras@usach.cl

Many public and private institutions related to the education, use technology resources (ICT and NNTT) to innovate in teaching and thus obtain better learning outcomes. However, for several reasons, these innovations often do not reach the classroom. One these reasons are the influence of teachers' beliefs in curriculum implementation. With the aim of describing curricular beliefs about practical activities in laboratory and ICT (information and communication technology) resources, and the relationship between thinking and practice, the author has carried out the case study of two teachers (biology and physics), both in their classroom activities and those in laboratory. The sources of information include field notes, questionnaire, interviews, class planning and class observation.

The results indicate that, what teachers believe is not the same as what they do, appearing more constructive in thinking and more traditional in practice. However both teachers have similarities to the relationship between thinking and practice. For example, they believe that ICT must be used to teach science, however, in practice, the most utilized resource is the textbook. The author considers that, taking into account this kind of incoherence is essential in order to reflect about teachers' knowledge of sciences, practices and the relationship between these. Therefore, it is important to consider what the teacher thinks about several aspects about the science teaching. Then establish the relationships with the practice and from this we can install really the innovations in the classroom. In other words, knowing what teachers think about a particular resource and establish a relationship with their practice is an essential link if we want innovation processes in the classroom, whit and from teachers. Moreover, the description of this thinking and its relationship with practice, can also approach the technology skills and competencies that teachers have, which of them will be implemented during classes

Keywords: Thinking, practice, technology, science teachers, skills.

THE USE OF IDRISI GIS FOR MODELLING EARTH LANDSCAPES

L. Polina
Dresden University of Technology (TU Dresden), Faculty of Forest, Geo and Hydro Sciences, Institute for Cartography. Technische Universität Dresden Helmholtzstr. 10 01069 Dresden, Germany
Polina.Lemenkova@mailbox.tu-dresden.de

Current paper demonstrates, how GIS techniques can be used for understanding, visualizing and modelling landscapes of the Earth. Practical example of this work is application of IDRISI GIS towards geospatial data.
Study region is located on the coastal area of the Baltic Sea, in Estonia, Pärnu region. The landscapes of Pärnu region represent unique part of Estonian nature. This region is known for its unique environment, precious coniferous pine forests, mild maritime climatic settings and high esthetic value of the landscapes. This makes it a popular tourist destination place among local population and international visitors.
The research purpose consists in interpretation of particular land cover types, typical for selected landscapes of Pärnu. These ecosystems were examined and identified using IDRISI GIS using Landsat TM raster image, which was interpreted and classified. The research method consists in GIS-based data integration, interpretation, spatial analysis and final thematic mapping. The workflow algorithm consists in following steps: identification and visual recognition of landscape types on the image; creation of training sites and spectral signatures; supervised classification of the digital image using training sites; final thematic mapping. Landsat TM image was classified according to system of land cover classification, made by Coordination of Information on the Environment (CORINE). The CORINE map was used for interpretation of the classification. The final result is thematic map of landscape types made using cartographic methods.
The work demonstrated how the Earth natural environment and ecosystems can be studied using combination of geoinformation techniques, IDRISI GIS tools and remote sensing data. Particularly, how technical support of GIS can be used for integration of various multi-source geospatial data and interpretation of landscapes. Presented work illustrated effective application of advanced, cost-effective GIS-based method of geospatial data processing towards environmental studies.

MEASUREMENT OF SOUND SPEED IN AIR WITH: SYRINGE, SOUND SENSOR AND COMPUTER-BASED LABORATORY

D. Amrani
Physics Laboratory, Service des Enseignements Généraux, École de Technologie Supérieure, University of Quebec, 1111 rue Notre-Dame Ouest, Montreal, Quebec H3C 1K3, Canada
djilali.amrani@etsmtl.ca

We present a simple and accurate experiment for undergraduate physics' students to measure sound speed in air through a 60 mL syringe at room temperature. The sound velocity was measured with sound sensor using Computer- Based Laboratory. The sound sensor was used to record the pitch noise produced by the plunger when pulled completely out of the syringe. Data logger setting was run by means of computer with installed PC software. Fast Fourier Transform (FFT) analysis was performed on measured data to determine the fundamental frequency of a column of air that can be used for the calculation of sound velocity in air.
The fundamental frequency of air columns in the syringe was measured from the real time displayed graph amplitude vs. frequency. The obtained average value of sound velocity in air was 344±3 m/s. This is in good agreement with an error of approximately 0.3 % compared to the expected value 343 m/s. The positive side of this experiment is that with such sensor and data logger it is easy to perform precise and accurate measurements of sound velocity of air in relatively small laps of time. Also, the simplicity of this real time laboratory experiment allows students and teachers to experiment and investigate enthusiastically different concepts of sound wave measurements.
The experiment can be proposed to college and university physics students for lab experiment or for class-room demonstration. It also can serve as a pedagogical tool to enhance students' comprehension in acoustics and related matters.

Keywords: Sound speed, sound sensor, Computer-Based Laboratory.

THE EFFECT OF SCIENCE AND TECHNOLOGY LABORATORY SUPPORTED BY ROBOTIC ON SCIENTIFIC PROCESS SKILLS

U. Böyük[1], A. Koç Şenol[2]
[1]*Erciyes University, Education Faculty, Department of Science Education, Kayseri.*
[2]*Yemliha Sami Yangın Secondary School, Kocasinan, Kayseri.*
boyuk@erciyes.edu.tr

Recently when we consider Science and Technology education in the world, a new technological area has been seen. This technological innovation called "Robotic" provides great advantages in obtaining data especially in Science and Technology laboratory applications and as well as gains students many skills such as problem solving, critical and creative thinking. In this study, the effect of robotic supported experimental activities on students' scientific process skills were investigated in "Force and Motion" unit of the 7th grade Science and Technology course. The research was carried out in 2011-2012 academic year with the 7th grade students (N=40) in an elementary school in Kayseri. The research model is "pretest-posttest control group design" of the experimental method. In the study, as a data collection tool *"Scientific Process Skills Test"* and *"Student Activity Diary"* were used. The activities in the experimental group were performed with *Lego Mindstorms NXT Robotic Educational Kits* and the same activities such as curriculum were applied in the laboratory in the control group based on Science and Technology curriculum. The activities in each group implemented for eight weeks. The quantitative data were examined with SPSS 17.00 package at the 0.05 level of significance. As a result, they were determined that the experimental group students' performed robotic supported science experiments scientific process skills were statistically significant from the control group students'.

BEING SCIENTIFIC OF INFORMATION ON THE WEB ABOUT PHYSICS CONCEPTS: DOCUMENT ANALYSIS OF TURKISH CONTENT IN WIKIPEDIA

V. Damli, H.Ş. Kizilcik
Gazi University Gazi Education Faculty Physics Education
volkandamli@gazi.edu.tr, hskizilcik@gazi.edu.tr

The purpose of this study was investigating the being scientific of information on the web used by students, teachers and researchers. The most frequently used source by students doing a project or homework expect for textbooks and teachers is internet. The reason for this is accessibility and substantiality of internet. At this point reliability and being scientific of information on the web gain importance. To assess the reliability and being scientific of information on the web Turkish content of Wikipedia was chosen. And also concepts in physics' curriculum of ninth grade were chosen from Turkish content. Physics concepts in Wikipedia were investigated and their being scientific was discussed. Because of Wikipedia is a kind of document, while being scientific of information was being investigated qualitative document analysis was used. While making document analysis concepts were assessed based on source related to concepts is given or not and also true or not. Hereby Turkish content investigated in Wikipedia contains lots of wrong information. Also most of wrong information in Wikipedia can lead to misconceptions. If students think information in Wikipedia is absolutely scientific, probability of having misconception of students could increase. Therefore raise the awareness of students about being scientific of sources on the web become important.

Keywords: Web, being scientific, concept, curriculum.

EDUCATIONAL IMPLICATIONS OF SLOWMATIONS (SLOW MOTION ANIMATIONS) IN SCIENCE EDUCATION AND PROSPECTIVE SCIENCE TEACHER'S OPINIONS ABOUT USING OF IT

E. Ekici, F. Taskin Ekici
PAU Faculty of Education, Denizli, Turkey
fenerma@gmail.com ftekici@gmail.com

This report that is part of research project has being conducted by the research team is about slowmations. The research project is related to gaining knowledge and skills to prospective teachers about the ICT integrations in science learning. In this study, after giving information about preparing and creating slowmations, prospective teachers' opinions related to using it in science instruction have been summarized.
When we interviewed with the participants about the study, student teachers (STs) have emphasized the positive and negative effects of these activities for the efficient science instructions and science learning. They stated that this activity (slowmation) provides more enjoyable and more engaging science learning and can also provide deep understanding in several science contents. Nevertheless, STs have emphasized some negative aspects when this activity process has been applied such as need for technological knowledge, skill and infrastructure and of course time.

ASTRONOMY WITH AN 8-INCH

R.K. Bhattacharyya
Department of Applied Mathematics
Calcutta University, Calcutta 700009, India.

An 8-inch reflecting telescope should be the pivotal equipment in amateur astronomy. An 8-inch Newtonian astronomical reflecting telescope with heavy duty equatorial mounting brings before the eyes of the observer the magnified and distinct images of the moon, the planets with their specific features, their satellites, stars and nebulae; the binaries are distinguished with clarity. Star-clusters are visible and the red, orange, greenish-bluish colours of celestial objects are discernible. The lunar surface topography, ridges and rills and the sunspots and solar flares and solar faculae can be studied rigorously with an 8-Inch. The worlds of distant, cloudy nebulae can be observed with delight and clarity. The exciting immense and living and overwhelming experiences of undergraduate students with an 8-Inch is discussed below. The discussion is carried out from the standpoint of astronomy education in India in particular and for developing countries in general.

COLLABORATIVE LIFE-LONG LEARNING ENVIRONMENT

O. Voychenko
IRTC, 04211, Ukraine, Kyiv, P.O. Box 44
alexp_p@mail.ru

Global changes have a serious impact on education. New challenges require new approaches in the use of information technologies for teaching and learning.
The work offers an approach to development of the environment for support of both learning and scientific activity on the basis of collaborative life long learning.
The environment consists of two major components. The first component is a wiki-based resource containing articles written by both students and scientists. All authors are encouraged to prepare articles in collaboration with each other forming small virtual teams. Diverse background and experience of the authors increase their motivation to collaborate with each other. Some innovative teaching and learning practices have been developed to implement flexible approach in authors' activities regulation.
The second component is a resource for supporting educational and scientific on-line events like conferences, workshops, etc. It allows managing, storing and disseminating heterogeneous multimedia content generated at the on-line events: webcasts, videos, audios, presentations, podcasts, twitter and forum threads, etc. It is used to form the community, which is able to interact using the full power of modern information technologies to present and discuss a wide range of scientific issues. This resource enables effective content aggregation of different media types from distributed sources (Youtube, Slideshare, etc) to achieve fruitful collaboration of students, University teachers, instructors, educational managers, and invited researchers.
New approaches in educational management allow uniting two entirely technically independent components in one powerful and flexible

environment enabling practical implementation of some collaborative life long learning concepts.

Finally, the cumulative effect from the use of the two components as one environment allows forming a kind of bridge between traditional way of learning and innovative scientific and educational approaches, enabling the different categories of users to participate in a flexible way in the processes of the collaborative life long learning.

© 2012 HSci. ISBN 978-989-98032-0-6

ENVIRONMENTAL EDUCATION IN TRADITIONAL AND NON-TRADITIONAL SETTINGS

© 2012 HSci. ISBN 978-989-98032-0-6

© 2012 HSci. ISBN 978-989-98032-0-6

EDUCATION IN SUSTAINABLE AND GREEN ENERGY FROM EUROPEAN PERSPECTIVE

S. Crina
"Mihai Bravu" Technical College,
Bucharest, Romania
crina.stefureac@gmail.com

Abstract: *The paper/presentation contains examples/results of good practice in our school, through European projects, with environmental protection as the main theme.*
MOTTO: small changes in our behavior can lead to significant energy savings and a major reduction in emissions
TARGET GROUP: secondary school students and teachers
FIELDS: Sciences and new technologies in the service of education, Environmental Protection
OBJECTIVE: Educating young people to save energy, to recycle materials, generally for Environmental Protection
PROJECTS IMPLEMENTED in our school:
- Comenius Projects - Multilateral School Partnership: "Waste not, Want not", "S.O.S. Earth"
- IUSES Project- Intelligent Use of Energy at School – ended by European Energy Saving Award – EESA (we obtained the first prize at "School section" from the 14 countries participating)
- Publications in online magazine "EPMagazine" (European Pupils Magazine) - articles about the history of science and technology for Green Energy published jointly by universities and secondary schools (Partnership: Italy, Greece, Romania, Bulgaria, Netherlands, and Turkey)
Total number of students involved: 800
Total number of teachers involved: 70
Details to:
http://sosearth.wikispaces.com/
http://www.iuses.eu/
http://www.epmagazine.org/

Keywords: behavior, bike, Class A, citizens' attitude, environmentally friendly transport, ecovolunteering, education, efficient consumption/using of energy, environmental protection, future, Intelligent USE, new technologies, NOT Waste, project, recycling, reduction of emissions, reforestation, renewable energy, saving energy, spreading, sustainable development, turns-off.

1. Introduction

European projects financed from European funds represent an opportunity to exchange ideas, for harmonious development of the young generation, so that, participating countries can quickly find effective solutions to solve problems regarding humanity. By this paper and by my participation to the 9th International Conference on Hands-on Science, I intend to promote the example of "Mihai Bravu" Technical College, as a model for other schools or companies. Our school was involved in several European projects having as primary objective education of young generation to find ways for saving energy, for using the renewable energy, generally for environmental issues. Small changes in our behavior can lead to significant energy savings and a major reduction in emissions.

"Mihai Bravu" Technical College has classes to study intensive English or French in the technical field - buildings and public works (electrical installations sanitary installations). Our school, its teachers, engineers and foremen, had permanent concerns in the field connected to energy, by participating in European projects on this theme. I have coordinated many of these projects. I also participated in individual mobility, conferences, and workshops on environmental issues. We are interested in teaching of democratic citizenship using the topic approaches based on key concept–energy and green technology as important element of the community welfare.

The students studied on the following topics:

- New Green energy sources
- The clean use of fossil based resources;
- The rational use of energy
- Energy and the environment
- Thermal insulation of buildings
- Energy efficient electrical and plumbing
- Methods of any type of energy savings, at home and in school

The youth need to become more aware of energy-related problems, and how they can change their own lifestyles, to limit environmental damage caused by the daily use of energy. As the decision-makers of tomorrow, we need to empower them to make the right choices. The projects are aimed at improving knowledge about: Renewable Energy, Energy Efficiency and Reducing Carbon Dioxide Emissions, among children and young people and their families using a fun approach and aimed at generating greater enthusiasm for clean energy. Students were also encouraged to help raise awareness and so to act as multipliers in their own communities, starting with their families and friends.

2. Description of our Projects

Here are some examples of European collaborations of our school, concerning the educational novelties in the energy field and environmental:

- Involvement in EU Altener Programme: Photovoltaic Training Courses in Candidate Countries (SOLTRAIN) Project 4.1030/Z/02 (Fraunhofer Institut Solare Energies Systeme). The main target of this project was writing a textbook on photovoltaic panels (electrical problems, advantages, and their integration in building design), translation into languages of partner countries for use in teaching our students.
- Participation in Geosciences Information for Teachers which had the theme “Energy and Sustainable Development” (as part of the EGU European Geosciences Union - Vienna, 2010) (lectures, workshops for teachers, modern teaching demonstrations, visits, exhibition of posters and exchange of experience).
- Visit to Sotavento, Spain, in the Comenius individual mobility “Science and Art - So Different, So Similar!” (Eolian Energy Park, station for hydrogen production and intelligent home, a project in the testing phase as models for environmental education)
- Participation, starting 2005, in activities and events that belong to the Educational Network “Hands-on Science” Comenius Network Project (110157-CP-1-2003-1-PT-COMENIUS-C3) http://www.hsci.info/ and http://education.inflpr.ro/. Many of the works accomplished by the pupils as part of this project are focused on the theme of the recoverable energies and the efficient consumption effected by employing the new technologies and the economic installations.
- Participation by EUROSCOLA Program in the European Parliament, at Strasbourg, in mixed teams of students from European countries, for proposed amendments to laws for the Environmental Protection.
- Comenius multilateral school partnership projects:
- ”Waste not, Want not” (2006-2007) (partners: United Kingdom, France, Bulgaria, Romania), Project 06-PS-N-532-B-UK, with theme: "Noise pollution", an environmental problem apparently less important but often serious influences on human health
- ”SOS Earth” (2008-2010) (partners: United Kingdom, Portugal, Finland, Romania) Project no. 2008 -1- RO1- COM06 – 000141 http://sosearth.wikispaces.com/ with themes: “Light pollution” for the first year and “Global warming” for the second year. Students of partner countries have developed these themes by communication of their studies on the project website and also in their motilities. They made measurements of various electrical consumers, measurements on carbon dioxide emissions in different parts of the cities (in partner countries), at different times of the day. They concluded that such pollution is higher in Bucharest than in Lincoln, Lisbon or Helsinki. Students have proposed several solutions for transport, which could reduce pollution.
- Our students are involved in activities of online magazine “EPMagazine” (European Pupils Magazine): Conferences of Editorial Boards, published articles about: History of science and technology and New Technologies for Green Energy.
- The most important results, both for environmental education and for environmental protection, we have had in the IUSES Project (“Intelligent Use of Energy in School”) ended with EESA Competition (European Energy Saving Award). In this project were 14 participating countries: Austria, Bulgaria, Czech Republic, France, Germany, Greece, Ireland, Italy, Lithuania, Netherlands, Romania, Slovenia, Spain and UK.
- IUSES Project started in 2009-2010 school year. This European project was part of EU Intelligent Energy program, aims to promote a more efficient way of using energy in daily life among secondary schools students and teachers. IUSES showed to students the basic principles of energy efficiency and give a comprehensive guide to saving energy in their everyday lives (a behavior-oriented educational kit including: handbooks, multimedia animations and experiment tool-kit). The project ended with the European Energy Saving Award, involving the 14 countries, which were rewarded schools and students that improve their energy efficiency. “Mihai Bravu” Technical College won first prize in the "Schools" section.

© 2012 HSci. ISBN 978-989-98032-0-6

The main reasons of our school's participation in the IUSES Project and EESA Competition had more components:

- the desire for direct involving of our school in solving the actual problems connected to the energy consumption (exhaustion, pollution)
- the effective energy savings in the school and also in consumption of students' families
- the necessity of forming, shaping of a durable, responsible behavior among young people regarding the energy consumption
- the advantage offered by the profile of our college in young people forming with regard to their future jobs: buildings and public works. The research and the studies regarding the energy consumers from the school could be made by our own resources owing to the specialized foremen and engineers.

I present below, with many details, activities undertaken and results that have brought us the first prize in the "schools" section of EESA Competition.

The name given to our project suggests the essence of our project going on during the school year:

"EFFIC ENERG SCHOOL"

The tools employed for accomplishing the objective:

SCIENCE AND THE SOLUTIONS OFFERED BY SCIENCE

The activities undertook in the two main directions:

Education through:

The advantage offered by the profile of our college in young people forming for their future jobs: building public works. This advantage was used in both senses: on one hand, the training offered for implementing the project by the foremen and engineers who are specialized in buildings for sanitary and electrical, and on the other hand, the ease, help in exploiting the knowledge offered by the IUSES materials in training the students. The research and the studies regarding the energy consumers in school could be made by our own resources, from the specialized foremen and engineers.

1.a. The applying, at school and within their families of the methods for efficient energy savings and intelligent using of the energy consumers (from small gestures to higher savings). The forming, shaping of the responsible behavior of the students for the low energy consumption by:

- The using of IUSES manuals and materials through the lessons of our teachers. All the students benefited by these lessons because 15 teachers and training foremen, out of 73 that work in our school, participated in the training held as part of the IUSES project
- Individual study of the pupils regarding the new sources of renewable energy, using magazines, manuals, internet and finished by accomplishing individual and grade portfolios, power point presentations, posters
- The designing of demonstrative experimental models referring to the electric consumers, which were made in the school workshops
- The accomplishing of posters, leaflets containing messages and warnings for the pupils from our school and other schools. A space with three big boards was arranged, which was meant for displaying the pupils' messages and the news concerning the ongoing of the project in the school
- The organizing of three Communication Sessions and Poster Exhibitions with messages, created by the students, dedicated to events like: The Week of Durable Energy, The Earth Day, and The Environment International Day. All had the theme: "THE DESCOVERING OF SOLUTIONS FOR THE FUTURE"
- Debates on the energy theme in our European Club
- Visits to museums with reference to the power-consuming technology evolution: The Technical Museum, The Village Museum, The First Hydropower Station, in Sinaia (Romania)

© 2012 HSci. ISBN 978-989-98032-0-6

All these were always accompanied by practical steps to save energy:

- students have made lists of things to be done at school and home to save the energy. Then they applied and followed consumption and bills
- students have prepared lists of prompting to colleagues, family members take care of energy consumption
- was envisaged to use natural light in most part of the program
- everyone turns-off after classes. Service personnel keep the lights-on only in the room that cleaning. Have been warned designed by students on all the school switches
- were used economical stand-lamps on hallways
- nobody leaves standby equipment
- were remove some consumers not absolutely necessary (refrigerators, air conditioning)
- were mounted economic light sources and Class A consumer at school and home
- family members were asked by students to take a shower instead of bath and follow consumption and bill

They were asked to recount their achievements:

- have made known their monthly bills. This has led to significant results!
- was achieved economy at methane gas used in the canteen by change of cakes with fruit (are healthier)
- few students began to come to school on bike even if they still parked near the school fence

The results seen by lowering bill at school and home

The involving of the students in the influence over the society by spreading our example and ideas for the improving of the citizens' attitude towards the energy consumption: family, neighbors, friends, the pupils from the neighboring schools.

1.b. The teachers, engineers and foremen applied in curriculum and extra-curriculum, giving information regarding the new ideas in the field of durable, recoverable, renewable energy and new technologies that allow the reducing energy consumption.

2. Savings by reducing the energy consumption

2.a. The main target was *the lower bill for the electric energy consumpted in our school* by elimination of wastes, the energy saving by efficiently using the school electric consumers. Warnings were used on the switches and also on other consumers, e.g. computers, in order to be disconnected when they are not used. Students' teams were formed in order to permanently draw attention to this problem. Initially, during January and February, insignificant decreasing was obtained, of only 1%-2%, but, in March, the energy savings were of 45% as compared to February. We mention that February and March are compatible as number of working days and hours of daylight, and the price per kWh wasn't changed.

The bills compared for Electricity are: February 17,941.55 lei – March 10,958.34 lei. In March we saved compared with February: money: 7,000.00 lei which means 1,800.00 euro, Active energy: 3,480 kWh, Reactive inductive energy: 1,271.52 kVARh

Reductions were also achieved, but much smaller, for the methane gas consumption (used in chemistry lab and the canteen) and for heat.

The bills compared for methane gas are: February 604.12 lei - March 574.04 lei. In March we saved compared with February: 255,438 kWh

Reduce heat to February was achieved by stopping heating on weekend, in most rooms. The bills compared for heat are: January 79,256.55 lei - February 75,443.73 lei. In February we saved compared to January: 34.87 Gcal

These results of save money may be used for next school years, as model. Was suggested to the City Hall that could promote such initiatives by equipping laboratories or for bike parking, in school, with the save money.

For the savings done in home consumption was initiated the competition "My lower bill!"

2.b. The significant reducing of the energy consumption by achieving the project for the thermal and electrical rehabilitation of the school building in partnership with the City Hall.

Our school has no installations destined to using the recoverable energy but the rehabilitation plan takes this into consideration. It has a good isolation through its masonry and its relatively new PVC windows. The thermal installation is relatively new, having connection to the city installations, but also its own thermal point for redistribution. The electric installation is mostly old, and for classrooms lighting we use neon. The school building is spacious, with big windows, a thing that allows the using of natural light, for the most part of the day.

In the project rehabilitation, specialists from the City Hall took part but also the teachers, engineers and foremen of our school. Studies were done with training a large number of students, in workshops, to prepare their job. The research and finalization of the study on the electric consumers from the school with the aim of identifying the ones that should be replaced for diminishing the energy losses and the intelligent, efficient utilization of this. The necessary funds were approved. See the rehabilitation plan published on the site on the 3rd District City Hall: http://www.oar-bucuresti.ro/anunturi/2010/03/11/a/39739fisa3.pdf

2.c. The encouraging of using the bikes as a means of ecologic, sustainable transport, for students, by implementing the project “Coming to school by Bike” in partnership with Association “Bate şaua să priceapă iapa” (“Dropping a Hint”) and City Hall of Bucharest.

Transport to our school is done with public transport. Thus, out of the 103 employees, only 5 (5%), use their car for going alone to school. Out of the 870 pupils, only 10–15 come alone to school in their cars, but only occasionally. We also mention two aspects:

- Our school encourages registration and transfer students who live nearby for save time and energy
- Generally speaking, teachers live close to school and take care to use means of transport. The problem is to educate them on those around and find ways to convince about danger of pollution produced by conventional fuels

Should be noted that Bucharest is a very crowded city, for traffic, and have no facilities for cyclists. Therefore cycling is dangerous for our students. They must be familiar with bicycle rules.

The activities for carrying on the project “Coming to school by bike” resided in:

- Introducing the bike into the young people’s lives by initiating them in using bikes for both a utilitarian and recreational purpose
- The organizing of rewarding competitions on the bike theme
- Lessons held by the Association “Dropping a Hint” regarding the advantages of bike using, the knowledge of rules for riding a bike on public roads
- The facilitating of riding bikes and parking them within the schoolyard. For this purpose an official request was signed on behalf of the school, to the local officials to insure safety and comfort measures for those who use bikes.

The request was sustained by a poll affected on 10 classes of different levels, as a consequence of which 250 pupils out of our 870. They all signed the request on funds for accomplishing a rack needed for parking the bikes in the schoolyard. Questionnaires were applied to 4 classes of different levels. From this result that about 8% of the school students would desire to use the bike to come to school. This means that about 70–80 pupils could use the bikes for going to our school, which implies the need of 70–80 parking places. At the same time, guiding strips on the main routes in the proximity of the school are needed.

By achieving this project, our school could contribute to eliminating pollution produced by the transport – reducing carbon dioxide emissions. The pupils can convince the “grown-up” to “put the brake” on the car.

In conclusion we can say that in our school we save energy daily.

2.d. We save energy by collecting, sorting and giving to recycle waste, packaging, paper, etc. in “Ecoclub for Nature”. In general we are fighting to reduce packaging!

In "EcoClub for Nature" students learn about conservation and protection of the nature and especially of Forest by activities such as: thematic excursions and camps in National Parks, trainings and sport contests, presentations of slide shows, posters, cartoons with theme “S.O.S. FOREST”, ecogreening, cleaning some areas, selective collection of waste products, marking trails, reforestation areas. Our students participate in Ecovolunteering activities, by actions for keeping healthy ecosystem. Activities are similar to the initiative of millions of volunteers worldwide to prevent the disappearance of certain animal and plant species and to reduce pollution caused by industrial activity or to maintain a balance in nature. The activities are organized both in Bucharest as well as in National Parks, marking important events on Earth, such as: Forestry Week, Parks Day, Youth Day, and International Day of Environment.

© 2012 HSci. ISBN 978-989-98032-0-6

We hope that all these activities to help reduce emissions of carbon dioxide or other gases harmful to nature and people. Young people

 ISBN 978-989-98032-0-6

should be aware to take action against causes that lead to Global Warming and Climate Change.

Acknowledgements
Thanks to Mr. Manuel Costa for the opportunity he gave us, to participate in Hands-on Science activities, thanks to the organizers in Turkey and to all partners and initiators of the projects we were involved.

References

All communication is written from personal experience. No materials were used.

SECONDARY SCHOOL STUDENTS' ATTITUDE TOWARDS ENVIRONMENTAL ISSUES IN KARACHI, PAKISTAN

A. Yousuf[1], S. Bhutta[2]
[1]*Federal Government Girls High School No 1, Gilgit. Pakistan*
[2]*Aga Khan University Institute for Educational Development, Karachi, Pakistan*
anisayousuf@gmail.com, sadia.bhutta@aku.edu

Abstract. *This paper examined high school students' attitudes toward the environmental issues (pollution of air and water, overuse of resources, global changes of the climate etc.) with respect to school system. The questionnaire-based Relevance of Science Education (ROSE) Project was used to collect data from 10th grade 312 students. Data was analyzed using (SPSS) the non- parametric equivalent of the independent t-test. The results of the study indicate that there were significant difference between government and private schooling systems students' attitudes. Private schools students reported to have a significantly high degree of positive attitude towards environmental issues as compared to their government counterparts. The results of the study provide significant insights into students' attitude towards environmental issues towards discipline in both government and private secondary schools. Based on the results of the study, some recommendations have been put forward for policy and practice. Furthermore, the results of the study can be used as a base line for further studies. The authors offer suggestions, based on the results, for further research to identify reasons for differences between government and private school, so as to improve environmental education in Pakistani schools.*

Keywords: Environmental attitude, Environmental education, Secondary school, gender, school systems

1. Introduction

Environmental degradation has emerged as a serious issue in the world today. Human factor is the largest contributor to the environmental degradation (Makki, Abd-El-Khalick, & Boujaoude, 2003) which might pose serious threats to sustain life on earth (Gore, 1993). Therefore, there is a dire need to pay serious attention towards protecting life on earth. As teacher and teacher educator, it is our prime responsibility to take measures to overcome this problem. UNESCO[1] (2005) emphasizes the role of education in shaping attitudes, values, and behavior, while developing the capacities, skills, and commitments needed for building a sustainable future.

Dunlap, Gallup, & Gallup (1993) conducted an international survey on environmental values. In this survey, twenty four countries all over the world including developed and developing nations had participated. From each country, around one thousands sample selected. The survey's results showed that citizens of many developing nations were highly concerned about the state of the environment.

Studies generally tend to examine students' environment attitudes in relation to environmental knowledge, interest, behavior as well as socio-economic variables (e.g., Huang & Yore, 2003; Makki, Abd-El-Khalick, & Boujaoude, 2003; Negev, Sagy, Garb, Salzeberg & Tal, 2008) have been carried out all around the world in developed as well as developing countries. Lavonen and Meisalo (2004) examined the Finnish students' environmental attitudes across gender. They found overall positive attitude towards environment across gender. In a comparative study by Huang and Yore (2004), they reported that both Canadian and Taiwanese 5th grade students held positive behaviour and attitudes towards the environment. Moreover, they expressed a high emotional disposition toward the environment and high concern about environmental problems and issues as well as a moderate level of environmental knowledge.

Makki, Abd-El-Khalick, and Boujaoude's (2003) study showed that Lebanese high school students held positive environmental attitudes but had inadequate environment knowledge. Young students' environmental attitudes were also investigated by many Turkish researchers (e.g., Alp, Ertepinar, Tekkaya, & Yilmaz, 2007; Taskin, 2009; Tuncer, Ertepinar, Tekkaya & Sungur, 2005). In one of these studies, Cavas, Cavas, Tekkaya, Cakiroglu, Kesercioglu, (2009) found that Turkish students generally have favorable attitudes and interest toward environmental issues. They seemed to be eager to find solutions to environmental problems and show optimistic trends about the future.

In ROSE (Relevance of Science Education) study Sjoberg & Camilla (2004) conducted survey in forty countries of the world. As part of ROSE study, the researcher examined how students relate environmental challenges. They found that students did not seem to be pessimistic about the global future. They put trust in themselves that they personally could influence what happens with the environment. However, the study showed no significant gender differences regarding environmental issues. Results of the study revealed that in general students have positive attitude towards environmental protection.

In summary, research studies which are carried out all over the world showed that students have positive attitude towards protection of environment. They are eager to find solutions of environmental issues.

Furthermore, school may play some role in the formation of students' views on the environment (Tuncer, Ertepinar, Tekkaya and Sungur, 2009). Kuhlemeier, Bergh, and Lagerweij(1999) also seems to agree by saying that , the student population (family background or prior achievement); the enthusiasm, experience and competence of the team of teachers; the curricular offering; the quality of instruction; and the social climate (Gamoran and Nystrand, 1994) may all play a part to develop attitude of students.

In Pakistan, government and private schooling systems are following the same curriculum (National curriculum, 2009). However, there is difference in teaching methodologies and resources in both the systems.. This study aims to explore students' attitude with respect to school system to know the environmental attitude of students. However, there is dearth of research studies which have been carried out to explore differences in students'/teachers' attitude towards environment across school systems. However, only a couple of studies have been carried out to address this issue all-around the world. A study was carried out by Tuncer, et al (2009) in Turkey to explore environmental attitudes of young people across school system. Results showed that students from the private school scored higher than their government counterparts. Another study was carried out by Shobeiri, Omidvar & Prahallada (2006) to know the environmental attitude of teachers of Iran and India across school system. Result showed that overall there is no significant difference in public

[1]United Nations Educational, Scientific and Cultural Organization

© 2012 HSci. ISBN 978-989-98032-0-6

and private school teacher environmental attitude.

In Pakistan, few studies have been carried out to explore students' learning out comes in various subject including science (Mirza, Munawer and Hameed, 1994, Das, Pandey, and Zajonc, 2006, LEAPS 2007, p.31). These studies have found that private children at private school have performed better as compare to their government counter parts in science and other subjects. As science is closely related to environmental education, it was important to find out whether this difference in achievement translates in children attitude as well. These were the main reasons to select the variable (i.e. school system) to explore further through the study. Having said that, I am cognizant of the fact that there are number of other factors (Scio economic status, class room practice, Media) which contribute to environmental attitude. However, keeping in mind the scope of this study, one variable was selected.

2. State of environmental education in Pakistan

Some researchers argue that formal environmental education helps students to develop more favorable attitudes towards environment (e. g Lee, 2008). Therefore, it is reasonable to look at the environmental education context in Pakistan within this study. The Environmental Education (EE) in Pakistan is in its very beginning stages. There is not a well-established environmental education policy for Pakistan. It is important to note that in Pakistan, EE is not taught as a separate subject. However, EE concepts like energy, greenhouse effect, pollution; microorganism, recycling, and ecosystem have been incorporated in the science curriculum of the primary and secondary classes. Moreover, textbooks of Urdu, English, Social Studies and Islamic Studies at primary and secondary levels also carry some environmental education concepts, which are presented as part of content in various chapters. There is very little attempt to make connections between concepts, especially between science and environment and vice versa. Furthermore, the textbooks lack guidelines for teachers to teach these concepts not only to create awareness and develop attitudes, interests and skills among students but also to equip students with strategies to take action in order to preserve the earth's natural resources and to deal with environmental issues.

An overview of the discussion presented above appear to indicate that although there is no separate environmental education course in the secondary education in Pakistan, environment related ideas are intended to provide to all students from both the science and non-science groups through different subject areas. However, curriculum review revealed that most of the topics related to environment failed to portray adequately the relationship between human activity and the quality of environment in the presentation of content. Furthermore, National Education Policy (2009) has not given attention to the area of environmental education. Rabia (2010) argues that by keeping in view the importance of EE, environmental education should be given proper attention. For example, it is important to relate EE with daily life as this strategy would help to develop positive attitude towards environmental issues.

PURPOSE

The study aimed to investigate secondary school students' attitude towards environmental issues across school system.

RESEARCH QUESTION

What is the difference in environmental attitude of secondary school students of government and private system in Karachi, Pakistan?

METHODOLOGY

Cross-Sectional Survey

The purpose of my study was to investigate the attitude of Grade Ten students towards environment. Accordingly, I opted for quantitative approach ,which seemed to be most appropriate as it aims to identify what a situation is like and the direction in which it is going (Punch,2005). There was no manipulation of variables required in the study and it only aims in describing the current attitude and differences across existing variables (i.e. school system and gender. An additional advantage of this design, according to Fraenkel & Wallen (2006) is that "it is quicker to conduct and cheaper to administer" (p.397). It produces a "snapshot" of a population at a particular point in time. (Cohen, Manion& Morrison, 2000)

This cross-sectional survey, involving the questionnaire proved to be an effective way of assessing environmental knowledge and attitude from large group as surveys can directly collect information from people about their ideas, feelings, and social and educational background (Fink & Kosecoff, 1998, p.1)

© 2012 HSci. ISBN 978-989-98032-0-6

Furthermore, attitude is a positive or negative thinking about a person, object or issue (Abell and Lederman, 2007). Therefore, asking directly from individuals through an attitudinal survey research method was the most logical method for gathering
information on attitude. (May, 2003).

3. Description of the Questionnaire

The questionnaire consists of 23 items divided into two parts. Part A, in which participants were asked to provide information about name, gender, age, and class and school system. In Part B, relevant section of ROSE[2] questionnaire was used. It is a Likert-type scale which includes ten sections (A to I). I chose section D which contains 18 items that focuses on students' attitude towards environmental issues column ranging from disagree to agree.

4. Sample

The ROSE questionnaire was translated from English to Urdu by five researchers working in the fields of Science Education, Urdu language and English language. Pilot study carried out for reliability. For drawing a representative, Multi stage cluster sampling sample of grade ten students from private and government schools of Karachi, I encountered two major constrains:

- Geographical spread of the target population
- Partially or complete unavailability of listing of schools

Keeping in mind the above constrains, from the eighteen towns, those towns were selected, which are half an hour's traveling distance from AKU-IED[3]. Of the eighteen towns, seven towns fulfilled this criterion. Of the seven selected towns, two towns were randomly selected in the first stage of sampling. In the second stage, 10 schools were selected from two towns through random sampling using SPSS. In the third stage, grade ten students were selected from each school by setting the criteria that the whole class will be included if the class size is thirty or more than thirty. Application of the questionnaires in the classroom took forty minutes. The sample of the study consist 312 students (154 girls and 158boys) who were enrolled in the 10th grade. A direct administration procedure was used for the survey.

5. Data Analysis

Table 1. *Overall attitude of students*

Items	Mean	Standard Deviation
1. Threats to the environment are not my business (-)	2.50	1.44
2. Environmental problems make the future of the world look bleak	3.74	1.29
3. Environmental problems are exaggerated (-)	3.17	1.26
4. Science and technology can solve all environmental problems	3.29	1.20
5. I am willing to have environmental problems solve even if this means sacrificing many goods	3.79	1.00
6. I can personally influence what happened with the environment	3.59	0.95
7. We can still find solutions to our environmental problems	4.26	0.92
8. People worry too much about environmental problems (-)	3.14	1.32
9. Environmental problems can be solved without big changes in our way of living (-)	2.56	1.29
10. People should care more about protection of the environment	4.24	1.04
11. It is the responsibility of the rich countries to solve the environmental problems of the world	2.67	1.34
12. I think each of us can make a significant contribution to environmental protection	4.13	1.05
13. Environmental problems should be left to the expert (-)	2.30	1.17
14. I am optimistic about the future	3.70	1.12
15. Animals should have the same right to life as people	3.91	1.14
16. It is right to use animals in medical experiments if this can save human lives	3.46	1.21
17. Almost all human activity is damaging for environment	3.27	1.29
18. The natural world is sacred and should be left in peace	3.69	1.30

Data was analyzed by using SPSS. Inferential analysis was used for comparing the mean scores of students' environmental attitude across systems. Group comparison (Mann-Whitney) was used to find out differences across school systems. This analysis was carried out in two steps: (i) overall comparison; (ii) item-wise comparison. Before, comparing group analysis was carried out on overall score to explore general trends across all items.

[2] http://www.ils.uio.no/forskning/rose/
[3] Aga Khan University, Institute for Educational Development

 ISBN 978-989-98032-0-6

6. Results

This section begins with a subsection of overall attitude of students followed by presentation of results at two levels to answer the two main research questions.

6.1. Over all attitude of students towards environmental issues

Table 1 shows the overall attitude of students at secondary level in Karachi, Pakistan. An examination of table shows that students hold moderately positive attitude in most of the items of ROSE questionnaire (section D "Me and environmental challenges"). The participants responses were distributed among the five options (i.e. strongly disagree, disagree, neutral, agree, strongly agree).The findings revealed that Pakistani students generally have moderately favourable attitudes towards environmental issues. They seemed to be eager to find solutions to environmental problems and showed optimistic trends about the future.

What follows is detailed analysis at item level. The students scored highest in item 7 which is about the vision for future. It is worth mentioning that the students scored (M = 4.26). Students' images of the future affect actions in the present, they try to adapt what they imagine and acts that they wish for future. Future images are influenced by the background, experiences, knowledge. By knowing the youth's images of the future; we can better understand their present motivation, choices and actions. The images students' hold of the future will make the future of country. Showing positive attitude regarding finding solutions to environmental problems suggest that students seem more concerned about the environmental problems. They own the problems and are enthusiastic to solve them. It is interesting to note that the youth of Pakistan is ready to take action for their better future.

It is quite surprising to note that students scored relatively higher (M =4.24) in item 10, which is about protection of environment. They think that it is important for the society that environmental problems should be solved. Students showed their concern for environmental issues and they want to protect the environment by their personal contribution. This attitude shows their determination towards protection of environment.

For item 12, which deals with the feeling of influence environmental problem, students have demonstrated an overall positive attitude (M= 4.13). Interestingly, students seem to be more motivated towards taking action instead of depending on other sources to solve environmental issues. They think that each of them can make significant contribution to environmental protection. They have demonstrated more positive attitude in terms of understanding their own responsibility to solve environmental problems. The average low score on the negatively worded item (*environmental problems should be left to expert)* indicates that in general students have shown their sense of responsibility to participate in solving environmental problems. It is heartening to observe that in general students have demonstrated more positive outlook for influencing the development.

Responding to the item 15, which is about whether animals should have the same rights to live as people, students showed positive attitude (M =3.91). This item is related to the bio centric value. The positive attitude of student shows that they recognize the pleasures and pains of non-human subjects to be considered. They might be of the view that at least some of what counts in ethics is common to our kinship with animals, not just specific to our species. Common sense first and science later teaches that we humans have many similarities with animals. For survival on planet earth, all members of ecosystem are equally important. Positive attitude towards same right of life of animals is encouraging in the sense that students love and care for animals.

On the other hand, in three items (4, 11, 17) students showed their less positive attitude. It is interesting to see that both items 4 and 11, which focus on external sources (i.e. technology and rich countries) to solve problems, have scored relatively lower. It is encouraging to observe that in general participant students have demonstrated their sense of responsibility and relatively less reliance on external sources. Item 17 (almost all-human activity is damaging for environment) is regarding the protection of nature. Relatively low scores show that the students believe that not all-human activity is damaging for environment. By doing environmental friendly activities, they can protect their environment.

Overall results reveal that in general students have moderately favourable attitude towards environmental issues. They seem to be eager to find the solutions to environmental problems and show optimistic trends about the future.

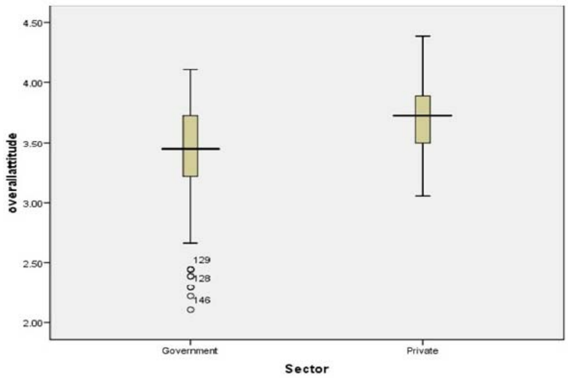
 ISBN 978-989-98032-0-6

6.2. Comparison between types of schools

This section presents the results of a comparative analysis between government and private school students' attitude towards environmental issues at the secondary level.

Figure 1 presents a comparative overview of overall attitude of students across school system. The results shows that on average, students from private schools have demonstrated more positive attitude (M= 3.71; SD= 0.28) as compared to government school students (M=3.40; SD=0.43). The difference was found to be significant [U= 7024.000; p<0.01]. Interestingly, the three outliers at the lower end shown in the visual graphics were all boys. Further analysis was carried out to explore detailed patterns at item level.

Figure 1. *Comparative Overview of Students' Attitude across School*



Item-wise analysis

The table 2 presents a detailed analysis at item level by comparing the mean scores and the standard deviation of government and private schools students' attitude towards environment.

Table 2. *Comparison across System of Schools – Item-Wise Analysis*

Items	Government M(SD)	Private M(SD)	Difference
1. Threats to the environment are not my business **(-)**	3.1(1.5)	1.9(1.1)	U=6.712; p<0.001
2. Environmental problems make the future of the world look bleak	3.4(1.4)	4(1.0)	U=9.544; p <0.001
3. Environmental problems are exaggerated **(-)**	2.9(1.1)	3.5(1.3)	U=8.500; p<0.01
4. Science and technology can solve all environmental problems	3.0(1.3)	3.5(1.0)	U=9.514; p<0.001
5. I am willing to have environmental problems solve even if this means sacrificing many goods	3.9(1.1)	3.6(0.8)	U=8.634; p<0.001
6. I can personally influence what happened with the environment	3.6(1.1)	3.6(0.8)	U=1.120; p>0.05 (ns[4])
7. We can still find solutions to our environmental problems	4.2(1.1)	4.3(0.6)	U=1.155; p>0.05 (ns)
8. People worry too much about environmental problems **(-)**	3.3(1.3)	2.9(1.2)	U=9.800; p<0.01
9. Environmental problems can be solved without big changes in our way of living **(-)**	2.6(1.3)	2.6(1.2)	U=1.187; p>0.05 (ns)
10. People should care more about protection of the environment	4.0(1.2)	4.4(0.8)	U=9.819; p<0.01
11. It is the responsibility of the rich countries to solve the environmental problems of the world	2.4(1.2)	2.9(1.3)	U=8.980; p<0.001
12. I think each of us can make a significant contribution to environmental protection	3.9(1.3)	4.3(0.8)	U=1.088; p>0.05 (ns)
13. Environmental problems should be left to the expert **(-)**	2.5(1.2)	2.2(1.1)	U=1.044; p<0.05
14. I am optimistic about the future	3.6(1.3)	3.7(0.9)	U=1.134; p>0.05 (ns)
15. Animals should have the same right to life as people	4.0(1.3)	3.8(1.0)	U=1.027; p<0.05
16. It is right to use animals in medical experiments if this can save human lives	3.4(1.4)	3.5(1.0)	U=1.191; p>0.05 (ns)
17. Almost all human activity is	2.8(1.4)	3.8(1.0)	U=6.923; p<0.001

[4] ns: not significant

© 2012 HSci. ISBN 978-989-98032-0-6

damaging for environment			
18. The natural world is sacred and should be left in peace	3.3(1.5)	4.0(1.0)	U=9.113; $p<0.001$

The results depict that there are significant difference among government and private school students' attitudes regarding environment. Private school students scored higher than their government counterparts on most of the items. However, it was surprising to observe that government schools' students had an edge over their private counterparts on two positively stated items (i.e. 5 and 15). It is argued that private school students seem more willing to solve environmental problem; however, when it comes to sacrificing goods to solve these issues government schools have clearly exhibited more positive attitude. Similarly, government school students have shown more concern about animals' right to life.

It is important to note that the difference between the two school systems was not significant on six items including statement number 6, 7, 9, 12, 14 and 16. Interestingly, both the groups have exhibited an optimistic outlook for finding solutions of environmental problems ("we can still find solutions to our environmental problems" and "I am optimistic about the future"). Similarly, both groups are confident that environmental problems can be solved through "personal influence" and "significant contribution to environmental protection". As far as the "level of changes required to solve environmental problems" is concerned both groups have equally shown a positive attitude towards this. In other words, sample students in both groups seem to have realised that they have to make drastic changes in their life style to 'fix' environmental problem – the first step is realizing and taking steps towards solving environmental problems. Students' from both systems are inclined towards 'saving human life' even if that means 'sacrificing animal life'. However, it would be unfair discussing results on item 16 without referring to students' views on item 15. Comparing an overall score on the two items indicates that on average students from both groups have shown relatively more positive attitude towards (government M = 4.0; private M= 3.8) equality of human and animal right to life (item, 15). However, when it comes to sacrificing animal life for saving human life, the score of both groups (item 16) have gone down (government M= 3.4; Private M= 3.5).

Based on results of overall comparisons, it was expected that private school would show positive attitude on majority of the items. As expected, private school students have shown more positive attitude on item 1[-], 2, 4, 8[-], 10, 11, 13[-], 17 and 18. Of these nine items, the first five focuses more on students' attitude towards environment in terms of their sense of responsibility (e.g. people should care more about protection of the environment) and possible strategies to solve environmental issues (e.g. science and technology can solve all environmental problems). On the other hand, the last two emphasizes more on students' environmental attitude through their bio-centric values (e.g. the natural world is sacred and should be left in peace). It is also interesting to note, that the students seemed to value their own contribution in solving environmental issues instead of putting this important responsibility on others. Relatively lowest score (from both groups) on item 11 (it is the responsibility of rich countries to solve the environmental problem of the world) is a manifestation of their sense of responsibility.

7. Discussion

This section discusses the results in light of literature. Discussion is about the comparison across school system.

7.1. Comparison across School System

Comparison across school systems revealed that private school students claimed a more positive attitude towards environment than students from government schools.

This result is in contrast to the study of average environmental attitudes in government and private, state-dependent schools in 12 European countries (Avram and Dronkers, 2011).A majority of those studies found that there is no difference in environmental attitude of private and government schools system. There are only two exceptions to this general pattern. In particular, students in private government-dependent schools in Portugal have, on average, higher scores on the environment attitudes scale compared to their peers in public schools. Whereas the results are in align with the results of the study of Tuncer et al (2005), in which they found that in Turkey students' attending private

schools were more aware of environmental problems, individual responsibility and national environmental problems, and had more positive attitudes toward solving the problems.
Item wise detailed analysis showed that private school students have shown a more positive behaviour about their personal contribution in environment protection (item 12). However, they seemed reluctant in sacrificing many goods (item 5) to solve environmental problems. This pattern indicates a lack of concern towards environmental problem on part of private school students. How to interpret these findings? Blake's (1999) model may help to see barriers between environmental concerns and actions. He identifies three barriers to action: individuality, responsibility, and practicality. According to him, individual barriers are the ones that reside within the person, having to do with attitude and temperament. He claims that barriers are especially influential in people who do not have a strong environmental concern. Environmental concern is therefore outweighing by other conflicting attitudes. This seems to be the case with private education system students as well. They showed positive attitude for contributing to the protection of environment, however when the time comes for sacrificing goods, they seem reluctant to do so.
Although the evidence from the data reported that young people are not overwhelmingly optimistic about the future, environmental issues are clearly a matter of concern for them. Such issues deserve explicit curriculum attention. However, there are significantly different views of private and government education systems students' about a range of environment-related matters, including how to respond to the challenges related to the environment. It is thus important in any programme of environmental education to address directly some of the issues that divide students in their responses to the 18 statements (e.g., the extent to which individual action and/or sacrifice can bring environmental benefits) so that they can appreciate that, there are different ways of thinking about environmental challenges and responding to them. Underlying such thinking will be an understanding of different ways of explaining the origins of the present difficulties faced by the environment, whether in terms of risk society theory or not (Beck, 1992). The need is for diversity, sensitivity, and experimentation in planning and teaching programs of environmental education and encouraging students to ask appropriate questions and search for answers rather than simply acquiring a body of environmental knowledge. The goal should be to enable students to engage in an informed conversation with expertise about the environment and help them develop the confidence and skill to add to it and, when appropriate, to challenge it.
It would be important to dig these differences across system further. In Pakistan, government and private schools are following the same curriculum that is the National Curriculum of Pakistan. One possible explanation of this difference could be that, in most of the statements, private students positive attitude shows that they may have more exposure to environmental issues as compared to government schools through environmental project works and different teaching strategies. Teachers, working in private schools may have better awareness as compared to government schoolteachers (Larijani, 2010). Another reason could be that in private schools, the recent developments might be emphasized more, encouraged to participate in various programs on environment related issues, which is not so prominent in government schools. Even, Dinakara (2000) reported significant difference in environmental awareness between government and private school teachers. However, Sabhlok (1995) reported that government teachers were found to be well aware as compared to the private school teachers.
Given that many environmental problems and their solutions are science related, there is clearly a role for school science education in such an engagement. However, environmental education is not simply a matter for science educators. To the extent that such education requires the accommodation of the personal, social, and economic with the science as an integral whole, it constitutes a challenge to a conventional subject-based curriculum and pedagogy.
To protect and conserve the Environment, emphasis should be given to EE in both government and private system of education. In any of these education systems, teachers play a very significant role in developing a greater awareness about environment among students. This calls for a radical change in the way we think, live and work. Hence, it is clear that sustainable development calls for a paradigm shift in our educational systems right from the

 ISBN 978-989-98032-0-6

school level up to the university level. In fact, a sustainable way of life cannot be achieved without an appropriate education system designed to internalize the principles of sustainability in the life and work of our youth.
Since, it is a government initiative to make EE an integral part of formal education through its national curriculum framework, considerable work is being done in the direction of integrating environmental concepts into the existing curriculum, developing new strategies, preparing instructional material for effective implementation of EE in the both systems. However, there is a dire need of training teachers in both the education systems of Pakistan, so that students of both the systems can develop their critical thinking skills to act positively towards environment in future as citizen of Pakistan.

8. Recommendations

For policy, it is recommended that teacher-training institutes should include environmental issues in their curriculum. Mere inclusion of topic would not work therefore, it is important to train teachers in pedagogical strategies to orient them as how to teach environmental education to students for critical thinking, problem solving, and action. For practice it is suggested that teachers both in government and private schools must re-examine traditional teaching strategies such as chalk-and – talk method that mostly do not match the learning styles of students. Teachers need to use variety of innovative teaching strategies such as cooperative learning strategies, while delivering their lessons. Besides that teacher should use problem solving teaching methods, so that critical thinking in students could be developed. Student should be encouraged to take positive actions in daily life so that they could be able to act positively in their practical life in future. In other words, action oriented pedagogy could be considered a first necessary step towards realizing and solving environmental problem. The heart of teaching lies in interaction and discussion with students. In the light of the results of the study, it is suggested that teachers must appreciate and encourage interactions and discussions in the classroom so that students can express and justify themselves.

9. Conclusion

The results of the study give us the overall impression of moderate attitude of students towards environmental issues. However, for positive changing of the prevailing level of attitude and hope among youth, there is a need of bringing change in different levels. For example, some rethinking need to be done regarding curriculum content and structure, teaching methods, teacher education and in-service training, and development of suitable resources. It is my hope that these efforts will make youth of Pakistan environmentally informed and friendly citizen.

10. References

Alp, E., Ertepinar, H., Tekkaya, C., & Yilmaz, A. (2006). A study on children's environmental knowledge and attitudes: The effect of grade level and gender. *International Research in Geographical and Environmental Education,* 15, 210-223**.**

Beck, U. (1992). *Risk Society — Towards a New Modernity*. London: Sage.

Cohen, L., Manion & Marrison, K. (2000). *Research Method in Education* .London: Routledge.

Dinakara, S. A.(2000).*Environmental Awareness, Environmental Attitude and Teaching Practices of Elementary School Teachers of Mysore District in Environmental Related Topics*. M. Ed. Dissertation. Department of Education, Mysore University.

Dunlap, R., Gallup, G. & Gallup, A. (1993). Results of the health of the planet survey. *Environment*, 35, 7-39.

Gamoran A. & Nystrand, M. (1994). Tracking, instruction and achievement, *International Journal of Educational Research,* 21, 217–231.

Gore, A. (1993) *Earth in the Balance: ecology and the human spirit* (Boston, MA, Houghton-Mifflin).

Government of Pakistan ,(2009). National Education Policy. Islamabad: Ministry of Education.

Kuhlemeier, H., Bergh, V. D. & Lagerweij, N. (1999) Environmental knowledge, attitudes, and behaviour in Dutch secondary education, *Journal of Environmental Education,* 30, 4–11.

 ISBN 978-989-98032-0-6

Larijani, M. (2010). Assessment of environmental awareness among higher primary school teachers. J Hum Ecol, 31(2): 121-124

Lee, E. B. (2008). Environmental attitudes and information sources among African American college students. *The Journal of Environmental Education, 40*(1), 29-42.

Leung, C. & Rice, R. (2002). Comparision of Chinese-Australian and Anglo-Australian environmental attiudes and behavior. Social Behavior and Personality, 30, 251-262.

May, T. (2003). *Social Research, Issues, Methods and Process. (2nd E*d.). Buckingham: Open University.

Makki, M. H., Abd-El-Khalick F., & Boujaoude S. (2003). Lebanese secondary school students' environmental knowledge and attitude. *Environmental Education Research, 9*, 21-33.

Negev, M., Sagy, G., Garb, Y., Salzberg, A., & Tal, A. (2008). Evaluating the environmental literacy of Israeli elementary and high school students. *The Journal of Environmental Education,* 39(2), 3-20.

Schreiner, C., Sjoberg, S. (2004). Sowing the Seeds of ROSE. Unipub AS, Oslo, Norway.

Shobeiri S. M., Omidvar, B., and N. Prahallada (2006). International Journal of Environment Science and Technology Center for Environment and Energy Research and Studies (CEERS) ISSN: 1735-1472 EISSN: 1735-2630 Vol. 3, Num. 4, 2006, pp. 351-357

Taskin, O. (2009). The environmental attitudes of Turkish senior high school students in the context of post materialism and the New Environmental Paradigm. Science Education International (20)1/2, December 2009, 69-78.

Tuncer, G., Ertepinar, H., Tekkaya, C. & Sungur, S. (2005). Environmental attitudes of young people in Turkey: Effects of school type and gender. Environmental Education Research 11: 215-233Journal of Science Education 31: 481–502.

Tuncer, G. , Tekkaya, C., Sungur, S., Cakiroglu, J., Ertepinar, H. & Kaplowitz, M. (2009). Assessing pre-service teachers' environmentl literacy in Turkey as a mean to develop teacher education program. *International Journal of Educational Development, 29*, 426- 436.

UNESCO (United Nations Educational, Scientific and Cultural Organization), (2005). EFA Global Monitoring Report.

UNESCO (United Nations Educational, Scientific and Cultural Organization) (2005). The Tbilisi Declaration. *Connect,* UNESCO/UNEP Environmental Education Newsletter, Vol.4.

ENVIRONMENTAL CONTENTS IN THE TEXTBOOKS OF THE PRIMARY AND SECONDARY EDUCATION IN THE REPUBLIC OF MACEDONIA

M.S. Srbinovski

Institute for Environment and Health,
Ilindenska nn Campus Bildg. 304.13
1200 Tetovo, Republic of Macedonia
m.srbinovski@seeu.edu.mk

Abstract. *The purpose of this study was to analyze the extent to which educational contents in the didactic materials in the Republic of Macedonia addressed to the environmental education (EE), and how this attention differed from primary and secondary school in this country. The contents taking place in textbooks in both levels were subjected to comparative content analysis. We analyzed almost entire student's books for all subjects and grades from both levels (primary and secondary- gymnasium schools) in the Republic of Macedonia.*

Content analysis of the textbooks reveals that all components of EE did not get same attention. The quantity and the quality of the environmental contents in our didactic materials varied from textbook to textbook, from subject to subject, and from grade to grade. Science education textbooks have a dominant position in the field of EE. There is no vertical and horizontal linking, as well as disharmony in presenting the width of some environmental problems and/or issues.

Sustainable development, causes and effects of the destruction, various types of environmental problems, interdependence among environmental degradation, development, and peace, as well as co-operative international action, are neglected topics.

Keywords: Environmental education, Didactic materials, Schools, The Republic of Macedonia.

1. Introduction

The general environmental awareness and environmental culture in the Republic of

© 2012 HSci. ISBN 978-989-98032-0-6

Macedonia is at a rather low level. The consequence of the public attitude towards environment is increasing degradation of the environment, pollution and such similar issues. On the other hand, some analysis shows that the concept of sustainable development is probably understood only by 10% of the regional population. This is not enough to achieve a "critical mass" of actively involved citizens. We need look for the answer of this situation in the education system, e.g. curricula, textbooks, teachers, students, teaching methods, etc.

Environmental education (EE) together with sound legislation, sustainable management, and responsible actions is an important component of an effective policy framework for protecting and managing the environment. From that, every nation needs to ensure if all aspects of lifelong learning is fully engaged on the provision of effective EE.

Schools play an important role in the formation of positive attitudes in young children towards the environment. The bases for everyday work in schools are textbooks, so the quality of EE will be significantly dependent on the quality of the schoolbooks and other didactic materials. “The inclusion of environmental issues in the curricula and supportive learning materials of the schools of the Republic of Macedonia is ‘left to chance’ and lacking in appropriate planning for consistency and theoretical grounding” [26].

2. Materials and methods

The purpose of this research is to analyze the circumstances, the requirements, and the possibilities of the formal EE through didactic materials in the primary and secondary schools in Republic of Macedonia. From this purpose emerges the next main task of the examination: to analyze the extent to which educational contents in the didactic materials in the Republic of Macedonia addressed to the EE, and how this attention differed from primary and secondary school in this country. The environmental issues are defined as issues which include "the interrelationship between organisms and their environment" [6], as well as, issues "that involve assessing and understanding human influence on the environment, suggesting actions that may be taken to mitigate that influence such as conservation, or examining values and attempting to resolve conflicting interests" [4].

We are conscious of the width of the EE, so we are limited above all on establishing the quantitative aspect of environmental issues in the workbooks. For this reason, in the frames of the main task of the examination, we placed the following sub-tasks: (i) to establish environmental issues in the students books by subjects, (ii) to establish environmental issues in the didactic materials by classes and, (iii) by educational levels.

There is a good basis for assuming that the environmental issues in the didactic material are insufficient and they are not in accordance with the aims of the EE.

We analyzed almost entire student's books by all the subjects and the levels in the primary and secondary schools in Republic of Macedonia. In this way, we included 91 student's books mainly published from 2002-2010.

3. Results and discussion

According to the Tbilisi Declaration (1977) "the incorporation of EE into existing curricula or teaching programs is often slow". In the Recommendation No.7 of this Conference stands that in order to achieve the objects of the EE preparation of books and scientific reference works necessary for the improved curricula is indispensable [33]. From this important date, a long period of time passed by. Now we can summarize the results of their realization and we can exchange experiences on the basis of international plan. According to the results of the Survey research Center at the University of Maryland, the most common and the most reliable used sources of environmental teaching materials are textbooks [30]. But, the occurrence of environmental aspects is ad hoc and depends on the attitudes of the authors [7].

The richest didactic materials in the Republic of Macedonia with environmental issues are in Science (26%) and Biology for the first classes of the secondary schools (20%). The textbooks of 49 teaching subjects don't include environmental issues at all. The poorest are the textbooks of Mathematics and Macedonian language, especially that these subjects are most frequent according to the number of hours per week. Dominant position of the teaching subjects from the Natural science, exist also in many other country in the World (especially in Biology, as for instance, Bulgaria, Poland, Hungary, Russia and so on).

A study of 62 Geography, Health, and Science textbooks used in Wisconsin shows that the average 6th through 10th grade student, as

© 2012 HSci. ISBN 978-989-98032-0-6

opposed to the student who uses an environmental science textbook in an environmental science course, is exposed to only one side of scientific debates which surround many environmental issues [13]. In addition, these texts often ignore basic scientific information that does not reinforce the "catastrophic" environmental message [13].

The Environmental Literacy Council reviewed selected chapter of six of the ten textbooks which are typically used for upper lover high environmental science courses. The Council's review found that the quality and accuracy of the presentation of environmental topics varied from textbook to textbook, and from chapter to chapter, as well as several of the textbooks focus disproportionately on the social and political aspects of environmental problems and provide only a limited introduction to the science of the environment [31].

The purpose of one of Arthur's reviews is to look at how well and to what extent the two textbooks Sciencepower 9 published by McGraw-Hill Ryerson and Science 9 published by Nelson provide for "relating science to the environment" and for involving students in learning about environmental issues. It would appear that the Nelson text does a better job with environmental issues in the Chemistry, Space and Physics units while the McGraw-Hill text does a better job in the Biology unit. It also seems that each publisher did not achieve a consistent treatment from their team of writers [2].

In all countries of the European Union EE is provided variously as a compulsory subject, as a part of a compulsory subject area (normally science) or as interdisciplinary theme in primary education and secondary general/academic education [29]. At the upper secondary level, there is increasing curricular specialization. Although some subjects may remain compulsory for part, or all, of the upper secondary phase, the curriculum divides into branches, orientations, directions or specialization programs in all countries (Eurybase, 2000; West et al., 1999, citation in [29]). In 36 countries in the Asia - Pacific region environmental concerns are incorporated into social science as well as physical science courses [3].

In Poland within the education programmatic base, environmental issues are present to a varying degree in many subjects and subject groups in the form of specific educational goals, school priorities, program contents, and expected standards of pupil performance [9]. Providing teachers with the right teaching aids (attractive textbooks...) is extremely important, but much will still depend on the teachers' innovative thinking and commitment [11].

The KMK Conference ("Kultusministerkonferenz, 1980) in Germany was instrumental in the introduction of EE in curricula and schoolbooks; and the Institute for Science Education, among others, has made a considerable contribution to its implementation by developing instructional materials and conducting empirical studies in EE [1].

The most prevalent trend in elementary and secondary education in US is towards an approach called "infusion". This approach integrates EE into existing lessons, units, or topics focusing on other subject such as History, Science, and the Social science. But despite the arguments in favor of infusion, many environmental educators are wary.... For this reason, many educators prefer the "second-course" or "block" approach [32].

The EE Needs Assessment Survey for Washington State has shown that ninety two percent of schools surveyed indicated that the Science curriculum was where EE took place [28]. A study indicates that the average teacher spends fewer than 50 hours per year on environmental subjects. Environmental-based education has the potential to dramatically increase the amount of time teachers spend on the environment each school year [10].

One of the main roles of the textbooks takes into account that the acquisition of knowledge should be progressive and sequenced according to succeeding years of scholarity and bearing in mind that curricula must not be overloaded [15]. There is unequal distribution of the environmental issues by classes and educational levels in the Republic of Macedonia. So, didactic material in the fifth grades is the richest in these issues (4%), and the other hand, the poorest is in the thirst class of secondary school (0.9%). At the same time, the research has shown that the present EE has no continual character. This considers the teaching system as a whole as well as the particular-teaching subjects. It is necessary to start from the childhood and to go on during the life. In average, didactic material for primary classes is richer with environmental issues than those in secondary schools. Analysis of the content of the didactic materials ha showed how

© 2012 HSci. ISBN 978-989-98032-0-6

little time (2%) is spent on ecology and environment.

Similarly, in the curriculum for the lower primary classes, exist about 2.31% explicit environmental issues [16], [23] and [25]), but in the curriculum for the secondary classes only 1,22% [16] and [20]. That means the authors of the didactic materials have been prevented from incorporating more environmental issues in these materials.

In Canada the emphasis placed on the environment is drastically reduced in grades nine to 12, especially when compared to grades one to eight. The clearest illustration of this is the elimination of secondary courses in Environmental Science [4].

Three stages in the formation of an ecologically-minded mentality may be differentiated in Lithuania EE: (i) Grades 1-4 are developing an awareness of the natural environment by means of the introductory subject "The World Around Me", literature, excursions, field work on school grounds, (ii) Grades 5-9 receive more detailed understanding of the environment when studying fundamental subjects such as Botany, Zoology, Geography, Biology and Chemistry, and (iii) grades 10-12 study the rational behavior concept [5].

Srbinovski M. has shown that there are weaknesses in terms of tasks and questions, as well as illustration as a part of ecologically educational contents in schoolbooks who interpreted biological science in primary and high schools in Republic of Macedonia [16], [17], [25]) and [22].

Biology as a teaching subject should be enriched with contents that will help students to realize the living organisms as a result of one long process of harmonizing their own needs with the conditions that are offered by the environment [16] and [19].

It was very important to define the aspects of the environment included in the didactic materials, according to the one of the EE’s aims: "to enable human beings to understand the complex nature of the environmnet as this results from the interaction of its biological, physical, social, economic and cultural aspects" [33], in terms of “maintaining a dynamic equilibrium between the quality of the live and quality of the environment [35].

In the existing teaching materials great attention is paid to the nature, living and working place, traffic and noise, but they don't pay enough attention to the natural and main-caused catastrophes, the ecology-health problems, soil and food, sustainable development, the acid rains, the greenhouse effect, ozone layer thinning and sustainable development.

In Slovenia a special cross-curricular board for EE was established which has a task to integrate environmental issues with environmental management, sustainable development and global issues into particular teaching subject at all levels of education [8].

Recycling and waste management is the most frequently included subject in the K-12 classroom in the US, so almost 90% of the teachers include it in their topics [30].

Many schools look for a "formula" for setting up successful, long-term, resource efficiency programs. Because schools are a microcosm of the community that surrounds them (and, as such each is a unique environment), formula don't always work. Instead of offering a formula, Oregon Green School Tools provides five tools to help you reduce your use of materials, energy and water. These tools include involving students in conducting resource assessments for materials, energy and water, identifying resource efficiency opportunities, planning, tracking, and reporting [12].

One of the specific criteria is that the environmental issues should include: sustainable development, causes and effects of the destruction, various types of environmental problems, interdependence among environmental degradation, development, and peace, as well as co-operative international action [34].

It is important that we address the concerns in two different ways: by attempting to enact changes to the curriculum and if that is not possible, by enhancing the curriculum. Lobbying can be an effective way to encourage the Ministry of Education and Training to revise the curriculum [4].

It is not sufficient to "tell" students about ecology. Students must experience a curriculum which allows them to discover how they interact with the environment themselves. Only in this way will citizens from all over the world be able to make sound and responsible decisions concerning environmental issues [35]

In the realization of the environmental issues influence also has the conception of the didactic materials. Here we speak of the professional-science, the ideal, the esthetic, pedagogical-psihological requirements and so on. The modern

© 2012 HSci. ISBN 978-989-98032-0-6

textbooks need to stimulate the overall students' development, their thinking, creativeness, and above all, to enable them for self -education. Although some of these problems are still obvious, some social aims are very clear, there is still a small consensus about EE- about what the ecological educators should do and know, even more – how the society should make the ends with the complex living environment in which we live and which is in a constant change [14].
We can conclude that in the didactic material the environment is mainly treated as a natural environment, but not as social, economic, political, cultural and historical surrounding. So, the first problem of the EE in Republic of Macedonia is a result of the curriculum and syllabus, as well as the didactic material. The EE in them has "formal" and "superficial" position [24], [21], [18], [25] and [27].

4. Conclusion

As well as in many others countries, the quantity and the quality of the environmental issues in our didactic materials varied, from textbook to textbook and from subject to subject. In our educational system, Science and Biology classes have a dominant position in the field of the EE. A lot of textbooks do not include environmental issues at all.
Most environmental issues exist in the didactic materials for the fifth grade. On the other hand, textbooks for third class are the poorest with environmental contents. In general, textbooks for primary and secondary schools in the Republic of Macedonia, include about 2% environmental issues. There is no vertical and horizontal linking, as well as the disharmony in presenting the width of some problems of the protections and the advancement of the environment. In the existing teaching materials great attention is paid to the living and working place but they don't pay enough attention to the sustainable development, various types of environmental problems, interdependence among environmental degradation, development, and peace, as well as co-operative international action.
Because of the lack of national guidelines and institutional coordination we are not able to make a qualitative leap, and we also need to seek a holistic approach to contribute to education about, in and for the environment. In addition, we must be creative and persistent.
The didactic materials must be changeable, as well as the living environment in which we are living. It is necessary to promote and foster EE, especially through elaboration of a national strategy of EE. In this sense, a priority should be given to the poor approach to environmental issues in the didactic materials.

5. References

[1] An Overview of School in Germany and Environmental Education. http://www.zhb-flensburg.de/dissert/dempsey/RDempsey/03CH1_3.htm: 8 [8/9/2012]
[2] Arthur D. Grade 9 Science Textbooks and Environmental Issues, http://www.osee.org/grade_9_science_texts.htm: 1 [5/13/2003]
[3] Bhandari B.B. & Abe O. Environmental education in the Asia-Pacific Region: Some Problems and Prospects, International Review for Environmental Strategies 2000; 1(1): 57-77.
[4] Bowyer J.& McEwan S., Where is the Environment in Ontario's New Science Curriculum: 2, http://www.osee/org/where_is.htm [5/13/2003]
[5] Denisov V. and Olenin S. Bioenvironmental education the Lithuanian experience, http://business.hol.gr/~bio/HTML/Pubs/Vol5/html/den1_lit.htm. [3/24/2012]
[6] Environmental Science. Eldon D. & Bradley S., WCB, McGraw-Hill, Boston, Burr Ridge, Dubuque, Madison, New York, San Francisco, St.Louis; 1995.
[7] Hungarian Society for Environmental Education. 2000. Hungarian Environmental Education Strategy, pillars: 35
[8] Krnel D. & Glazar A.S. (n.d.) How the ideas of sustainable development and environmental management are reflected in the new primary school curriculum in Slovenia: 653-
[9] Ministry of the Environment. Through Education to Sustainable Development, National Environmental Education Strategy; 2001. http://pdc.ceu.hu/archive/00002821/01/strategia_ang.pdf : 14 [8/10/2012]
[10] NAAEE and NEETF: Using Environment-Based Education to Advance Learning Skills and Character Development; 2001. http://www.neefusa.org/pdf/EnviroEdReport.pdf: 3 [8/10/2012]
[11] Environment in Poland, Nowicki M. KAP, Dordrecht / Boston / London

[12] Oregon Green School Tools. ODEQ. Version 1.0, Creating Healthy School Environmental through Resource Efficiency; 1996/97. p 4.
[13] Sanera M. Environmental Education: Promise and Performance, Canadian Journal of environmental education, vol.3; 1998, http://www.edu.uleth.ca/ictrd/cjee/volume_3/Sanera; [3/24/2003]
[14] Schmieder A. A. The nature and philosophy of environmental education: goals and objectives, Trends in environmental education, UNESCO; 1977. 23-34
[15] Seguin R. The Elaboration of School Textbooks: 18-19 http://www.unesco.org/education/pdf/55_16.pdf [8/10/2012]
[16] The environmental education in the primary and secondary schools in the Republic of Macedonia from biological aspect, dissertation, Srbinovski M. University "St. Cyril and Methodius", Faculty of Natural Sciences, Institute of Biology, 2001.
[17] Srbinovski M. Tasks and questions in ecological school contents in schoolbooks who interpreted biological science in the primary and the high schools, Prosvetno Delo 2002; 3: 79-87.
[18] Srbinovski M. Environmental issues in the curriculum of the upper primary classes. Ekol. Zast. Zivot. Sred. 2002/03; 8 (1-2): 87-98.
[19] Srbinovski, M. Environmental issues in the didactic material of the primary and secondary schools in Republic of Macedonia, Ekologija 2003; 38 (1-2): 41-54.
[20] Srbinovski M. Environmental issues in the secondary (gymnasium) school's curriculum, Prosvetno delo 2003; 2: 104-115.
[21] Srbinovski M. Comparative aspects of the position of the formal environmental education in our country and in the world. Proceedings of the 2nd Congress of Ecologist of the Republic of Macedonia with International Participation, 25-29.10.2003, Ohrid. Special issues of Macedonian Ecological Society; 2003. 6 pp 314-320.
[22] Srbinovski M. Illustration likes a part of ecologically educational contents in biology text-books, Prosvetno Delo 2003; 1: 57-64.
[23] Srbinovski, M. Environmental issues in the curriculum of the lower primary schools, The contemporary pre-school and primary education - states and perspectives, Scientific meeting with International Participation, Pedagogical faculty, Skopje, 2003: 375-386.
[24] Srbinovski, M. Contemporary problems of the ecological education and the up-bringing of the pupils of primary schools of Republic of Macedonia, Proceedings, Pedagogical college, Dobrich; 2003. III (B): 82-84.
[25] Environmental education. Srbinovski M, Prosvetno delo; 2005.
[26] Srbinovski, M. & Palmer J. Environmental Education in Macedonian School: An Analysis of Curriculum Content and Supporting Materials for Teaching and Learning; Ecology, Biology and Biotechnology 2008; 4:19-30.
[27] Srbinovski, M., Erdogan, M. & Ismaili, M. Environmental Literacy in the Science Education Curriculum in Macedonia and Turkey, International journal Procedia - Social and Behavioral Sciences 2010; 2: 4528-4532.
[28] State Education and Environment Roundtable. Washington State Report; 2002, http://www.seer.org/pages/seminars/13thsemin.pdf: 1 [8/10/2012]
[29] Stokes E. et al. (2001): Environmental education in the educational systems of the European Union, Final report, Commissioned by the Environment Directorate-General of the European Commission, Centre for Educational research, London School of Economics and political Science; 2001, http://www.medies.net/_uploaded_files/ee_in_eu.pdf: 10-17 [8/10/2012]
[30] Survey Research Center. Environmental studies in the K-12 classroom, A teacher's view; 2000, http://www.enviroliteracy.org/pdf/survey2001.pdf: 1 [8/10/2012]
[31] Science for Environmental Literacy, A Review of Advanced Placement Environmental Science Textbooks. The Environmental Literacy Council
[32] Report assessing environmental education in the United States and the implementation of the national environmental education act of 1990, U.S. Environmental Protection Agency and Environmental Education Division. Washington, DC; 1996.
[33] Environmental education in the light of the Tbilisi Conference. UNESCO; 1980.
[34] Guidelines for Curriculum and Textbook Development in International education. UNESCO; 1988.

[35] A Prototype environmental education curriculum for the middle school, environmental Education Series; UNESCO. 1994.

POPULARIZATION OF ASTRONOMY THROUGH HANDS-ON ACTIVITIES

B.K. Tyagi, V. Prasar
Department of Science & Technology, Govt. Of India, A-50, Institutional Area, Sector 62, NOIDA (Uttar Pradesh), 201307 India
bktyagi@vigyanprasar.gov.in , tyagi.bk@gmail.com

Abstract. The declaration of 2009 by UNO as "International Year of Astronomy" and the occurrences of Total Solar Eclipse on 22 July, 2009, Annular Solar Eclipse on January 15, 2010 and recently the Transit of Venus on 6 June, 2012, were witnessed throughout the India. These three celestial events in row provided a great opportunity to Vigyan Prasar (VP), an autonomous organization, Government of India, for creating awareness about astronomy through hands-on-activities. For these celestial events, a much focused packages of outreach activities on astronomy were developed by building up nationwide campaigns involving children, science clubs, schools and common people. The main aim of these campaigns was to promote the interest in astronomy through hands-on activities among the people. The hands-on activities include making of low-cost equipments for undertaking some observational projects and other activities relating to astronomy to understand the science and it application in self-exploratory mode. The understanding part of science relating to astronomy also helped the people in the removal of myth and superstitions prevalent in India as part of its social and cultural milieu. Two activity based camps were also organized for the members of Science Clubs with an objective to provide the basics of Astronomy through a series of hands- on- activities.

This paper highlights the institutional efforts of VP in popularizing astronomy over the year through hands-on activities and to what extend the efforts were successful in enhancing the scientific literacy on astronomy among the members of science clubs of VP.

Keywords: Astronomy, Science Clubs Science Popularization.

Introduction

Science Communication, today, has emerged as a new field of expertise, a new profession to practice. It is evident from the fact that there are new journals of science communication, universities are conducting research and training programme in science communication and job market is also developing for trained science communicators. In countries like India, there are specialized government agencies like National Council for Science and Technology communication and Vigyan Prasar, which are devising and formulating new and innovative strategies and methodologies to implement large scale science communication programmes and activities by keeping in mind the socio, economical and cultural realities of India.

Science communication, unlike few years back, is now no longer confined to print media alone. The radio, TV, folk media (puppets, folk theatres etc), modern theater, audio-visual programmes, digital media, field level activities and campaign built on specific themes are already acquired a niche for science communication in India for spreading the message of S&T. Over the period, the conceptual framework of S&T, the strategies and methodologies specific to a target group are become so complicated that a whole lot of expertise, with high level of competency in specialized field, has evolved through various training programmes. In India S&T communication is now a well established field of expertise and a new profession to practice. One unique feature of S&T popularization programmes is development of learning/teaching aids, kits and hands-on activities on topics like astronomy, biodiversity, and environment. The hands-on activities include making of low-cost equipments for undertaking some observational projects and other activities relating to understand the science and it application in self-exploratory mode.

The activity kits and other hands- on activities developed in the past has been utilized for creating awareness among large number of people through various programmes and activities. A few such national campaign undertaken in the past by Vigyan Prasar are National Campaign built around celestial events like Total Solar Eclipses (TSE -1995, 1999 and 2009), Annular Solar Eclipse (ASE 2010), Transit of Venus (2004 and 2012), Emergence of Modern Physics as part of International Year of Physics (2005), Dharti Meri Dharti for Understanding Biodiversity as part of International Year Planet Earth (2008 and 2010) and recently concluded campaign "Chemistry in

© 2012 HSci. ISBN 978-989-98032-0-6

Our Daily Life as part of International Year of Chemistry 2011. These are a few examples of such successful S&T popularization programmes in which a number of low- cost activities and kits were designed and developed to reach to maximum number of people through various programmes and activities. In this paper, an attempt has been made to highlights the institutional efforts of VP in popularizing astronomy over the year through hands-on activities and to what extend the efforts were successful in enhancing the scientific literacy on astronomy among the members of science clubs.

Campaign Built Around Eclipses

International Year of Astronomy 2009 (IYA) offered a great opportunity to promote astronomical activities among all types of target groups ranging from amateur astronomers, common people, experts, teachers, media personals, science communicators and captive science clubs of Vigyan Prasar. The theme "The Universe: Your to Discover" appeals to all target groups regardless of their physical and intellectual capability. During 2009-2010, both the eclipses further provided impetus, especially to field level activities which were organized throughout the year.

Keeping in mind the specific need of the target group, with the help of experts, a series of communication material was developed in the form of books, charts, posters, activity kits, exhibition, CD ROMs, radio and TV programmes, low cost teaching equipments through the networking and collaboration of specialized agencies, Institutes, groups and individual experts. A series of training programme were organized throughout the country to train the science practitioners, coordinator of science clubs, communicators and journalists for field level programmes. A special *modus-operandi* was developed for the captive science clubs of VP, which are present in more than 534 districts of India, for the viewing of Total Solar eclipse (14-16 July 2009) at Bhopal, and Annular Solar Eclipse (14-16 January 2010 at Kanyakumari, Tamilnadu. Care was taken that the training programmes have and emphasis not only on information and content, but also on method of science and to promote rational outlook in the society or the scientific temperament as the term used in India. A conscious attempt was made to convey the thrill and excitement of science. The campaign had many components addressing various issues, but the specific objectives were as follows:-

1. To create an awareness about celestial phenomena in general and enhance astronomical literacy among the member of science club through hands on activity.
2. To remove and dispel the myths and superstitions associated with solar/lunar eclipses and other celestial bodies among the people as part and parcel of social cultural milieu of India, so as to make them more rational in their attitudes and scientific in approach.
3. To motivate the general public to witness the celestial events safely.

Methodology

After a series of brainstorming sessions, meetings and interactions with subject experts, science communicators and voluntary organizations, the content/resource material to be developed and implementation strategy is to be adopted were finalized. The outreach activities and programmes were designed mainly for two target audience. The one, addressing to common people to create an awareness and interest as how astronomy is part and parcel of our daily life. For second target group, i.e. science clubs, a package of open-ended hands-on-activities were developed for enhancing the understanding about the basics of astronomy and to promote the learning by doing beside preparing them to view both the celestial events (eclipses) safely.

Outreach Programme for Common People

Incidentally, the first phase of the IYC 2009 consisted of five regional Training Programmes for Master Resource Persons drawn from different States. Once they returned to their home States, they trained more people within their States and organize a host of activities coordinated by the respective State Councils/Department of S&T. Indeed the exercise for the regional training programme started well in advance. The participants invited were required to possess a good academic background and a flair for communicating science to various target groups. The training programmes consisted of lectures/ demonstrations by well known astronomers, demonstrations of innovative experiments and hands-on activities, astronomy kit, Films/video programme made by VP and visits to planetarium. Participants were also given a set of resource material comprising of resource articles, astronomy kit, books, a CD with 20 power point presentations on basics of astronomy besides training in fabrication of low cost telescopes.

In general the response was positive and the participants appeared to be an inspired lot and the feedback received during these training programmes was incorporated during the field level activities.

To supplement the efforts, a series of low cost learning /teaching aids/experiments, exhibitions and radio/video programmes etc were developed. A special link on the official website was created on which all the resource material was made available to public in downloadable format. The 26-episode video serial and 51-episode radio serial were broadcast on the national channels i.e. Doordarshan and All India Radio, covering almost 95 % population of the country. In both the programme, the interactivity of the target group was insured by putting up two questions to viewers/listeners after the programme. The selected winners were given prizes in the form of books/kits. The radio serial" Beyond Stars" was broadcast from 117 radio Stations in 18 major languages of India. The dub versions of video serial on astronomy were also broadcast in regional languages from the regional centres. The media, particularity print, was also utilized to achieve the desired objectives. Newspapers and magazines were chosen for publishing articles on specific topics related to science of eclipses & other celestial phenomena for demystifying the superstitions associated with them.

For Science Clubs

Vigyan Prasar has a network of science clubs within the school and outside the school setup in more than 534 district of India. Majority of these cubs are situated in the rural area and the accesses to internet by these clubs is not more than 5% of the total 11,000 clubs. The only link between clubs is the newsletter "VIPNET NEWS", brought out monthly by VP. Since the beginning of 2009, a number of informative articles, open ended observational and other hands-on activities built around the celestial events, survey based field project on the myth and superstitions associated with solar eclipsed were suggested to clubs. On the basis of the feedback received from the clubs though letters, mails and telephonic discussions and personal interaction during the orientation programmes, special articles, resource material, and linkages with specialized agencies and planetarium etc were made available to clubs. Kit developed by VP and certified solar filter to view sun were sent to all registers clubs. All clubs were also suggested to organize group viewing of Eclipsed at their respective places. Some simple yet practical project ideas/hands-on activities were floated for the science clubs, to be taken up collectively or individually by the members.

As a special incentive, to most active clubs, on the basis of the projects undertaken by them on theme and activities suggested, about 200 clubs were invited at the Belt of Totality at Bhopal (TSE July 2009) and in Kanyakumari (ASE January 15, 2010). (Table 1. & 2.)

Table 1. *The kit comprised of following activities:-*

1	What can you see during Total Solar Eclipse
2	Mini Book on Planets
3	Expansion of the Universe
4	Mini Book on Universe
5	Mini book on Nebulea
6	Structure of the Sun
7	Safe Solar Viewer
8	Star Dial
9	Weight on different Planets
10	Sun Can Contain......
11	Pin Hole Camera
12	Sun as Seen in different wavelengths
13	Measuring the Altitude of Stars
14	Why do the Stars twinkle
15	Solar Eclipse Card
16	Make your Own Sundial
17	Comets and Meteors
18	Make a Model of Venus Transit
19	The Milky Way
20	Why are Stars Not Visible during Day Time
21	Project the Image of the Eclipsed Sun
22	Moon Through Binoculars
23	Solar Eclipses
24	Lunar Eclipses Visible from India
25	Sun Eclipses Visible from India
26	Why do Stars Twinkle
27	Spectrum with help of CD

Table 2. *The activities suggested to VIPNET Clubs*

© 2012 HSci. ISBN 978-989-98032-0-6

Sl. No.	Activities
1	Which month has larger and smaller day time?
2	Path of the Sun in the Sky.
3	What are Dakshinayan and Uttarayan?
4	Phases of the Moon.
5	Distance of The Sun in Terms of Light Minutes.
6	Composition in different colours in the Sunlight.
7	Observation on full moon days-why we see only one side of the moon?
8	How to locate your Geographical North?
9	How to make your own magnetic compass?
10	How to find your longitude?
11	How to find the Pole Star?
12	How to make your own astrolabe?
13	How to find the latitude of your place?
14	Understanding the rising and setting of Star.
15	Understanding the phases of Moon.
16	Understanding the time of Moonrise.
17	Activity 10 Observation of Full moon.
18	Activity 11 Making Solar Projector.
19	How to find the angular size of Sun and Moon?
20	Understanding the angular separation,
21	How to identify the constellations?

National Camp at Bhopal (21-23 July 2009)

A national camp was organised for observing the total solar eclipse from the belt of totality at Bhopal (Madhya Pradesh) in the foothills of Bhim Betka, from 21-23 July 2009. The three day camp was attended by the 150 VIPNET clubs (325club members) from twenty States of the country. These clubs were selected for joining the camp on the basis of the project report submitted on “myths and superstitions prevalent in their area relating to Eclipse and other Celestial bodies.” (The analysis of the reports submitted is shown in Fig. 1)
During the camp, a series of activities like demonstration of kits, quiz on astronomy, interaction with scientists, film shows, sky observations etc., were organised. For conducting the experiments during the eclipse, special working sheets were developed and distributed among the participants. As part of this programme, a telescope assembling workshop was also organised and teachers were trained to work as facilitators for the participants for observing the TSE on 22 July 2009
Unfortunately, due to heavy clouds and rain, participants could not see the Sun. Consequently they could not carried out the experiments assigned to them (like the coverage of sun from the start of first contact viz-a-viz at different time intervals, time of first, second, third and forth contact, and the duration of totality, fall in atmospheric temperature during the eclipse etc). But the total darkness for 3 ½ minutes at the time of totality was a unique experience to be enjoyed by all of them.

Projects undertaken by VIPNET Clubs to create awareness about TSE

Type of Project	*%*
Survey on Myths & Superstitions associated with Eclipse among people	82
Awareness creation through activities using Folk Media	25
Creating of awareness through personal contact and enhancing the understanding about the science of celestial event.	69
Organization of activities based on Astronomy kit developed by VP	35
Distribution of Solar filter & observation of Eclipse safely in group	35

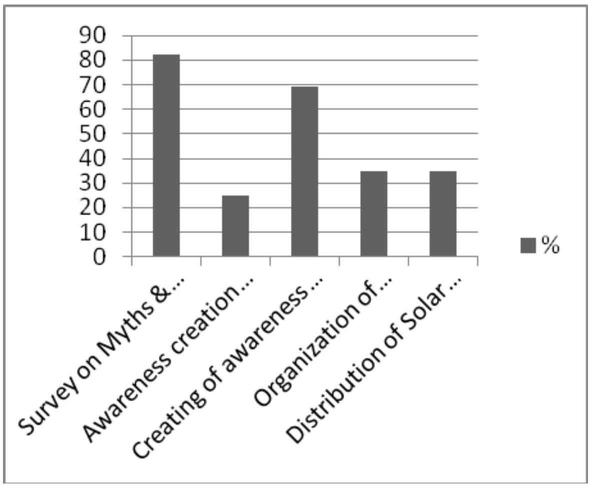


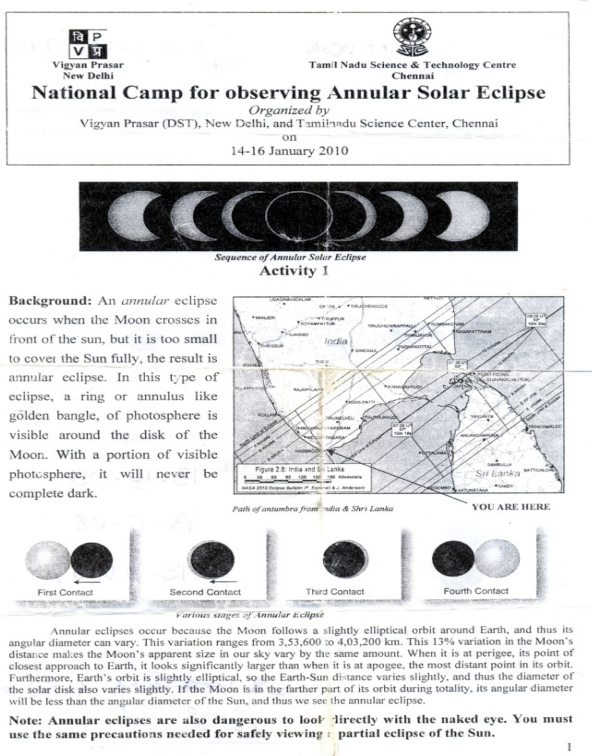
Figure 1. *Projects undertaken by VIPNET Clubs during TS 2009*

Other Places in India

However, the sun was clouded in many parts of western, central, northern and north-eastern region through which the path of totality passed, also disappointing thousands of people, who gathered to observe the eclipse. A number of

© 2012 HSci. ISBN 978-989-98032-0-6

VIPNET clubs and other agencies also arranged the community viewing of the eclipse at Indore (Madhya Pradesh), Patna (Bihar) and Dibrugarh (Assam). Though the partial phases of eclipsed was observed by many from other parts of the country by using safe solar filter distributed by VP. Undoubtedly, the enthusiasm amongst the students and general public was unprecedented and far exceeding the previous occasions of 1995 and 1999. As per an estimate about more than 10 lacks people were gathered in different parts of the country to witness the rare celestial drama. Those, unable to witness the eclipse directly due to geography or cloud, took the advantage of broadcast on TV and Internet.



Vigyan Prasar
New Delhi

Tamil Nadu Science & Technology Centre
Chennai

National Camp for observing Annular Solar Eclipse

Organized by

Vigyan Prasar (DST), New Delhi, and Tamilnadu Science Center, Chennai

on

14-16 January 2010

Sequence of Annular Solar Eclipse

Activity 1

Background: An *annular* eclipse occurs when the Moon crosses in front of the sun, but it is too small to cover the Sun fully, the result is annular eclipse. In this type of eclipse, a ring or annulus like golden bangle, of photosphere is visible around the disk of the Moon. With a portion of visible photosphere, it will never be complete dark.

Path of antumbra from India & Shri Lanka

YOU ARE HERE

First Contact

Second Contact

Third Contact

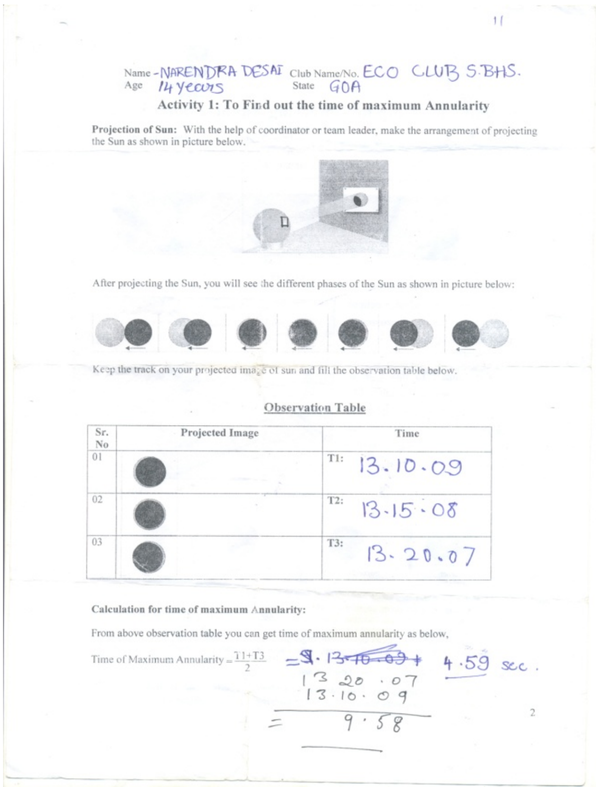
Fourth Contact

Various stages of Annular Eclipse

Annular eclipses occur because the Moon follows a slightly elliptical orbit around Earth, and thus its angular diameter can vary. This variation ranges from 3,53,600 to 4,03,200 km. This 13% variation in the Moon's distance makes the Moon's apparent size in our sky vary by the same amount. When it is at perigee, its point of closest approach to Earth, it looks significantly larger than when it is at apogee, the most distant point in its orbit. Furthermore, Earth's orbit is slightly elliptical, so the Earth-Sun distance varies slightly, and thus the diameter of the solar disk also varies slightly. If the Moon is in the farther part of its orbit during totality, its angular diameter will be less than the angular diameter of the Sun, and thus we see the annular eclipse.

Note: Annular eclipses are also dangerous to look directly with the naked eye. You must use the same precautions needed for safely viewing a partial eclipse of the Sun.

1



Name - NARENDRA DESAI Club Name/No. ECO CLUB S.BHS.
Age 14 years State GOA

Activity 1: To Find out the time of maximum Annularity

Projection of Sun: With the help of coordinator or team leader, make the arrangement of projecting the Sun as shown in picture below.

After projecting the Sun, you will see the different phases of the Sun as shown in picture below:

Keep the track on your projected image of sun and fill the observation table below.

Observation Table

Sr. No	Projected Image	Time
01		T1: 13.10.09
02		T2: 13.15.08
03		T3: 13.20.07

Calculation for time of maximum Annularity:

From above observation table you can get time of maximum annularity as below,

Time of Maximum Annularity = $\frac{T1+T3}{2}$ = ~~9. 13.10.09~~ + 4.59 sec.

13 20 . 07
13 . 10 . 09
= 9 . 58

2

Figure 2. *Activity Sheet Developed for ASE 2010*

National Camp at Kanayakumari (14-16 January 2010)

National Camp for viewing Annular Solar Eclipse (ASE 2010) was organized during 14-16 January 2010 at the sea beach of Kanyakumari (Tamilnadu). About 1000 people including VIPNET Clubs members along with their coordinators, teachers and parents attended the camp. The VIPNET club members were invited on the basis of projects on Astronomy and related activities undertaken by them (Table 2 & Fig 3.). In total, 827 participants representing more than 26 States/UTs registered for the camp. Some distinguished scientists and science communicators were the special invitees for the programme. During the 3-day camp, a series of programmes and activities, lectures, demonstration, quiz, cultural activities etc. were organized for the participants. Representatives of various planetaria, Research Institutes, Universities also joined the camps and shared their experiences with the participants.

© 2012 HSci. ISBN 978-989-98032-0-6

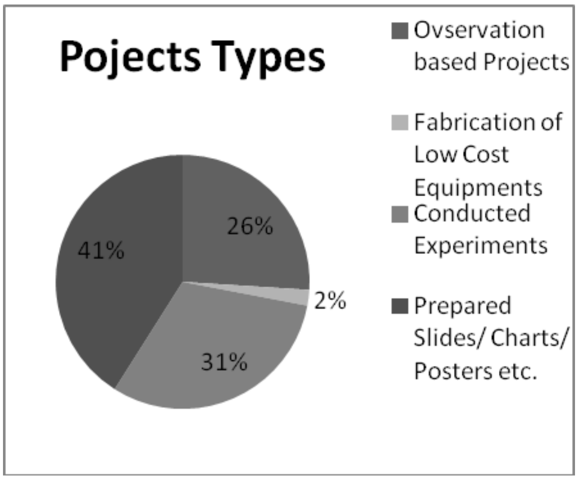


Figure 3. *The types of project/activities undertaken by VIPNET Clubs before the camp*

For the projects undertaken before the camp, about 29 % searched internet for additional information and 33% relied on VIPNET News and about 38 % consulted other sources like reference to magazine, book, and encyclopaedia. The time spent on these project ranges from 10 days to 130 days. In majority of cases, it was either teacher or the club coordinator who helped in the projects. Interestingly in 42 % cases, even friends also extended full help in the completion of projects.

Considering the number of participants, on the first day in three parallel technical sessions, a series of lectures, discussions and demonstration were organized. The lectures by scientists were on subjects covering various aspects like understanding eclipses, the anatomy of eye and science of vision, and how to view eclipses safely. The demonstration of the kit comprising hands-on activities and how to perform activities during the eclipse was also organised. Each club member was assigned an activity, which he/she was supposed to perform during the eclipse. The required material for performing the activity along with activity sheets (Fig 2.) with instructions was also made available to group leaders.

The day of Eclipse (January 15, 2010)

All the participants gathered at the observation site. At the observation site, telescopes were installed for projecting the image of Sun during the eclipse. Small mirrors, fixed to balls were distributed for projecting the image of Sun on screen for taking necessary observations and readings as part of the activity assigned to each participant. The team leaders and volunteers were also provided with additional material for the activities. Regular announcements by experts were made to instruct all about the first and the last contact and precautions to be observed during the entire period of eclipse. Everyone watched the eclipse with the filters provided for the purpose. Scientists and volunteers assisted the children in conducting the activities during the eclipse. All participants constructed/fabricated their own devices for taking readings/observations related to sun and eclipse. The activities include the comparative angular sizes of Sun and Moon, percentage of eclipse and the maximum time of annular eclipse. About 300 children submitted the reports of their findings. The analysis of the three activities undertaken by the participants by designing and fabricating their own equipments is as follows:

Activity 1. To find out the time of maximum Annularity (***by projecting the image of sun by ball-mirror method***).

Out of hundred students about 89 performed the experiment completely

Duration of maximum annularity was for 10 minutes and 08 Seconds

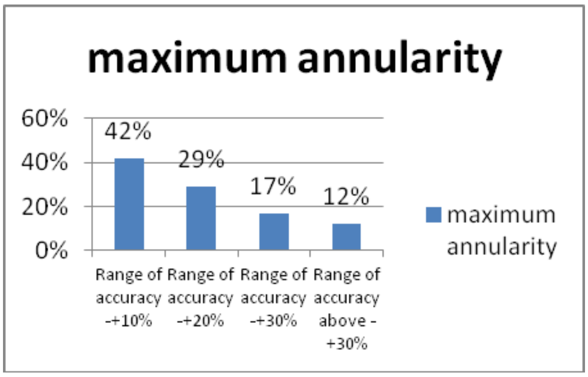


Figure 4. *The Percentage of students with range of accuracy of their findings*

Activity 2. Percentage of Annular Solar Eclipse of January 15, 2010.

Out of 100 students 72 performed the experiment completely

(The sun was covered by 84.26% (as seen from Kanyakumari, Tamilnadu, India.)

Range of accuracy - +1%	0
Range of accuracy - +2%	0
Range of accuracy - +3%	10
Range of accuracy - +4%	10
Range of accuracy - +5%	8
Above all of 5%	24

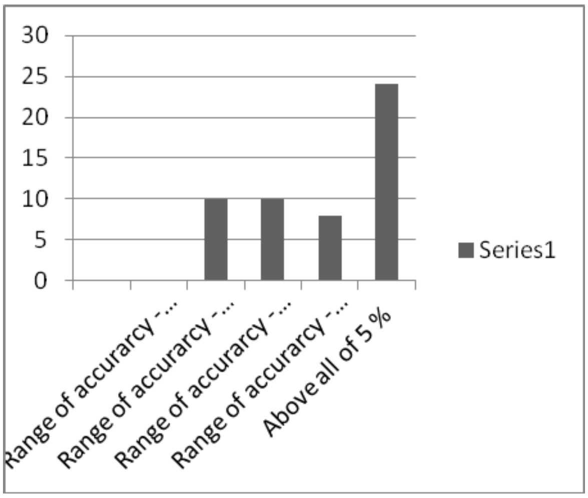


Figure 5. The Percentage of students with range of accuracy of their findings

Activity 3. The Annular size of Moon and Sun:

Out of 100 children 83 performed the experiments completely.

(The annular size moon/ sun ratio value was .91807)

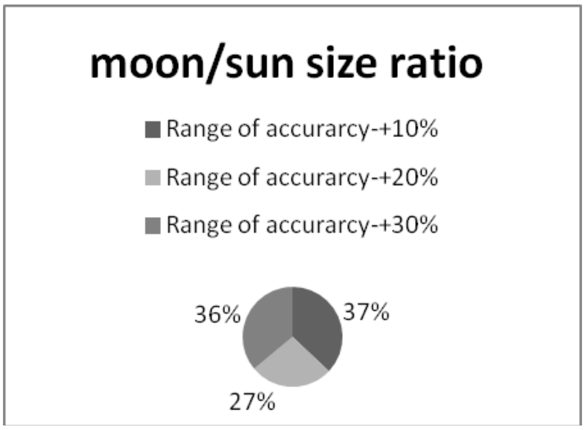


Figure 6. *The Percentage of students with range of accuracy of their findings*

Conclusion

It is necessary to mention here that many science communication outcome are long term or of a personal nature, hence, difficult to recognize or assess. The campaign built around the two eclipses of 2009 and 2010 was one of the biggest science communication programmes in India. The campaign need to be accessed within the broad framework of conceptual framework science communication, as has been evolved in India over the years i.e "S&T communication is not only flow of scientific & Technological information and facts from source to target group through some medium." "It also includes spreading and nurturing of scientific temperament/ values and method of science". Accordingly, science communication ought to focus more on conveying the basic approach, the attitude, the method, the processes and the values of science and less on its content, facts and information. Particularly, for common people and children Science communication needs to aim at promoting and encouraging "Curiosity and a sense of wonder (meaning how and why) about things, happening, events/phenomena around them and spirit of inquiry and asking and seeking well-reasoned and convincing answers to these questions" [2]. The basic premise over which this campaign was developed, presumed that Science Communication is just not just a process and it should never be done for its own sake, in an ad-hoc or inappropriate manner. It must always have predetermined and appropriate aims and objectives. The specific aims and objectives of this campaign was to create awareness about celestial phenomena among the general public do dispel the myths and superstitions associated with it and develop the understanding of science as far as astronomy is concerned.

To the extent the campaign was successful as a science communication programme in achieving its objectives, a clue can be taken from the contemporary definition of science communication i.e. AEIOU vowel analogy. According to Burn et al, "Science Communication is the use of appropriate skill, media, activities and dialogue to produce one or more of the personal response to science (the vowel analogy) i.e. Awareness, Enjoyment, Interest, Opinion-forming, and Understanding in the target group"[6]

The campaign was designed to create two responses in two different target groups' i.e; general public and members of science clubs. Among general public it was to stimulate awareness of, and positive attitudes (or opinion) towards science and for clubs members, it was understanding of science (Astronomy to be

 ISBN 978-989-98032-0-6

specific) which focuses on its content, processes and social factors.

There is no gainsaying the fact that the untiring and concerted efforts initiated by VP and carried forward by a number of organizations / agencies engaged in science popularisation, both Government and non- Government, as far as general people are concerned, was successful to a great extent in creating awareness about the science of celestial events and dispelling the myths and superstitions. The campaign has created an interest which is evident from the voluntary involvement of the people, science communicators, coordinators of science clubs and their members. People in hundreds of thousands come out on their own to watch astronomical events unlike the total solar eclipse of 16 February 1980, when there was a virtual curfew throughout the country. Today people are aware of the scientific aspects of this wonderful phenomenon.

On the other hand, the activities undertaken by the members of science clubs before both the eclipses and experiments conducted during the annular solar eclipse on January 15, the analysis of the results/findings (Fig 4, 5 & 6.) clearly established the fact that not only the content part of the astronomy was understood by the participants, they also well internalized the scientific methodology as well . So the campaign was successful in achieving it all broad objectives.

References

[1] Amelis Ortiz Burn et al, Communicating Astronomy to special needs audience, CAP(11/July 2011) 12

[2] B. K. Tyagi, Conceptual framework and parallel approaches of PCST- an Indian Experience, PCST-8, proceeding.

[3] Communicating science in social context, www.springer.com

[4] Editorial Team, Rashtriya Surya Mahotsava 2009 – Active participation of VIPNET CLUB, across the country, VIPNET News, November 2009 / Vol. 7 / No. 11, 8-9

[5] Report on National Observation Camp for Annular Solar Eclipse14-16 January 2010, March 2010 / Vol. 8 / No. 3, 10-11

[6] T.W Burns Burn et al, Science Communication: a contemporary definition Public understand. Sci. 12(2003) 183-202

[7] V.B. Kamble, Editorial, Science Popularization:- whose cup of tea is it, Any Way, Dream 2047, August (2005) 1

[8] V.B. Kamble, Editorial Longest celestial Drama of the century, Dream 2047, June (2009) 1

HABITATS & MYSTERY: LET'S MAKE A TERRARIUM HABITAT AND OBSERVE THE MYSTERY

A. Taşcı, D. Kahraman
İTÜ Geliştirme Vakfi Okulları
asli.tasci@itugvo.k12.tr,
deniz.ozkaya@itugvo.k12.tr

Abstract. *The world today has come to accept that science education in its new form is being restructed around bringing science and environmental studies together. Especially, living in metro cities makes our students unfamiliar with nature. Hence, in city schools curriculum is focused on familiarizing the students with soil, plants and animals. Therefore, we made a terrarium habitat and observe the life in it.*

Keywords: Earthworms, Environment, Habitat, Living, soil, water.

A different world -of earthworms and insects, seeds and plant roots, tunnels and burrows -exists beneath the surface of the ground. This underground habitat supports tiny plants, animals, and bacteria called decomposers. Decomposers, such as earthworms, pillbugs and fungi, recycle the nutrients in once living things and return them to the soil. The cycle begins again when plant roots take up these nutrients for the growth of new leaves and stems. These plants eventually become food for other animals.

This process of decomposition takes place continuously in the soil without most of us noticing or understanding its significance. Since all animals, including humans, depend on plants fort he basis of our food supply, the natural recycling process going on beneath or feet is of tremendous importance. Squeeze some garden soil through your fingers and smell its earthy smell after a warm spring day. Observe a tiny sprout push through the ground. This series of activities gives students firsthand experiences with the work of the tiny soil inhabitants.

You may be lucky enough to have a garden or forest floor nearby for your class to investigate. Still, bringing soil indoors and creating a living terrarium provides a vital laboratory for observing nature's processes. There are opportunities for students of every age to learn from terrariums. Students of different levels will approach a terrarium in different ways. As their teacher, you can provide older students with increasingly more sophisticated challenges. This is one activity that can be done each year with more and different benefits.

In this study, the activities bring the natural world into our classrooms and students make connections to all living things. The terrarium habitat study begins by exploring the soil. Soil is a mixture of air, water, mineral particles, living and dead organisms. This soil layer can be seen all around the world. Also, the soil can not be reconstructed in laboratory conditions. The next step to produce the terrarium habitat is to analysis of the soil particles through the qualifications, importance and the benefits. Secondly, by placing unliving things in our habitats, such as soil, dead organisms, bird foods, potato, branches and leaves, the students will try to predict what will happen in the habitat. They observe and record changes over time. A week later, living things, such as grass seeds and earthworms, and crickets are added into the habitat. The habitat is observed and any changes are recorded over a cause of week. Finally, the students observe the decomposition of the habitats to find the answer ''Are the products at the habitats useless or do the habitats help the nature of life?''

The studies develop the students science skills of students observing, making comparison, guessing, planning a experiment, measuring, recording and making conclusions. On the other hand, the science study facilitate mathematical skills of students such as comparing, classifying, recording data, making graphics and tables. Also, the study supports sustainable education by observing decomposition.

References.

[1] Hosoume K, Barber J, Terrarium Habitats, California: LHS GEMS, Publishing; 2000.

[2] Bağcı N, Bahadır Ö, Enik C, Evecen M, Koç R, 5. Sınıf İlköğretim Fen Bilgisi Kitabı, Ankara: MEB,Publishing;2012.

OUR HOMES AND THE GREEN HOUSE EFFECT

A. Taşcı, D. Kahraman
İTÜ Geliştirme Vakfi Okulları
asli.tasci@itugvo.k12.tr
deniz.ozkaya@itugvo.k12.tr

Abstract. *Life on earth depends on energy from the sun. About %30 of the sunlight that beams toward Earth is deflected by the outer atmosphere and scattered back into space. The rest reaches the planet's surface and is reflected upward again as a type of slow-moving energy called infrared radiation. If infrared radiation can not be reflected upward because of the high concentration of carbon dioxide, nitrogen dioxide or by the other atmospheric gases, it stays in our world and that makes our world's temperature to rise day by day. So that effect calls as greenhouse effect, and greenhouse effect causes global warming.*

Keywords: Global Warming, Green House Effect, Home, İnfra red Radiation, Sun.

Advances in solar technology enable people to build successful solar-heated and solar-cooled homes. A family can now choose to use solar power to reduce their monthly heating or cooling bills, while helping to conserve our rapidly diminishing fossil fuel reserves. Most solar houses and water heaters rely on a phenomenon known as the greenhouse effect. One of the most familiar examples of the greenhouse effect is left in the sunlight with the windows rolled up. The inside of the car becomes uncomfortably hot. The seat may even burn bare skin. Because, sunlight consists mostly of visible light and infrared light in about equal amounts. Nearly all the visible light passes easily through clear glass or plastic windows, but about half of the infrared light is blocked by a clear window. (Windows are partially opaque to infrared light.) So about %75 of the sunlight energy gets in through the window. Once inside the room or car, the visible light is absorbed by objects and nearly all of it is changed into heat energy and infrared light/ heat rays. Because only about half the heat rays hitting the window from the inside can get out, heat keeps accumulating inside, and the room or car becomes very warm. If the window is opened, the air can cool off because fresh air can come in to replace the hot air. Our world is face to the same effect as the car. İnfrared radiation can not be reflected upward because of the high concentration of carbon dioxide, nitrogen dioxide or by the other atmospheric gases, it stays in our world and that makes our world's temperature to rise day by day. So, that causes global warming. [1]

In this project, we mainly focused on to understand and appreciate the sun energy and the greenhouse effect. The study comes up from two part that performed at school garden as an experiment, and performed at classroom to appreciate the experimental data to understand the greenhouse effect.

In first part; in this activity the students discuss the ways energy is used in their homes and the sources of this energy. The idea of heating homes with solar energy is introduced. [1]

Secondly, each student built a model house that have one window. Some of students closed their houses' windows but some of them did not. The students that have a closed window and an open window made a pair to experiment at school garden in a shiny day. They paid attention that the houses' windows should face to the sun. In each minute, students measured the temperature of the both houses and recorded the test results. After that, they analyzed their experiment results by graphics at classrooms. So they realised that, the houses, which's windows are closed, holds heat much more than the houses which's window's are open. And this is reason is the infrared radiation.

The studies develop the science skills of observing, making comparison, experimenting, measuring, recording, making graphic and making conclusions. On the other hand, the students can be draw attention a social problem, such as greenhouse effect and global warming in an existing way by this study.

References

[1] Gould A, Hot Water and Warm Homes From Sunlight, California: LHS GEMS, Publishing; 1995.

[2] Bağcı N, Bahadır Ö, Enik C, Evecen M, Koç R, 5. Sınıf İlköğretim Fen Bilgisi Kitabı, Ankara: MEB,Publishing;2012.

THE EFFECT OF OUTDOOR EDUCATION ACTIVITIES ON STUDENTS' ATTIDUTES TOWARDS TO ENVIRONMENT

A.G. Balim, H. Deeniş Celiker, S. Türkoğuz, S. Kaçar

Dokuz Eylül University Institute of Educational Sciences, Turkey

agunay.balim@deu.edu.tr, denishuriye@yahoo.com, suat.turkoguz@deu.edu.tr, sevinckacar@hotmail.com

Abstract. *In this study it is aimed to reveal the effect of Reflections of Science on Nature Project supported by TÜBİTAK where the majority of the activities performed as outdoor education activities on students' attitudes towards to environment. The study group comprises 49 students which were selected randomly from 6th and 7th grade student who has got different socioeconomic level in İzmir city that involved in Reflections of Science on Nature Project during the period of first, second and third periods. In the study pre-test post-test model was used. During the project in order to determine whether there is a difference among the attitudes of students towards to environment scale of attitude towards to environment that was developed by other researchers with reliability coefficient a=0.86 was used. Analysis of data was carried out by using group t test with the help of SPSS packet program. Due to the fact that some of students didn't participate in post-test who participate in pre-test and there were scales that were not appropriate for evaluation 40 scales used in the evaluation. As a result of the research it was seen that students' attitudes towards to environment was high before and after the project. It was understood that there was a significant increase in students' scores towards to environment at the end of the Reflections of Science on Nature project, t (39) =3.36, p<0.05. Students' average attitude towards the environment was 96.42 whereas this rose to 102.97 after the implementation of project. As a result it can be said that Reflections of Science on Nature project activities in which outdoor education activities are mostly used is effective in increasing students' attitudes scores toward nature.*

Keywords: attitude towards nature, outdoor education activities, reflections of science on nature.

1. Introduction

The environment which means inhabited place of all living things has conditions that enable each living species maintenance has its own

 ISBN 978-989-98032-0-6

generation. Recently contaminations in the environment shows that these conditions aren't regarded enough by the people. Every day it is encountered that such environmental problems as water, air, soil pollution (Sülün, 2002). It is thought that as a result of the growth individuals who has a conscious about nature environmental problems will decrease rapidly. The education about this subject has a great importance. Environmental education is a interdisciplinary approach which takes lifelong and aims to create a world in which everybody has a knowledge, skills, attitudes, motivation, personal and social responsibility to prevent former problems and conscious about nature and everybody contribute to solving existing environmental problems (Moseley, 2000). Environmental education is the learning of nature's language (Ozaner, 2004). Storkdieck, Ellenbogen and Heimlich (2005) stated that people who took part in outdoor environmental education changed their knowledge, worldviews, attitudes and behaviors about environment positively. Outdoor environmental education enhances student's knowledge of environment and affects their behavior about environment positively (Bogeholz, 2006; Bogner, 1998). It is stated that educational experiences based on the experience of nature and take place in childhood facilitate child to establish a close bond with nature, active experiences that children gain in nature is more effective in their perception of natural environment correctly than classroom experiences carried out in the class (Bogner & Wiseman, 2004; Delay, 2001; Özdemir ve Uzun, 2006; Phenice ve Griffore, 2003). It is thought that by showing students science is not include only lessons and assignments it is in life, their motivation toward science, nature and learning can be increased and knowledge that are gained in this way is more permanent (Farmer, Knapp & Benton, 2007). Dresner and Gill (1994) stated that students who took part in environment camp during two weeks showed developments in their eco-friendly behavior and their interest to environment increased. Erten (2003) pointed out that as a result of practice environmental education students' knowledge about their environment increased and they gained eco-friendly behaviors. In the behaviors that people acted toward to environment their perceptive features such as interest and attitudes are effective as well as their information (Poortinga, Steg and Vlek, 2004). Environmental attitude is learned trends that are show themselves in the form of exhibit attitude positive or negative and consistent toward to environment (Pelstring, 1997). Since children gain their knowledge from experiences nature experiences are provided them so that their environmental experiences enhance and in this way they can develop positive attitudes toward to environment (Surbrook, 1997). In Turkey in the aim of scientific formation, concepts and innovations' introduction, teaching and popularization to society, taking these issues on the agenda of the country in times and in this way promote scientific culture in our country The Scientific and Technological Research Council of Turkey (TÜBİTAK) science and society division has project proposal made and accepted projects are supported by TÜBİTAK science and society division. The overall mission of this project is to raise awareness of the ecological environment of the participants and enable them to transfer experiences to their own students and friends that they learn in nature education (Yardımcı, 2009). In the Reflection of Science on Nature project supported by TÜBİTAK it was aimed that children make observation at the first-hand and interpret the results of this observation and create knowledge about the concepts they examined. The purpose of field work with students is to provide understanding of natural environment through first-hand observation. First-hand observations increase students' motivations in cognitive learning, they provide better understanding and allow students to develop positive attitude (Stevenson, 2007). In the project trips were organized to İzmir Ödemiş Bozdağ and Dilek Peninsula National Park for collecting first-hand material and make observations. Different activities were done about the harmful of current environmental problems on biological diversity and solutions by ensuring the active participations of students. To increase the stability of the gains made in the project activities conducted in the form of three terms. Based on this study it is aimed to find the effects of Reflections of Science on Nature project in which mostly outdoor activities take place and supported by TÜBİTAK on students' attitudes towards to environment.

2. Method

In this study pre-test post-test model without control group was used. In this model the effect of experimental study was tested by studying on

© 2012 HSci. ISBN 978-989-98032-0-6

only one group. The measurements of subjects related to dependent variable were gained by using same measurement tools same subjects before applications pre-test and after post-test. There was no matching. In this sense model can be defined as a single-factor or repeated measurement model. In the model the meaningfulness of differences between pre-test and post-test values that are belong to one group (Büyüköztürk, Kılıç Çakmak, Akgün, Karadeniz and Demirel, 2008).

2.1. Working group

The working group of research includes 49 students chosen randomly from 6th and 7th class and from different socio-economic level in İzmir. These students took part in Reflections of Science on Nature project that was conducted in 12.10.2011-15.06.2012 as a three semester. Before reference to project formal letters were written to primary schools in the district and provinces of İzmir through İzmir Directorate of National Education and in the letters the aim, importance and required things for participants were stated. Especially the importance of students' willingness in participation of project and obtaining permit from parents and schools as a priority were emphasized. Later students were asked to these questions: what means of science and nature words for you? And what are your expectations from activities carried out in this project? These questions take place in application form. As a result of these evaluations students who took part in project were chosen randomly in computer by regarding their interests, desires and curiosities. % 59.18 (29) of the students were female and %40.81 (20) students were male in the project.

2.2. Measurement tool

In the project 5 point likert type attitude scale towards the environment which was developed by Aslan, Uluçınar, Sağır, Cansaran (2008) and whose reliability coefficient was a=0.86 was used in the aim of detect whether there was a difference in the attitudes of students towards environment. The lowest possible score is taken from the scale is 24, the highest possible score is 120.

2.3. Data analysis

Data analysis was done by using dependent group t test with the help of SPSS packet program. 40 scales were used in evaluation since some students who took part in pre-test didn't take part in post-test and there were scales that were not suitable for evaluation.

2.4. Reflections of Science on Nature Project

Reflections of Science on Nature project that is supported by TÜBİTAK in the sense of 4004 code nature education and science schools was conducted by one technician five experts four teachers and three guidance staff. In the project which students took part in actively nine activities in first semester, seventeen activities in second semester and twelve activities in the third semester and totally 38 activities was done. During the project trips to Dilek Peninsula National Park and Ödemiş-Bozdağ were organized. Details of the activities conducted in project are available at this website: http://www.bilimindogayayansimalari.com/.

3. Findings

The lowest and highest point of pre-test of attitude scale toward environment, arithmetic average, standard deviation and data concerning general attitude scores are given in Table 1.

Table 1. *Pre Test Results of Attitude Scale towards Environment*

N	Min. Point	Max. Point	Mean	Sd	Attitude Points
49	52	112	96.95	42.15	4.08

In accordance with the answers which 49 students solved in the attitude scale toward environment it was found that the lowest score is 52 the highest score is 112. The arithmetic average of attitude scale toward environment is 96.95. It is seen that the attitude score of student is 4.08. This result can be interpreted as students have positive attitudes towards the environment. The lowest and highest point from last test of attitude scale toward environment, arithmetic average, standard deviation and general attitude score are given in Table 2.

Table 2. *Post Test Results of Attitude Scale Towards Environment*

N	Min. Point	Max. Point	Mean	Sd	Attitude Points
40	64	120	102.97	11.05	4.29

In accordance with answers which 40 students solved the lowest point of last test of attitude scale toward environment is 64 the highest point

© 2012 HSci. ISBN 978-989-98032-0-6

is 120. The arithmetic average of attitude scale toward environment is 102.97. The attitude score of students is 4.29.

The results of t test which was made for the meaningfulness of differences between average scores of pre-test and post-test of attitude scale toward environment are given in Table 3.

Table 3. *Related Samples t-Test Results Students' Pre test - Post test Attitudes towards Environment Scale Scores*

	N	Mean	S	sd	t	p
Pre test	40	96.42	12.46	39	3.36	0.002
Post test	40	102.97	11.05			

In the last tests 40 scales were evaluated it was found that there was a significant increase in students' attitude scores toward environment after the reflections of science on nature project, t(39)=3.36, p 0.05. Students attitude average was 96.42 before the application whereas after the application this average increase to 102.97. This finding shows that reflections of science on nature project have important effect in increasing the attitude scores of student toward environment.

In Figure 1 the pre-test post-test average attitude scores of students who took part in research toward environment are given.

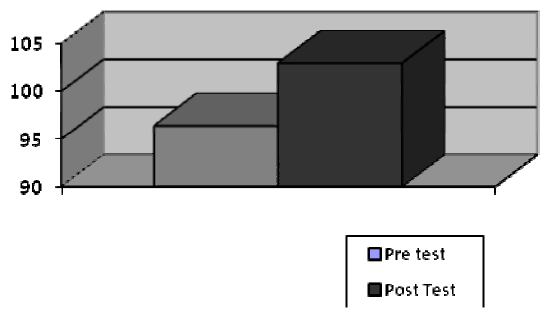


Figure 1. *The Pre Test - Post Test Attitude Average of Participants of Reflections of Science on Nature Project toward Environment.*

When the figure one is examined it is seen that the post-test attitude scores of students who took part in project is higher than pre-test attitude scores toward environment.

4. Results

In this research whose subject is the effectiveness of Reflections of Science on Nature project on the attitudes of students toward environment the following results were obtained. It was found that students have positive attitude toward environment in pre-test and post-test. Post-test of the students toward environment is higher than their pre-test scores. It s seen that the project has significant contribution to the environmental attitude of participant students. Zandvliet (2007) stated that individuals' understanding of environmental problems and subjects are effective for them to have positive attitude toward environment. The first foundation of the development of values and information is interactions with nature (Bogeholz, 2006). During the project students made one to one interaction with nature. Similarly Mittelstaedt, Sankerand and Vanderveer (1999) stated that in the summer school program in which various activities were done about biological diversity at first students have positive attitude toward environment and they left summer school gaining stronger positive attitudes. Ballantyne and Packer (2002) pointed out that as a result of the nature experiences which was made with students group at the age of 8-17 participant students' behaviors and attitudes toward environment changed positively. Dresner and Gill (1994) found that in the summer camps there was a significant change in the attitudes of students who took part in activities actively and their behaviors about this subject. Eaton (2000) found that outdoor learning experiences are more effective than classroom education in development of cognitive and perceptive skills. Yardımcı (2009) stated that after the camp which 24 students finishing 4th and 5th grade took part in and whose aim introduce the environment children' perception of nature expanded and deepened.

Based on the result of the research it can be said that supporting and conducting such projects as nature education and science schools supported by TÜBiTAK have positive contribution to attitudes of individuals toward environment. Awareness of nature which start from young age will prepare ground to attitude and behaviors of mature. Considering that the target audience is elementary school students similar projects may be spread in order to help future generations to learn environment, gain environment awareness and positive attitudes. It is thought that activities

 ISBN 978-989-98032-0-6

in which students took part in actively can be used different studies considering that concepts that are learned during the project are formal concepts the increasing of practical nature educations in formal education environment may contribute students to gain positive attitude toward environment.

5. Acknowledgements

This study was carried out with the scope of Reflections of Science on Nature project which was supported by TÜBİTAK 111B118-coded.

6. References

Aslan, O., Uluçınar Sağır, Ş. ve Cansaran, A. Çevre Tutum Ölçeği Uyarlanması Ve İlköğretim Öğrencilerinin Çevre Tutumlarının Belirlenmesi. Selçuk Üniversitesi Ahmet Keleşoğlu Eğitim Fakültesi Dergisi 2008; 25: 283 -295.

Ballantyne, R. & Packer, J. Nature-based excursions: school students' perceptions of learning in natural environments. International Research in Geographical and Environmental Education 2002; 1(3): 218–236.

Bogeholz, S. Nature experience and its importance for environmental knowledge, values and action: recent German empirical contributions. Environmental Education Research 2006; 12(1): 65-84.

Bogner, F. X. The Influence Of Short-Term Outdoor Ecology Education On Long-Term Variables Of Environmental Perspective. Journal of Environmental Education 1998; 29(4): 17–29.

Bogner, F. X. & Wiseman, M. Outdoor Ecology Education And Pupils' Environmental Perception İn Preservation And Utilization, Science Education International 2004; 15(1): 27–47.

Büyüköztürk, Ş., Kılıç Çakmak, E. A., Akgün, Ö. E., Karadeniz, Ş., & Demirel, F. Bilimsel Araştırma Yöntemleri. Ankara: Pegem Akademi; 2008.

Delay, R. Nothing Here To Care About: Participant Constructions of Nature Following a 12-day Wilderness Program. The Journal of Environmental Education 2001; 32(4): 43-48.

Dresner, M. & Gill, M. Environmental Education at Summer Camp. Journal of Environmental Education 1994; 25(3): 35–42.

Eaton, D. (2000). Cognitive and Affective Learning in Outdoor Education. Dissertation Abstracts International – Section A: Humanities and Social Sciences 2000; 60, 10-A: 3595.

Erten, S. 5. Sınıf Öğrencilerinde ''Çöplerin Azaltılması'' Bilincinin Kazandırılmasına Yönelik Bir Öğretim Modeli. Hacettepe Üniversitesi Eğitim Fakültesi Dergisi 2003; 25: 94–103.

Farmer, J., Knapp, D., & Benton, G. M. An Elementary School Environmental Education Field Trip: Long-Term Effects on Ecological and Environmental Knowledge and Attitude Development. The Journal of Environmental Education 2007; 38(3): 33-42.

Mittelstaedt, R., Sanker, L., & VanderVeer, B. Impact of a week-long Experiential education program on environmental attitude and awareness. The Journal of Experiential Education 1999; 22(3): 138-148.

Moseley, C. Teaching for Enviromental Literacy. Clearing House 2000; 74 (1): 23-25.

Ozaner, F. S. Türkiye'de okul dışı çevre eğitimi ne durumda ve neler yapılmalı? V.Ulusal Ekoloji ve Çevre Kongresi 5-8 Ekim 2004 Taksim International Abant Palace, Abant İzzet Baysal Üniversitesi & Biyologlar Derneği, Abant- Bolu. Bildiri Kitabı (Doğa ve Çevre), Biyologlar Derneği, İzmir; 2004, 67-98

Özdemir, O. ve Uzun, N. Yeşil Sınıf Modeline Göre Yürütülen Fen ve Doğa Etkinliklerinin Anasınıfı Öğrencilerinin Çevre Algılarına Etkisi. Çocuk Gelişimi ve Eğitimi Dergisi 2006; 3(1).

Phenice, L. A., & Griffore, R. J. Young children and the natural world. Contemporary Issues in Early Childhood 2003; 4(2): 167-171.

Poortinga, W., Steg, L., & Vlek, C. Values, Environmental Concern, And Environmental Behavior: A Study Into Household Energy Use. Environment and Behaviour 2004; 36 (1): 70-93.

Prince, H. E. Experiential Environmental Education for Primary Aged Children. In "Outdoor Education in the UK" ed. Higgins, P & Humberstone, B. Verlag Erleibnispadagogik-Luneburg, Germany; 1999.

Sülün, Y. Çevre Kirliliğini Önlemede Eğitimin Rolü, Muğla Üniversitesi Sosyal Bilimler Enstitüsü Dergisi 2002; 8: 1-9.

Stevenson, R.B. Schooling and environmental education: contradictions in purpose and practice. Environmental Education Research 2007; 13(2): 139–153.

Storksdieck, M; Ellenbogen, K. & Heimlich, J.E. Changing minds? Reassing outcomes in free-choice environmental education. Environmental Education Research 2005; 11 (3): 353-369.

Yardımcı, E. Yaz Bilim Kampında Yapılan Etkinlik Temelli Doğa Eğitiminin İlköğretim 4. ve 5. Sınıftaki Çocukların Doğa Algılarına Etkisi. Yayınlanmamış Yüksek Lisans Tezi, Abant İzzet Baysal Üniversitesi, Sosyal Bilimler Enstitüsü, Bolu; 2009.

Zandvliet, D. Learning Environments That Support Environmental Learning. *National* Association for Research in Science Teaching Annual Meeting, New Orleans, Louisiana; 2007: 1-13.

AN OUTDOOR ALTERNATIVE FOR HANDS-ON SCIENCE EDUCATION: RECREATIONAL SCUBA-DIVING

S. Yürekli[5]
sitki.yurekli@gmail.com

Abstract. *Scuba-Diving as a recreational outdoor activity, by bringing the divers into the realm of underwater and introducing the aquatic life to them represents several benefits from different aspects for the hands-on science education participants. Into this study, following the emphasized differences between being out of and being into the water and its consequences on the divers, limiting factors of any promising hands-on science education setup will be mentioned. Afterwards, a small number of examples as hands-on science education setups will be proposed by referring the most favorable topics of hands-on science applications, for instance the sound, light, heat and the physical laws in line with the pressure and buoyancy will be mentioned in this favor.*

Keywords: Recreational scuba-diving, outdoor activities, hands-on science education.

1. Introduction:

From the very beginning of the scuba-diving adventure, upto the instructor level trainings, the essentials of many scientific disciplines could be found embedded into the activity itself. Mostly perceived with fun, but never loosing their vital importance for the divers and for their environment, physics and physiology of diving are always given the higher priority, where the biology even history and archeology enhances the benefits of this activity. Currently, scuba-diving has a huge number of enthusiasts and available in many destinations, and supported by a long history of inventions this activity becomes more secure and safe than before.

The most prosperous era of the technologies which have been developed for the diving practice and promotes the recreational scuba-diving would be the hundred years passed after the invention of scaphandres by the early 19th century. This invention, the scaphandres begun to be frequently utilised by the sponge gatherers nearly to the mid 19th century [1,2,3,12,19]. On the lead of economic initiatives, parallel to the studies taken on the submersible devices for diving purposes and identified problems gained and accelerating trend. Resolved problems of diving practice, developed standards, lead the recognition of new outdoor activity, scuba-diving which is favorably marketed in many touristic destinations [19].

Recreational scuba-diving, as an outdoor activity, is promising various benefits to its enthusiasts by introducing them the underwater realm. Although common attitude on practicing this activity is mostly appears in parallel to its challenging nature, by bringing the scuba-divers into an unfamiliar environment, under the huge mass of water, lakes, seas and oceans, it may also be found promising for the hands-on science education which can be taken in educational setups in a relation with several topics.

Here, into this paper, in order to clarify the possible setups for hands-on science education which is utilizing scuba-diving following issues will be discussed. Primarily, the differences between being-into and being-out of the underwater realm will be clarified. Well known aspects of two different environments, in a comparison, the one which is common to us and in which we live and sense the world, and, the

[5] He holds PhD. in Economics and the author of several studies which are published and/or represented as proceeding on 19th and 20th century sponge-gathering and sponge trade in Otoman Empire and Republic of Turkey. He is also PADI OWSI, Speciality Instructor and CMAS One-Star Scuba-Diving Instructor.

© 2012 HSci. ISBN 978-989-98032-0-6

one which is somehow strange to us, while being in which we must consider the changing factors which has identified effects on all of our body, will be mentioned. Accepting these differences as main determinants for any setup for hands-on science education, necessary precautions will also be underlined.

In an interaction with the underwater environment, divers, from different age-groups, and who are supposed to met the necessary requirements at minimum by the completed entry level trainings, will be mentioned in relation with the varying limits of scuba-diving practice. Different depth limits for underwater practices are primarily determined by divers' ages. Because of their physiological and psychological beings, and in order to keep them at the safe side for all times in such an extreme environment, they are advised and allowed to practice scuba-diving within certain safety limits. Beside the laws of physics in action into the mentioned environments, as a complementary set of constraints for proposed hands-on science education setups, these limits will be given into the following part.

The consequences of the same laws of physics in different environments, by referring to a highly limited number of phenomena, i.e. buoyancy, pressure, light and sound waves and their behavior in different materials would be taken as main topics for promising hands-on education setups. Each of them will be underlined with references to the previously mentioned constraints, so the target age-group and their benefits for the participants. Also, it is worth to mention that, nearly all of these topics are included into the standard training process for entry level scuba-diving enthusiasts. Consequently, any hands-on style education focusing these topics would give a chance to the participants to enhance their knowledge more.

Before verbalizing the conclusive remarks on recreational scuba-diving as an alternative for hands-on science education, the question of to which extend would be the scuba-diving promise an application alternative to increase the awareness on the environmental problems will also be underlined. Not being apart form the whole body of science, history, and the question of how it may improve the hands-on science participants' gathered knowledge, is going to be another stance which will be discussed into this part.

2. What is the difference between being out of and into the underwater realm?

With a special focus on science education, the answer of this question fairly well known. One of the most simple setup would be identified by the help of aquariums. Either constructed as complex buildings which are open to hundreths of visitors in each day, or as a small one which is staying somewhere in your living room, this water-stock into the glass-made container with the ongoing life inside, may help to understand the differences between being-out and being-into the underwater realm.

For any person having a look inside of the aquarium, his/her feelings, exitements are all experienced out of this realm. However, for any person diving into one of these complex aquarium constructions, and moves into the water, all of them are experienced into this environment. Beside this appearant, structural differences on the sensed outer space, while the diver is being into the underwater realm, in relation with the mentioned differences, too many constraints must also be considered carefully [17].

Once anyone decides to be into the underwater realm, air to breath, one of the most essential need of human body, becomes a vital concern. While we are having a look to the underwater realm, in front of the glass-made wall of aquariums, as the outsiders, usually any possible problem which may be related with breathing the necessary air shouldn't be considered, but, once we decide to dive into this mass of water, even into the swimming pools, the lack of breathing air is always having a potential of giving serious harms to the human body [6,7].

Also, while we are standing in front of the glass-wall of aquariums, as outsiders, the weight of the mass, the stocked water, doesn't effect our body and metabolism, while it has a vital importance for whom decide to dive into this mass. Primarily, air spaces in our body always deserve the upmost importance and usually signals their reactions to the changing pressure. For instance, our ear-drums give these signals, our sinuses are also effected by the increasing and decrasing pressures [17]. And, our lungs, while we are breathing pressurized air under the pressure of water are also requiring upmost care. Additionaly, not only for the immediate effects of the ambient pressure that might be sensed during the dives, but the dissolved pressurized

© 2012 HSci. ISBN 978-989-98032-0-6

breathing air which is circulating in our body, needs necessary precautions must be taken [6,7]. Non of them is under the concern of anybody who stands out of the underwater and having an eye-contact with the ongoing life into an aquarium.
Moreover, as we've mentioned before, by the help of glass-wall of aquariums, we usually don't experience any visual difficulties. Following any fish which is swimming from one place to another, perceiving the colors on its body, or watching to the bubbles going up to the surface of the water, may be the interesting appeareance of any sponge sticked on to a stone, all gives a certain exitement in a relaxed, secure environment.
However, without using any equipment protecting our eyes and assuring a continuous air contact with them, it's highly difficult to perceive all these details into the water that much clearly. Recognition of certain objects with naked eyes, in the absence of any equipment, always requires exercises and development of certain skills. Even by using masks to protect our eyes, physical characteristics of water cause various differences between the physical characteristics of seen objects and the perceived image of them. They are perceived closer at a distance than they are being, and, larger in size than they are. Because of the refraction occurs while the ray of light passes through the glass shield from water to the air filled inside of masks, changing behaviour of light causes this distortion on the perceived image of objects.
In relation with the changing behaviour of lights into the water, may be one of the most surprising effect of this phenomena caused by the water density is experienced when the diver begin to see that, the colors are changing, while the dive reaches to the deeper parts of the underwater. Water absorbs different waves of colors in different depths, starting from red to green and they gradually dissapear and, by reaching closer to the recreational dive limits, all colors perceived in a scale close to the blue. Consequently, without utilizing a light source, after ten meters down under the sea surface, it becomes quite difficult to recognize the seen colors.
Sound and movement of sound waves are also changed their behaviours under the water. Usually it becomes difficult to make a guess on the origin and the distance of the source of sound during the dives. Sound is transmitted by water faster, and reach to a distant locations than it can reach on the surface, into the air. Perceiving the changing behaviour of sound is quite difficult for any person standing out of the aquarium.
And also, when we dive into the water, our body temperature tends to drop faster than we stays out of the water. Water, as a matter which is denser than the air, transmits the heat faster which necessiates a proper protection, isolation on the diver's body in order to protect it from the vital consequences of drastic body temperature changes [7].
Finally, the aquatic life, exhibiting itself in an engineered environment of aquariums, is physically always been away from a direct contact with ourselves, while this is not the case during scuba-diving. As it is advised with a high priority, usually divers need to spend upmost attention to the underwater life and try to minimise the direct contact during their dives. Reason of such an attiude is twofold. While it's protecting the diver from the potential adverse effects of living organism of underwater, such an attitude also protects the underwater life from the possible harms might be given to the underwater environment by the divers' contacts [15].
Literally, all these underlined items are skecthing out the main differences between being-out of the underwater realm and being-into there, and, briefly human-underwater interaction is bringing a certain set of concerns mainly in relation with these mentioned items.
While these factors are requiring certain precautions, they are also promising several setups for hands-on science education as well. Utilisation of most of the mentioned topics, i.e. applications subject to the physical characteirstics of sound, light, heat and also different applications for which water is utilised are fairly well known for hands-on science education setups [7,8,9,10,12,13]. All these topics which are mostly subject to hands-on science education setups is also found promising setups which utilizes scuba-diving as an alternative outdoor activity.
While the scuba-diving is considered as such, in addition to the physical phenomena mentioned with respect to the underwater and out of water environment, depending on the natural differences which are mainly correlated with the age and the gender of divers, all of these considerations, requires different types of precautions in order to keep the life at the safe side for all times. Age groups, as main indicator

of physiological characteristics of participants, are always having the higher priority for the existing standards and it's constituting the main constraint for any discussion on promising setups which has a certain goal to provide a hands-on science education.

3. Who could be benefited from scuba-diving supported hands-on science education?

Effects of underwater realm are required to be considered separately from one age-group to another. Although, the physical laws are remaining the same, depending on the physiological and psychological differences, necessary precautions determines varying limits for any practice which may be taken under the water. Physical laws are the main determinants for the scuba-diving training and shaping the training standards nearly for all certification organizations. In line with the existing standards, which are embodying all previous findings of different scientific disciplines, any person who is in the age of 15 or older, while the younger entrants are also welcomed in their own diving setups, could be benefited from hands-on science education taken place under the water and supported by scuba-diving [4,5,13,14].

Depending on their age, some precautions gain higher importance and some practices are needed to be limited or wait for the older ages. Even within these limits, scuba-diving, as an outdoor activity can be facilitated for hands-on science practices nearly for all age groups. Consequently it may be utilized in different levels of education, from secondary school to graduate, while the academics is also fairly well known on their own path of developing science.

With slight differences depending on their own training standards, the maximum allowable depths for different age groups are nearly same for all training institutions. Entrants between 8 to 10 years old are advised to practice scuba-diving into the pools, not deeper than 4 meters. For the age group of 10-12, the maximum depth is advised again in the limits of pool or pool-like conditions to 12 meters, with the assistance of adult supervisor, and depending on the level of training completed. For the ages higher than 14 years old, by completing the necessary training, entrants are allowed to dive within the advised limits, which are not exceeding 18 meters for the beginners.

These limits are also needed to be considered in line with the possible hands-on practices. According to the previously mentioned factors, several exercises could be proposed for the hands-on science education which might be taken in an outdoor environment for different age groups. Possible training setups, a very limited number of them, for the benefit of hands-on science education can be given as in the below list of activities.

Most of them are already residing into the scuba-diving training sessions. However, all these subjects are taught, practiced and mastered with a certain focus on scuba-diver training and in order to introduce the scuba-diving to the entrants. Usually they are tailored for the development of necessary skills and knowledge while giving prior emphasize to the necessary precautions in relation with them.

That is not to say that, these are in conflict with any other focus, for instance, bringing the same practices to the hands-on science education. Moreover, in order to reach the aimed benefits of each proposed activity, participants own confidence on their scuba-diving skills should have the priority. Once the confidence is assured in a requested level by the scuba-diving training, as knowledgeable divers, they can concentrate on the planned activities more comfortably. Consequently, participants can find a chance to improve their knowledge during the hands-on science education session.

4. What could be the areas of application for scuba-diving supported hands-on science education?

Below proposed activities mostly refer to the fairly well known practice sets which reside into both the introductory and the advanced level scuba-diving trainings. As it's mentioned before, these subjects are including the buoyancy, pressure, behavior of light and sound, effects of the underwater environment to our audio-visual abilities and the possible simple mechanical setups under the effect of pressure and buoyancy. These subjects are usually taught in introductory scuba-diving trainings by carrying these to the hands-on science education setups, participants could enhance their knowledge on to these subjects which are favorably utilized in the hands-on science education sessions [8,9,10,11,15,16].

Finally, by getting closer to the ongoing life of the underwater, identification of living organisms, developing knowledge on them should be another outcome of such an education setup. Not only the living organisms but also the historical and archeological findings residing under the water are can be found promising for the participants' knowledge enhancement. Last two set of proposed hands-on science alternatives are referring to these subjects.

Again, by the advanced level scuba-diving training, once participants gain the necessary basics on the scuba-diving related subjects, they could enhance their knowledge by the hands-on science setups. Scuba-diving, by unveiling the curtain of sea-surface and introducing the potential threads to the underwater environment, proposing another set of benefits that might be received by this outdoor activity, and develop a certain environmental awareness.

Buoyancy:

- Keeping himself/herself buoyant has an up most importance for scuba-diver. By the help of scuba set and buoyancy control devices, provided buoyancy always keeps the diver comfortable during many exercises. In addition to the main skills to be developed during scuba-dive training, different practices could also be design to show how the buoyancy can provided under the water. Any activity to improve the diver's buoyancy, so while controlling their buoyancy enhancing their knowledge on the effecting factors, can be taken as an activity which could be practiced either in swimming pools or in open water conditions.
- Into the swimming pools, by the help of a balloon or by using an inflatable surface marker, a certain material, for instance a piece of lead weight (1 kg.), could be tried to be kept at a certain dept in a balance without moving up or down. It may be found demonstrative to show the balance between different forces applied to this simple mechanical design.
- Again by using an inflatable device, moving any weight from the bottom of the pool to the surface can be found demonstrative for the participants.

Pressure:

- Slight changes could be observed on the volume of air which is filled in a sealed container on the bottom of the pool and carried up to the surface from 2 to 4 meters. Beside the confined water conditions, between 5 to 10 meters, any demonstration carried out by an empty plastic container, i.e. plastic bottle, filled with air, would be more demonstrative to show the effect of changing pressure levels on the volume of gasses. During ascends, by the decreasing pressure, the volume of air could be observed increasing, expanding into the container, while, during ascents, by increasing ambient pressure an opposite change into the volume could be observed.
- Also by the help of introductory exercises of scuba-diving, like mask-clearing, effect of increasing pressure could be exercised, by exhaling air into the mask and, consequently releasing the water out of the mask.
- Somehow more complex mechanical systems could also be found demonstrative. By using additional air sources and a wheel, and installed mill-like constructions -in their miniature sizes these are fairly well known as decorative elements, and for oxygenizing aquariums- can also be utilized to show how the rotative motion is initiated by using previously mentioned physical phenomena, which is effecting the volume of gasses with the decreasing pressures from bottom to the top of water.

Light, Sound and Heat:

- Swimming without using a mask or goggles, may help the participant to understand the effect of water on our visual abilities. Such an exercise can be practiced even into the very shallow parts of the pools and open water.
- May be the most suitable place to show the effect of underwater environment on our visual abilities is the surface of the water. By using a known material i.e. ruler, at the surface and by the help of a diving mask, nearly all age groups can see how the water density is effecting the seen size and the distance of objects by comparing the visible part of the material resides out of the water and into the water. With the scuba-diving equipment, it may be practiced again by using known materials, and by giving special emphasize how the seen objects are magnified under the water.
- Between 10 to 20 meters, painted papers which are put in an empty, tapped, plastic bottle, or a container, as the instructor Dave's

most favorite tool for demonstration, or balls in different colors, could be found demonstrative to show the effect of water density on the waves of light and colors. Moreover, the squeezed plastic material, the tapped plastic bottle, could be found demonstrative in order to show the effect of higher pressures on the volume of gases.

- Also, by using warm water filled in a tapped plastic bottle which has a temperature inside, time intervals can be recorded by the diver, both on the surface and during the dive to see the differences caused by fast heat conduct of water.
- By utilizing a sound source, a small shaker, in which a small metal ball or other metal pieces found and tapped, differences between the heard sound both out of the water and into the water may be the simple tool to utilize for this purpose, and known by many divers. Again during the dives, while standing in a known distance from a changing source of sound, a small model ship tied to a rope at one end and to a stick at the other, which moves on a circle like trajectory, divers could be asked to identify the origin of sound under the water as well.

Underwater Environment and Environmental Problems:

- Possibly the most astonishing experience would be observing the underwater life into its own realm. Nearly all scuba-diving training organizations encourage this attitude by their training standards and developed specialty programmes. In any environment, and in any depth, this may help the scuba-divers, to get closer to the living organisms of underwater, more than they can do while they stay outside of the underwater realm. Again by using different publications on the aquatic life, identifying the seen living organisms in their livelihood can be another option to be utilized for the hands-on science education. By the help of before and/or after dive briefings, also either by using taken pictures, video films, or by personal observations, and taken notes, participants would enhance their knowledge on the underwater life. Again, by utilizing the night dives, by visiting the same locations, changing patterns of life could be observed by the participants.
- While diving, in order to develop a certain awareness on environmental problems, special emphasize can be given to the unveiled pollution, and to the well known phenomenon of possible harms which could be given to aquatic life. Certain activities for cleaning the underwater wastes, i.e. plastic wastes, often organized by many organizations and develop a certain awareness on the environmental problems which resides under the sea surface.

History and Archeology:

- Historical wrecks, sunken bodies of ships, archeological findings are always plays an important role for the historical and archeological studies. High number of sunken ships, underwater archeological findings are already discovered and recorded and most of them are accepting visits of recreational divers. These are letting the divers to learn about the history by the help of before and after dive briefings, and by their own observations during their visits as well.

5. Conclusive remarks.

In order to provide the necessary self-confidence and to release the inherent risks of scuba-diving, proper training on the introductory level skills and knowledge is having the priority. All of these previously proposed hands-on science education setups would be more effective with a previously taken training on scuba-diving with respect to the participants' reached outcomes. Without distracting their concentration on the subjects covered into these setups, with the developed confidence on diving skills, participants may enhance their knowledge more comfortably. In such a complementary favor, while scuba-diving training is giving the basics with a certain focus on diving itself, any hands-on science education would enhance the participants' knowledge on the studied subject.

Also, while considering the scuba-diving, as an outdoor activity, for the hands-on science education, which might be found promising for un-traditional education setups, it also asserts its own constraints and availability of applications with respect to the participants' characteristics. While some of these proposed setups may give a chance to all age-groups to participate, depending on the essence of applications and their requirements, some of them may be found

© 2012 HSci. ISBN 978-989-98032-0-6

limited with certain age-groups. However, once these requisites are all met within the existing standards, by utilizing the scuba-diving, participants could found a chance to learn with more fun in a different outdoor environment.

6. References.

[1] Acott C. A Brief History of Diving and Decompression Illness. SPUMS Journal Volume 29 No.2 June 1999:98-109.

[2] Bevan J. Diving Bells Through The Centuries. SPUMS Journal Volume 29 No.1 March 1999.

[3] Bevan J. The Diving Helmet. SPUMS Journal Volume 29 No.2 June 1999.

[4] Confédération Mondiale des Activités Subaquatiques, World Underwater Federation (C.M.A.S.). Standards & Requirements-Diver/Instructor, Version 9, 2002.

[5] Confédération Mondiale des Activités Subaquatiques, World Underwater Federation (C.M.A.S.). Children's Diving Standards, Version 2003/00, 2003.

[6] DeGorordo A. Vallejo-Manzur F. Chanin K., Varon J. Diving Emergencies.Resuscitation 59 (2003) 171 -180.

[7] C.J. Edge. Recreational Diving Medicine. Current Anaesthesia & Critical Care (2008) 19: 235–246.

[8] Feinberg L.Watercraft Hands-On Challenge, Students Explore Buoyancy With PBS's Design Squad Nation. Available online in ScienceDirect queries by "Technology & Engineering Teacher" copyright, 2012. http://pbskidsgo.org/designsquadnation [July.2012].

[9] George Hatsidimitris G., Connor R., Ginges J. Wolfe J. Glimpses of Science: Multimedia-enhanced hands-on activities for primary school students. Teaching Science, Vol.56, No.3, September 2010:39-42.

[10] Gerstner S. Bogner F.X. Cognitive Achievement and Motivation in Hands-on and Teacher-Centred Science Classes: Does An Additional Hands-on Consolidation Phase (concept mapping) Optimise Cognitive Learning at Work Stations?. International Journal of Science Education, Vol. 32, No. 7, 1 May 2010, pp. 849–870.

[11] Guha S. It's More Fun Than It Sounds - Enhancing Science Concepts Through Hands-on Activities For Young Children. Teaching Science, Vol.58, No.1, March 2012.

[12] Northwest Diving History Association. Timeline of Diving History. http://www.divinghistory.com/id11.html [28/July/2012].

[13] Professional Association of Diving Instructors (PADI). Instructor Manual. Digital Version. 2008.

[14] Professional Association of Diving Instructors (PADI). Open Water Diver Manual. 2007.

[15] Recreational Scuba Training Council (RSTC). Minimum Course Content for Open Water Scuba Certification, RSTC; 2004.

[16] Sadi Ö, Çakıroğlu J. Effects of Hands-on Activity Enriched Instruction on Students' Achievement and Attitudes Towards Science, Journal of Baltic Science Education, Vol. 10, No. 2, 2011:87-97.

[17] Satterthwait D. Why are 'hands-on' science activities so effective for student learning?. Teaching Science, Vol.56, No.2, June 2010: 7-10.

[18] Straughan E.R.. Touched by water: The body in scuba diving.Emotion, Space and Society xxx (2010):1-8

[19] Uyarraa M.C. Coteb I. M. Coteb.The Quest For Cryptic Creatures: Impacts of Species-focused Recreational Diving on Corals. Biological Conservation, (2007): 77-84.

[20] Wikipedia - the free encyclopedia. Timeline of diving technology. http://en.wikipedia.org/wiki/Timeline_of_diving_technology . [28/July/2012].

© 2012 HSci. ISBN 978-989-98032-0-6

USING OF THE MEANINGFUL FIELD TRIP IN RENEWABLE ENERGY EDUCATION: ITS EFFECTS ON STUDENTS LEARNING AND ATTITUDES

H.S. Tortop
Bulent Ecevit University, Eregli Faculty of Education, Science Education Department, 67300, Zonguldak, Turkey
hasansaid@yahoo.com

Abstract. *Today, many countries focus on renewable energy resources (RERs) due to their economical and ecological aspects. RERs have not been utilized to a sufficient extent yet. Education is an important factor that increases the awareness of RERs. Teaching of RERs, especially Solar Energy Applications (SEAs) for Turkey, with new learning strategies and as connected with life, is important to realize the awareness. The field trip (FT) is defined as an excursion away from the physical classroom accompanied with the teacher. Many researchers consider FTs to be very important educational tools, and it provides students with effective learning facilities and firsthand experiences. Meaningful field trip (MFT) was designed as to the learning cycle approaches by Kisiel (2006). Applications of MFTs activities with regard to SEAs were carried out by Tortop et.al. (2007) and Tortop (2010, 2012) with primary and secondary school students at the Research and Application Centre for Renewable Energy Research at Suleyman Demirel University in Isparta, a city in western Turkey. The aim of this research is to show how effectively the MFT can be conducted and to present its effects on students' attitude, achievement and so on.*
In this study, example of the MFT activity was presented. After that, a discussion was made regard in the effects of the MFTs activities on students' achievement, learning RERs and attitudes towards SEAs .The MFT designed in the field of Solar Chimney Application (SCA) involves five stages. The first refers to engagement, second stage to exploration, the third stage to explanation, the fourth stage elaboration), and the fifth stage to evaluation. Some activities were performed in all the stages of MFT. In the literature, the MFT activities are very enjoyable and instructive. The MFT provides permanent learning and helps getting the project idea at project based learning.

Keywords: The Meaningful Field Trip, 5E Learning Cycle Model, Renewable Energy Sources, Science Education.

1. Introduction

Renewable energy resources (RERs) are also referred to as "inexhaustible energy sources (hydroelectric, solar, biomass, geothermal, wind and so on) and offer many environmental profits over conventional energy sources" [1,2,3]. Turkey has a high potential for RERs. However, renewable energy technology is not used on a large scale when compared with developing countries [4]. One factor that limits the use of renewable energy technologies is lack of public awareness [5]. Tortop stated that "education is the key factor for building the awareness and consciousness of renewable energy resources applications", and effective teaching strategies must be used for renewable energy education [5].

1.1. Importance of Renewable Energy Education in Turkey

The Republic of Turkey is located at a point where three continents meet, has an area of 779, 452 sq. km and a population of over 70 million [6]. Turkey's energy consumption has increased in parallel with the increase in the population and economic growth for the last decade. Turkey is dependent on other countries for its energy need. More than half of the energy Turkey consumes is imported from other countries because Turkey has limited energy sources. However, Turkey has a high potential for renewable energy resource [7,4].

Many developed countries are aware of the importance of renewable energy resources in terms of requirement of energy demands and its environmental effects. For this reason, these countries changed their educational programs to raise public awareness of renewable energy and environmental issues [4].

Renewable energy education is a new field which has only been developing for the last 10-15 years as part of general education. Many studies have been carried out in this area worldwide. In contrast, there exist very limited published studies in Turkey [8].

Renewable energy education must include, at every level, many activities related to the teaching of some concepts such as renewable and non-renewable energy resources and what renewable energy technologies involve. Thus, students would become aware that renewable energy resources may provide a solution aimed at avoiding an energy crisis that may occur in the future [4].

© 2012 HSci. ISBN 978-989-98032-0-6

Universities in Turkey do not offer graduate education in the field of renewable energy resources. Instead, they offer master degree and doctoral programs in other fields. This is mainly due to the fact that there are not enough qualified personnel and researchers in this area [8].
Keser et al., (2003) investigated the case of Turkey in terms of renewable energy education. They reported that the coverage of the energy and renewable energy concepts in the curricula is scant and pointed out that the area suffers from a lack of good textbooks and examples of teaching activities are insufficient [9].
However, in 2004, an amendment was made to the science curriculum, which was aimed at eliminating these deficiencies. A special emphasis was placed on subjects such as renewable energy resources and energy saving. Similarly, some amendments were introduced at the high school level as well. The previous physics curriculum included a unit entitled Solar Energy and Application Areas because solar energy was a rapidly developing sector for Turkey and its neighboring countries [10]. By contrast, the new physics curriculum has been expanded to include renewable energy resources and their significance as part of the physics, chemistry and biology subjects [5].
Indeed, the fact that university entering exams do not include questions about renewable energy resources causes many teachers and students to ignore this issue [11, 5]. Also, new developments are taking place at the university or academic level. Recently, many research institutes have been founded to conduct research on renewable energy resources [12]. “Research and Application Centre for Renewable Energy Resources (RACRER) was founded in 2003 to determine the potential of renewable energy for the region of Isparta, which is a city in western Turkey, in the first place and then the whole country. The purpose of this is to produce and train more researchers in this field and conduct project studies [13].
The newly amended science curriculum encourages the usage of contemporary teaching approaches that lead the student to search, inquire and produce [14]: These goals can be achieved by utilizing the field of RERs. However, Tortop (2012) established that students in Turkey exhibit low awareness of RERs. In fact, it is interesting to note that 91% of students who live in the city of Isparta are not aware of the existence of RACRER where they live. This finding is very important since it reveals at what level teachers provide an education in the field of renewable energy sources [5].

1.2. New Science Education Curriculum in Turkey regarding the New Learning Approaches

In 2004, the science education curriculum in Turkey was changed to include the constructivist-based approach [15]. However, it cannot be said that many science teachers have adopted the new science curriculum [16,17,18].Researchers attribute this to many reasons. Among them are ignoring opinions of teachers, a lack of infrastructure, and teachers’ lack of knowledge about the new learning and alternative assessment approaches [19].
Many researchers agree that the new learning approaches are those which take the students to the center of learning, encourage them to learn, to think and reason [20,15]. Tortop and Özek (2009) stated that the new physics curriculum presents some effective contemporary student-centered teaching and learning approaches such as Constructivism, Discovery Learning (Bruner), IM Theory, Project Based Learning, 5E Learning Cycle Model, Predict Observe Explain (POE) and so on [19].
The field trip may also be added to these new learning strategies since it provides firsthand experience and focuses on the students during the process of learning [21,22]. However, many researchers stated that these new learning approaches have been used by teachers at a very low level, and they have not enough knowledge about the new learning approaches [19,23]. Interestingly enough, some teachers said that “new learning and alternative assessment approaches may take too long time to be taught in class” [19,24,25,26].
The new science curriculum came into force in 2004 and some researchers investigated the applicability of curriculum, its effects and so on. However, the findings of researchers are not pleasant in terms of the adaptation of teachers to the new curriculum, the use of the new learning and alternative assessment approaches. Moreover, teachers lack sufficient in-service training [5,19,2,28,29].

1.3. The Field Trip and The Meaningful Field Trip

The field trip is defined an excursion guided by teachers outside the school for the purpose of

© 2012 HSci. ISBN 978-989-98032-0-6

learning. Many researchers stated that the field trip is an important educational tool that enables students to identify this learning process with their life, gain firsthand experiences, create an enjoyable learning environment and so on [22,30-37]. It is interesting that this educational tool has been used by teachers rarely [33].These are ascribed to administrative reasons, unwillingness of teachers because it takes a long time and involves some burdens and responsibilities. However, it is important that these obstacles must be overcome and teachers must be encouraged to conduct more field trips for the quality of science education [11,21,38]. Kisiel (2005) determined the following reasons that encourage teachers to get motivated to carry out field trips as follows:

Figure 1. *Solar Chimney with 5E Learning Cycle [43]*

"Apart from becoming integrated with the classroom curriculum, field trips also provide a general learning experience, encourage lifelong learning, enhance interest and motivation, provide exposure to new experiences, provide a change in setting or routine, creating enjoyment, and meet school expectations" [21].

Many suggestions have been put forward by researchers for an effective field trip. These are as follows: teachers should visit the location prior to the field trip and talk to the personnel about the expectation of the field trip, teachers should arrange some activities after the field trip in the classroom and students should be helped to focus on the field trip and its educational goals and so on [22,37-39].

 First Stage (Engagement): The teacher asks the students questions about SCA such as what it is and how SCA works So, The students will be curious about SCA.
 Second Stage (Exploration): The teacher wants to investigate and explore the SCA.
 Third Stage (Explanation): The students discuss on the working principals of SCA. The teachers correct any misunderstanding of SCA. In addition, in this stage, an expert of SCA also answers questions asked by the students.
 Fourth Stage (Elaboration): The teacher asks the students what the best working conditions of SCA are and how solar energy can be applied best for energy production and they engage in discussion.
 Fifth Stage (Evaluation): The teacher assesses the knowledge of the students on SCA.

Table 1. *Teaching the Solar Chimney Applications (SCA) according to 5E Learning Cycle Model (MFT)*

Researchers emphasize that an effective and ideal field trip should be based on constructivist approaches, and they explain what attributes MFT should have [22,40].The MFT course plan was designed by Kisiel (2006) based on learning cycle approaches [41].Tortop et al., (2007) applied the 5E learning cycle model to MFT regarding SEAs in physics courses [42]. Similar studies have been carried out by Tortop (2010,2012) [34,43]. Tortop (2010) described how the Solar Chimney Applications were taught with MFTs as follows (See Table1).

The RACRER at Suleyman Demirel University was selected for the MFTs activities [42,34,43]. At the RACRER, there are many applications of RERs such as biogas plant, wind energy, wind power, and solar energy applications (such as solar chimney, solar pond, photovoltaic, solar collector).Many projects and research activities about RERs have been conducted at RACRER. The Solar Chimney studies were carried out by Koyun (2006), Üçgül and Koyun, (2010), Şenol et al. (2011) at Suleyman Demirel University [45, 46, 47]. See Figure 1.

"The solar chimney produced electricity from solar energy. Ambient air is drawn into the glass collector. This is warmed by solar energy and rises up the chimney. The current of rising warm air drives a turbine" [48].

Some questions are at the evaluating stage at MFTs as follows [43]:

What effect would a chage in the width of the collection area of the solar chimney have?

In your opinion,how should a more practical application be?

2. Conclusion

In this study, the "meaningful field trip" concept was explained which was set forth by Kisiel (2006) by means of a designed course plan regarding the application of the learning cycle approach to MFT [41].T this end, some studies were undertaken for applications of MFT [42,34,5].These studies examined MFTs in terms of applicability in science education and its effects on attitudes and achievements of students. MFTs made for solar energy and its usage areas were given in detail. Suggestions regarding MFTs were presented. On the traditional field trip everything is explained by teachers or experts as with the traditional lecture method. However, the roles of teachers and experts are as a facilitator or guide, knowledge is not transferred directly and students are at the center of learning at MFT. This situation is important in that students develop positive attitude towards this issue and permanent learning.

3. Implications

In future studies, other parameters must be investigated which are affected by MFTs. MFTs must be designed at science museums and research centers for students to learn them in science education. Teachers have to be subjected to an in-service trainee program on MFTs. Provisions or facilitators of field trips and MFTs must be made better at every level of education, and the organizational burden of teachers for field trips (such as procedures of allowance, collecting money) must be eased.

4. References

[1] Kaya D. (2006). Renewable Energy Policies In Turkey. *Renewable sustainable energy review. 10*, 152–163.

[2] Kaygusuz K, & Sarı A. (2003). Renewable Energy Potential and Utilization in Turkey. *Energy Convers Manage. 44*, 459–478

[3] Evrendilek F., & Ertekin C. (2003). Assesing The potential of renewable energy sources in Turkey *Renewable Energy; 28*, 2303–2315.

[4] Açıkgöz C. (2011). Renewable energy education in Turkey. *Renewable Energy, 36,* 606–611.

[5] Tortop, H.S. (2012). Awareness and misconceptions of high school students about renewable energy resources and applications: Turkey case. *Energy education science and technology part b: social and educational studies.4*(3), 1829-1840

[6] TurkStat, (2012). Turkish Statistical Institute. Retrieved from: http://www.turkstat.gov.tr/Start.do

[7] Keçebaş A, & Yumurtacı M. (2011). Renewable energy and its university level education in Turkey. *Energy education science and technology Part B-social and educational studies. 3,* 143-152.

[8] Karabulut, A., Gedik, E., Keçebaş, A., & Alkan, M.A. (2011). An investigation on renewable energy education at the university level in Turkey. Renewable Energy, 36, 1293-1297.

[9] Keser, Ö., (2003): Energy, Environment, and Education Relationship, in Developing Countries' Policies: A Case Study for Turkey, *Energy Sources, 25*(2), 123-133.

[10] Ottinger, R.L.(2005). Experience with Promotion of Renewable Energy: Successes and Lessons Learned. *parliamentarian forum on energy legislation and sustainable*

development. Cape Town, South Africa 5-7 October, 2005

[11] Tortop, H.S. (2010). The application of project based learning model supported by prepared according to constructivist approach the field trip to the solar energy and its usage areas**.** Doctoral Thesis.Isparta.

[12] Tortop, H.S., Bezir, N.Ç., & Özek, N., "Ülkemizde Güneş Enerjisi ve Uygulamalarının Teknolojik Gelişiminin İncelenmesi" *III. Türk bilim ve teknoloji tarihi kongresi*, 6-7 Kasım 2008, Uşak Üniversitesi, Uşak.

[13] YEKARUM, 2012. Retrieved from: www.yekarum.sdu.edu.tr

[14] MEB, 2012. National Education Ministry. The Board of Education. Retrieved from: http://ttkb.meb.gov.tr/ .

[15] Turkey Board of Education, 2004. Retrieved from: http://ttkb.meb.gov.tr/

[16] Tortop, (2012b). Adaptation of Physics Teachers On New Physics Curriculum: A Case Study. *Adıyaman university journal of social sciences institute*. (in press)

[17] Tüysüz, C. & Aydın, H. (2009). İlköğretim fen ve teknoloji dersi öğretmenlerinin yeni fen ve teknoloji programına yönelik görüşleri. *Gazi Eğitim Fakültesi Dergisi, 29*(1), 37-54.

[18] Kurt, S. & Yıldırım, N., (2010). Ortaöğretim 9. sınıf kimya dersi öğretim programının uygulanması ile ilgili öğretmenlerin görüşleri. *19 mayıs üniversitesi eğitim dergisi, 29*(1), 91-104.

[19] Tortop, H.S., & Özek N., (2009). Investigation of Physics Teachers‟ Kownledge and Using Ability The New Learning and Assessment Approaches.FISER'09. *Frontiers in science education research. an international conference on science and mathematics education research* 22-24 March 2009. Famagusta, North Cyprus.

[20] Trigwell, K. and Prosser, M. (1996) Changing approaches to teaching: A relational perspective. *Studies in Higher Education*, **32**, 77-87.

[21] Kisiel, J., (2005). Understanding elementary teacher motivations for science fieldtrips. *Science Education, 86*(6), 936–955.

[22] Falk, J.H., & L.D. Dierking (1997). School field trips: Assessing their long-term impact. *Curator*, *40,* 211–218.

[23] Tekbıyık, A. & Akdeniz, A.R., (2008). İlköğretim fen ve teknoloji dersi öğretim programını kabullenmeye ve uygulamaya yönelik öğretmen görüşleri. *Necatibey eğitim fak. elektronik fen ve matematik eğitimi dergisi, 2*(2), 23-37.

[24] Doğan, B.A. (2005).The teachers' opinions about assessment activities in science instructions (Example for Van), Unpublished master thesis. Yüzüncü Yıl University, Institute of Science, Van.

[25] Yangın, S. & Dindar, H. (2007). İlköğretim fen ve teknoloji programındaki değişimin öğretmenlere yansımaları. *Hacettepe üniversitesi eğitim fakültesi dergisi, 33,* 240-252.

[26] Karacaoğlu, Ö.C. & Acar, E., (2010). Yenilenen programların uygulanmasında öğretmenlerin karşılaştığı sorunlar. *Yüzüncü yıl üniversitesi, eğitim fakültesi dergisi. 7*(1), 45-58.

[27] Aydın, S., & Çakıroğlu, J., (2010). Teachers' views related to the new science and technology curriculum: Ankara case. *İlköğretim Online, 9*(1), *301-315*

[28] Kırmızı, F.S. & Akkaya, N., (2009). Türkçe öğretimi programında yaşanan sorunlara ilişkin öğretmen görüşleri. *Pamukkale üniversitesi eğitim fakültesi dergisi, 25*(1),42-54.

[29] Kenan, O. & Özmen, H., (2010). İlköğretim Okullarında Görev Yapan Öğretmenlerin Yeni Öğretim Programı Tanıtımı Seminerleri Hakkındaki Görüşleri. *II. International Congress of Educational Research.* April 29-May 2, 2010, Antalya-Turkey

[30] Gennaro, D.D.(1981). The effectiveness of using pre-visit instructional materials on learning for a museum field trip experience. *Journal of research in science Teaching*, *18*, 771-781.

[31] Flexer, B. K., & Borun, M. (1984). The impact of a class visit to a participatory science museum exhibit and a classroom science lesson. *Journal of research in science teaching*, *21*(9), 863 - 873.

[32] Beiers, R.J. & McRobbie, C.J. (1992). Learning in interactive science centers. *Research in science education. 22,* 38-44

[33] Orion, N. & Hofstein, A. (1994). Factors that influence learning during a scientific field trip in a natural environment. *Journal*

of research in science teaching, *31*(10), 1097–1119.

[34] Sebasto, N.J.S. & Cavern, L. (2006). Effects of pre- and posttrip activities associated with a residential environmental education experience at the New Jersey School of Conservation students' attitudes toward the environment. *Journal of environmental education*, *37*(4), 3-17.

[35] Farmer, J., Knapp, D., & Benton G.M. (2007). An elementary school environmental education field trip: long-term effects on ecological and environmental knowledge and attitude development. *The journal of environmental education*, 38(3), 33-42.

[36] DiEnno, C.M, & Hilton, S.C. (2005). High school students' knowledge, attitudes, and levels of enjoyment of an environmental education unit on nonnative plants. *The journal of environmental education.* 37(1), 13-25.

[37] McLoughlin, A., (2004). Engineering Active and Effective Field Trips. *The clearing house, 77,* 160–163.

[38] Kaspar, M.J. (1998). *Factor affecting elementary principals' and teachers' decisions to support outdoor field trips.* Doctoral Thesis. The University of Texas. Austin.

[39] Johnson, D.T. & Chandler, F.J., (2009). Pre-service Teachers' Fieldtrip to the Battleship: Teaching and Learning Mathematics through an Informal Learning Experience. *IUMPST: The Journal. Vol 2 (Pedagogy), April 2009.*

[40] Kisiel, J., (2006). Making Field Trips Work. *The science teacher*, *73*(1), 46 – 48.

[41] Hargreaves, L.J. (2005). *Attributes of the meaningful field trip experiences.* Master Thesis. Simon Fraser University.

[42] Kisiel. J., (2006). More than lions and tigers and bears-creating meaningful field trip lessons. *Science activities classroom projects and curriculum ideas,43*(2),7-10.

[43] Tortop, H. S., Bezir, N. Ç., Uzunkavak, M., The Field Trip About Solar Energy and Applications of The Effect of Students' Attitude and Achievement, International *conference on environment: survival and sustainability*, 19-24 February 2007, Near East University, Nicosia-Northen Cyprus.

[44] Tortop (2012). The Meaningful Field Trip About Renewable Energy With Gifted Students. Abant İzzet Baysal Universitesi Eğitim Fakültesi Dergisi (in press).

[45] Koyun, A. (2006). *Investigation of energy production by the solar chimney*. Doctoral Thesis. Suleyman Demirel University. Isparta.

[46] Üçgül İ., & Koyun, A., (2010). Experimental Investigations on Performance and Design Parameters of Solar Chimney. *Pamukkale üniversitesi mühendislik bilimleri dergisi,16*(3), 255-264.

[47] Şenol, R., Üçgül, İ., Koyun, A., & Acar, M., (2011). 10 MW'lık SDU Güneş Güç Kulesi Tesis Tasarımı, *Journal of the faculty of engineering and architecture of gazi university, 26*(4), 813-821.

[48] Schlaich, J., (1995). *The solar chimney: Electricity from the sun*. C. Maurer, Geislingen, Germany.

STUDENTS' ENVIRONMENTAL ORIENTATION IN THE REPUBLIC OF MACEDONIA

M. Srbinovski[1], I. Jonuzi[2]
[1]*Institute for Environment and Health, Ilindenska nn Campus Bildg. 304.13*
1200 Tetovo, Republic of Macedonia
[b]*29 November, bb, 1200 Tetovo, The Republic of Macedoni*
m.srbinovski@seeu.edu.mk,
ibromedical@yahoo.com

Abstract. *The aim of this paper is to determine the students' level of environmental orientation in the Republic of Macedonia. We define environmental orientation as a degree on which the student accepts the environmental values and his own ones as a subject of the pollution control.*

A Likert scale instrument was used to measure environmental attitudes. It was 13-items, 5-point, two-way scale instrument. In this research we included 484 students from 19 secondary schools in the Republic of Macedonia.

The average students' level of ecological orientation is about 3.8 or 76%. We must look at student's environmental education achievement in the context of the overall social-economic conditions in which we carry out the education process.

Keywords: attitudes, environmental education, schools, students, The Republic of Macedonia.

© 2012 HSci. ISBN 978-989-98032-0-6

1. Introduction

Environmental orientation is defined as a degree on which the student accepts the environmental values and his own values as a subject of environmental protection. Attitudes and values reflect feelings of concern for the environment. Attitudes are mental states based on personal beliefs towards pollution, technology, economics, interdependence and equal importance of all life forms, dependence of human life on the resources of a finite planet, power of human beings to modify the environment, conservation, environmental action etc.

On the basis of the Law on Primary Eduation (2004), primary education in the Republic of Macedonia is compulsory for all children in the age group 6-15 years and includes: one preparatory pre-primary year, and two four-years cycles (classroom teaching and subject teaching). In accordance with the amendments introduced 2007, compulsory primary (basic) education lasts nine years dividet into three three-years cycles. According to the changes and amendments to the Law on Secundary Education adopted 2007, secundary education is compulsory and free of charge in public educational institutions [31].

The aim of the reforms which are being conducted in recent years, was improving the quality of the educational system in the Republic Macedonia. Certanly, these reforms have affected environmental education (EE) as a part of teaching process. For us it was interesting to find out what is happening in the field of EE in teaching practice? How much these reforms touch and improve the quality of EE in practice?

Motivated by the need to define the current situation in the field of EE in our schools, we approached to this research. In particular, since some previous studies have shown some weaknesses in the field of EE in the Republic of Macedonia in terms of curriculum content and supporting materials [17], [18], [22], [26], [27], [30]; didactical conditions for EE [17], [19], [24], [29]; learning in the field of EE [21], [25], [28]; national strategy for sustainable development [1], and so on.

From this point of view, we have a paradoxical situation. On one side, we have a tendency of conducting certain educational activities; on the other hand, we have an unfavorable factual situation. This was our main motivation to grasp with this kind of work.

2. Materials and methods

The aim of this study is to determine the students' level of environmental orientation in the Republic of Macedonia. Environmental orientation expresses the degree to which a student accepts given values about the environment. We assume that the majority of students have positive attitudes towards the environment.

A 13 item, 5-point, two-way Likert scale instrument was used to measure environmental attitudes. Items were related to the reasons and the consequences of irresponsible behavior towards the environment, ecological balance in nature, ecological principles, the mutual dependence of the members in the biosphere etc. The scale was taken from the literature [17].

In the last survey (2009) were included 484 respondents from 19 secondary schools in 18 cities in the Republic of Macedonia. Obtained results were compared with those from 2005 on the sample of the 488 students from the same school. In this way, we tried to reduce the impact of parasitic factors. Given the fact that students learn about environment in all school years, students from final classes were included.

3. Results and discussion

Attitudes are learned predispositions to respond in a favorable or unfavorable manner toward objects, events, and other referents [17], and therefore reflect students' interests and disinterest [12]. Attitudes are defined as the enduring positive or negative feeling about some person, object, or issue. Closely related to attitudes are beliefs, which refer to the information (the knowledge) a person has about a person, object, or issue [15]. Students' attitudes toward the environment extend well beyond their interests; they encompass dispositions toward selected aspects of the environment and environment-related matters such as nature, energy, pollution, technology, and economics [5], [8], [13] and [16].

Student's ecological knowledge does not mean by itself environmental awareness and culture. EE should equally treats all student's components. This includes, among other education for developing positive attitudes and values towards the environment.

Students' environmental orientation is determined on the basis of verbal statements of the respondents. The results of the applied instrument are given on the Table 1.

Table 1. *Students' attitudes toward the environment. Legend: A- totally disagree, B- disagree, C- disagree and agree, D- agree, E-totally agree, F- no answer, G- Average.*

STATEMENT	Year	A	B	C	D	E	F	G
1. Progress of the society can be reflected by how much man utilizes nature.	2009	78	133	68	102	94	9	3.00
	2005	85	106	96	83	68	50	3.13
2. Survival of man is determined from existence of other organisms.	2009	43	88	53	138	147	15	3.55
	2005	34	26	46	99	240	43	4.09
3. Protecting nature, we protect ourselves and future generations.	2009	30	48	35	73	285	13	4.15
	2005	11	14	23	29	368	43	4.64
4. The man destroys nature as much as it can renew itself again.	2009	50	64	52	146	161	11	3.64
	2005	240	86	55	28	30	49	4.09
5. Funds should not skimp when it comes to environmental protection.	2009	43	55	57	151	169	9	3.73
	2005	17	12	32	109	269	49	4.37
6. The only chance to survive on the Earth is ecological awareness.	2009	214	133	57	46	28	6	2.04
	2005	9	11	40	104	276	48	4.43
7. Nature is our common treasure and because of that nature must be concern of everybody.	2009	48	49	28	68	289	48	3.79
	2005	23	17	28	43	329	48	4.45
8. Nature is un destroyable and precious	2009	69	37	70	100	198	10	3.68
	2005	243	74	39	27	49	56	4.01
9. Despite technological progress in this millennium man still depends on plants.	2009	36	65	89	139	149	6	3.09
	2005	19	20	48	95	257	49	4.26
10. Material assets do not have practical value, if we live in damaged environment.	2009	47	72	79	102	176	8	3.61
	2005	26	20	50	92	249	51	4.19
11. Only man has the privilege to act in nature as he likes.	2009	92	83	79	86	131	13	2.78
	2005	195	62	66	48	66	51	3.62
12. Man is the most responsible factor for protection of environment.	2009	38	43	45	138	201	19	3.91
	2005	18	18	33	83	287	49	4.37
13. Many things in life of man are more important than environmental ones.	2009	89	83	106	106	93	7	3.06
	2005	134	107	82	63	68	44	3.44

In general, the respondents had positive environmental attitudes in 2009 school year. On the other hand, for any statement they do not have maximum points (5). Most of the respondents agree with the statement "Protecting nature, we protect ourselves and future generations." Also, most of the students think that the man is the most responsible factor for environmental protection (3.91). A large percentage of the respondents agree with the statement "Nature is our common treasure and because of that nature must be concern of everybody" (3.79). A large part of the students believe that social development is dependent on how we behave in the environment. It implicitly shows that the youth respect and accept the concept of sustainable development. It can be seen from their assessment of the statement "Funds should not skimp when it comes to environmental protection".

We are concerned about a small percentage of students who value the first statement: "Progress of the society can be reflected by how much man utilizes nature". With this statement agree about 40% of respondents. The nature observation only as a source of resources, thereby not taking into account the natural laws, could have far-reaching consequences for organisms' survival on the Earth. A small part of the respondents agree with the statement "The only chance to survive on the Earth is ecological awareness". It clearly shows that young people are aware that the survival of the planet is conditioned by several factors. Most of the students think that the man should be privileged creature in the nature. About 200 students considered that "Many things in the life of man are more important than environmental ones".

On the basis of the presented results, we can conclude that the bigger part of the respondents

have a positive attitude towards the values of the environment. The students' level of the environmental orientations is about 3.39 or 68%.
Respondents had 5 points for only one statement in 2005: "Protecting nature, we protect ourselves and future generations". On the other hand, only two statements are evaluated under 4 points. Most of the respondents agree with the following statements: "Protecting nature, we protect ourselves and future generations." Nature is our common treasure and because of that nature must be concern of everybody, "Funds should not Flavorings when it comes to environmental protection". Small percentage of students correctly evaluated the first statement "Progress of the society can be reflected by how much man utilizes nature". The students' level of the environmental orientations in 2005 is about 4.08 or 81.66%. We can conclude that in the examined period, the level of environmental orientations shows a decrease of approximately 13.66%.
The Environment Directorate-General decided to commission a public opinion survey to measure the opinions, attitudes and behavior of Europeans towards the environment. The survey was carried out in the 27 Member States of the European Union between the 13th November and 14th of December 2007. Nearly 27,000 respondents were interviewed face-to-face at their homes in their national languages. According to this survey European citizens attach great value to the environment and are increasingly aware of the role that the environment plays in their lives. The environment has an indisputable importance in the lives of European citizens. 96% of Europeans say that protecting the environment is important for them personally. For two-thirds of this group it is even very important. Most Europeans have environmentally friendly attitudes and they are aware of their role as individuals in protecting their environment… However, although Europeans are aware of the need to protect the environment, their green attitudes do not always translate into environmentally friendly behavior and concrete actions [6].
The obtained values of $\chi2$ (14.465-55.791) and coefficient of contingention- C (0.125-0.242) show there exists a significant difference between students from primary and secondary schools in terms of their level of environmental orientation [20]. The difference probably is a result of the higher level of the students' environmental information from secondary schools. Namely, Srbinovski M. has shown that between these variables there exists a significant coefficient of correlation- 0.45 [23].
"Students, who learn about the environment and the effects of human interaction with the environment, actually demonstrate a higher awareness of environmental issues and incorporate that knowledge into the decision-making processes of their everyday lives. There is overwhelming evidence that students' environmental attitudes and knowledge are directly related" [14]. A research by Srbinovski M. (2003) confirms this statement [23]. In short, "these findings suggest that increased knowledge may help to improve environmental attitude, which in turn may affect behavior when making decisions about environmental issues" (Culen & Volk, 2000, cit. in [14]).
The connections between environmental attitudes and pro-environmental behaviors are part of environmental psychology. Attitudes can indirectly influence our pro-environmental behavior [3]. Additional reviews of research have indicated that the relationship between environmental attitudes and behavior is moderate [4], [8] etc.

4. Conclusion

In general, the respondents have positive environmental attitudes. The students' level of the environmental orientations is about 3.39 (out of 5) or 68% in 2009, and 4.08 or 81.66% in 2005. In the examined period, the level of environmental orientations shows a decrease of approximately 13.66%.
The next researches should be directed toward identifying factors that influence on the students' level of environmental orientation in Macedonian schools.

5. References

[1] Abazi A, Ismaili M, Srbinovski M. Environmental education in Macedonian national strategy for sustainable development: promise and prospects, ACE – International conference, 2009 October 24-25; Osaka, Japan, pp. 681-688.
[2] Abazi A, Ismaili M, Srbinovski M. Environmental Education for Sustainability in the Republic of Macedonia: Some Problems and Prospects. The Forth International Conference on Environmental Science and Technology; 2008 July 28-31;

Houston, USA, The American Academy of Sciences, 2: 355-360.

[3] A Kollmuss, J Agyeman. Mind the Gap: why do people act environmentally and what are the barriers to pro-environmental behavior? Environmental Education Research 2002; 8(3): 239-260.

[4] Bamberg S, Moser G. Twenty years after Hines, Hungerford and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behavior. Journal of Environmental Psychology 2007; 27: 14-25.

[5] Borden R. Psychology and ecology: Beliefs in technology and the diffusion of ecological responsibility. The Journal of Environmental Education 1984/85; 16 (2): 14-19.

[6] European Commission. Special Barometer, Attitudes of European citizens towards the environment; 2008. http://ec.europa.eu/public_opinion/archives/ebs/ebs_295_en.pdf [8/18/2012].

[7] Fishbein M, Ajzen I. Belief, attitude, intention, and behavior. Reading, MA: Addison-Wesley, 1975.

[8] Hines J, Hungerford H, Tomera A. Analysis and synthesis of research on responsible environmental behavior: A meta-analysis. The Journal of Environmental Education 1986/87; 18 (2): 1-8.

[9] Hollweg KS, Taylor JR, Bybee RW, Marcinkowski TJ, McBeth WC, Zoido P. Developing a framework for assessing environmental literacy. Washington, DC: North American Association for Environmental Education; 2011. www.naaee.net [8/18/2012].

[10] Ismaili M, Abazi A, Srbinovski M. Students' level of environmental education in Macedonian high schools, SEEU (South East European University) Review 2009; 5 (2): 125-135.

[11] Jonuzi I. High school students' environmental education in the Republic of Macedonia, Master thesis, SEEU, 2009.

[12] Taxonomy of educational objectives:Book II: The affective domain. Krathwohl D, Bloom B, Masia B. New York: David McKay; 1964.

[13] Marcinkowski T. An analysis of correlates and predictors of responsible environmental behavior. (Doctoral dissertation, Southern Illinois University at Carbondale, 1988). Available in Dissertation Abstracts International: Section A. Social Sciences and Education 1989; 49 (12): 3677.

[14] McVittie E, Chamberlain L. Implementing an environmental Education Program in a High School, EDU 555; 2000. http://www.oswego.edu/~shindler/enviroed.htm: 2-4 [8/18/2012].

[15] Newhouse N. Implications of attitude and behavior research for environmental conservation, The Journal of Environmental Education 1991; 22(1): 26–32.

[16] Sia A, Hungerford H, Tomera A. Selected predictors of responsible environmental behavior. The Journal of Environmental Education 1985/86; 17 (2): 31-40.

[17] Srbinovski M. The environmental education in the primary and secondary schools in the Republic of Macedonia from biological aspect, PhD dissertation, "St. Cyril and Methodius" University, Skopje. 2001.

[18] Srbinovski M, Palmer J. Environmental Education in Macedonian School: An Analysis of Curriculum Content and Supporting Materials for Teaching and Learning; Ecology, Biology and Biotechnology 2008; 4:19-30.

[19] Srbinovski M. Are the basic didactical conditions for environmental education in schools fulfilled. Prosvetno delo 2005; 4: 61-67.

[20] Srbinovski M. Valuable environmental component of the students from the Republic of Macedonia, Prosvetno delo 2005; 3: 41-49.

[21] Srbinovski M. Students' affective attitudes towards environment, Nastava i vaspitanje-Journal of Education 2006; 1: 22-33.

[22] Srbinovski M. Environmental issues in the didactic material of the primary and secondary schools in Republic of Macedonia, Ekologija 2003; 38 (1-2): 41-54.

[23] Srbinovski, M. The relationships between some cognitive and affective environmental educational areas, SEEU (South-East European University) Review 2005; 2 (2): 223-239.

[24] Environmental education. Srbinovski M. Prosvetno delo Skopje; 2005.

[25] Srbinovski M. Affective Relations of the Students towards the Environment, Pedagogy 2006; 2:198-204.

[26] Srbinovski M, Abazi A, Ismaili M. Environmental Education for Sustainability in Macedonian High Schools: An analysis of

 ISBN 978-989-98032-0-6

new curriculum content. Abstract book of the 5th World Environmental Education Congress; 2009 May 10-14; Montreal, Canada; 2009. p. 3.

[27] Srbinovski M, Erdogan M, Ismaili M. Environmental Literacy in the Science Education Curriculum in Macedonia and Turkey, Procedia - Social and Behavioral Sciences 2010; 2: 4528-4532.

[28] Srbinovski M, Ismaili M, Abazi A. The Trend of the High School Students' Level of the Environmental Knowledge in the Republic of Macedonia, Procedia - Social and Behavioral Sciences 2011; 15:1395–1400.

[29] Srbinovski M, Ismaili M, Zenki V. Didactic preconditions for environmental education in the Macedonian high schools, Abstract book, 4th World Conference on Educational Sciences; 2012 February 1-5; Barcelona, Spain.

[30] Srbinovski M, Palmer J, Ismaili M, Abazi A. Environmental Education in High Schools: An Analysis of New Curriculum Content, Environmental Science and Technology Proceedings from the Third International Conference on Environmental Science and Technology; 2007 August 6-9; Houston, USA; 2007. (2) p. 441-446.

[31] UNESCO-IBE. World Data on Education, 7th edition; 2010/11. http://www.ibe.unesco.org/en.html [8/18/2012].

EXPLORING PUBLIC AWARENESS LEVEL OF WASTE MANAGEMENT IN ROBAT-KARIM CITY, TEHRAN PROVINCE, IRAN

S. Panahi, M. Yekkalar

Office of sustainability, Amirkabir University of Technology (AUT), Hafez Ave., Tehran, Iran. Postal code: 15875-4413

s.panahi12@gmail.com, yekkalar@gmail.com

Abstract. *The increase in waste generation can be primarily attributed to factors such as rapid rates of urbanization, rural-urban migration, changing consumption pattern and high population growth rate. One of the primary steps of policies associated with a waste management system is ameliorating the people's involvement through public education. This study aims to examine the level of people's awareness with regard to waste management in Robat-Karim city of Tehran province, Iran. The study accomplished in summer 2011. Preliminary investigations on collected data showed that about 2.3% of the individuals have very low awareness of the low quality of their waste management.*

Keywords: Public Education, Robat-Karim city, SPSS, Waste Management.

1. Introduction

In recent decades, population growth due to unplanned urbanization, the invention of new materials, changing lifestyle patterns human activities without attention to environmental pollution control has resulted serious concern, especially in the developing countries. One of the consequences of these alternation is an enormous increase in the volume of solid waste generation poses a serious threat to environmental quality and human health. These days, in most developed and developing countries, solid waste management remain a major challenge for municipalities, administrators, engineers and planners because the ineffective organization of solid waste leads to environmental impacts. In Asia because urbanization and economic development increases, today, the urban areas of Asia produce about 760,000 tons of municipal solid waste (MSW) per day, or approximately 2.7 million m3 per day. In 2025, this amount will increase to 1.8 million tons of waste per day, or 5.2 million m^3 per day. These estimates are conservative; the real values are probably more than double this amount [1].

Development of a modern and effective waste management system cannot be achieved only by the support of public institutions and organizations or through the efforts of industrial and commercial establishments. All parts of society are responsible in this way. Thus, participatory strategies should be developed so as to increase the support and contribution of institutions and organizations such NGOs, professional unions, educational establishments, academic institutions, media, etc. [2]. Studies show success of many environment programs relies almost completely on support among the all of users in the society. Lack of awareness, knowledge and responsibility among generator, untrained workers in industrial health care establishments, municipal corporations and urban local bodies have been the main obstacle in the waste management systems [3]. In general process of decision making for solving an environmental problem, public awareness and people participation is very necessary especially for developing countries. Environmental education is an essential part of environmental programs; its aim is to prepare the individual and society for the task of protecting the environment by raising their level of environmental knowledge, awareness, understanding, responsibility and ethics [4]. The improvement of people's awareness as waste generator is important for reducing the environmental problems. Creating public awareness, understanding, willingness and motivate all concerned (those who are contributing in generating waste & victim of improper waste management) to follow the instructions for waste management be a very efficient instrument to avoid and minimize waste generation and the harmful effects of waste [5]. Public education is important step in achieving the goal of public involvement in waste minimization. In order to have an efficient and well-functioning waste management system it is most important that the public understands and accepts the system and supports it. [6]. "Public refers not only to private citizens but institutions, civil society, labor unions, the government, public officials, industrial, agricultural and trade associations, scientific and professional societies, environmental, educational and Health associations and other minority groups"[7].

In recent years, various studies have done about public awareness regarding different environmental issues by Alavi Moghaddam and Delbari, 2009 [8]; Ifegbesan, 2009 [9]; Arba'at et al., 2010 [10]; Dolnicar et al., 2011 [11]; Dewaters and Powers, 2011[12], Azadegan and Alavi Moghaddam, 2012 [13].

This paper attempts to evaluate the level of awareness of the community about waste management in Robat-Karim city and analyzing the information, to create awareness that those who are in the field of environmental management may put all hands on deck to plan waste management based on education all concerned.

2. Methodology

2.1. Area Information

The study covered an area of 329 km^2 with a population of about 115000, the entire Robat-Karim city in Tehran province, Iran (Fig. 1). It is located at south-west part of Tehran, situated at latitude 51°4′, and a longitude 35°28′ [14].

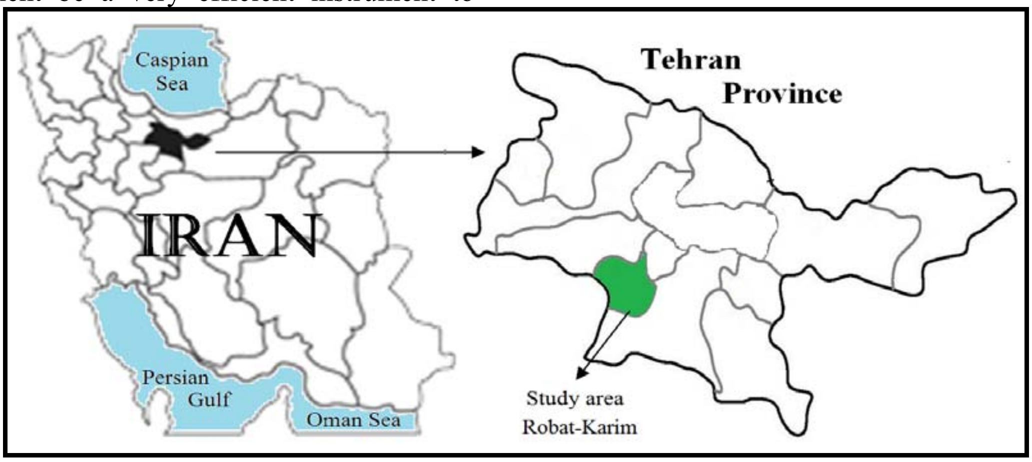


Figure 1. *Location of Robat-Karim city in Tehran province, Iran*

With the continued improvement of health facilities and employment opportunities, percentage of increasing population be expected to increase. Largely because of the increasing migration from rural to urban areas, cities are expanding at an extraordinary pace and the result of this growth is increasing volume of waste generation. According to the information obtained from different organizations like Robat-Karim's Health Center and Water & Sewage Company, the per capita waste generation is assumed 1.5-2 kg per day irrespective of whether it is urban or rural.

2.2. Data collection

With the potential for large sample sizes, questionnaires make it easier for the researcher to generalize their finding data from the sample to the target population. Therefore, the necessary data and information was obtained from the mentioned questionnaire form that distributed randomly among persons (13-60 years old) in the study area. This questionnaire is designed to estimate the level of awareness of waste management. The statistical methods used in this research consisted of descriptive statistics of frequency count, percentage, mean and standard deviation and carried out during summer 2011. Other statistical methods employed included Chi-square, T-test and Pearson product moment correlation in order to determine the significant difference or relationship between some people's background variables and their awareness and practices of waste management. The size of the population sample is one of most important aspects of this type of research study because it determines the reliability of the results obtained. Based on statistic methods, equation (1) and population of city, total sample calculated [15].

$$n = \frac{Nz^2pq}{Nd^2 + z^2pq} \tag{1}$$

N is the total population (115000); *d* is the error of estimation (0.05); *z* is the sampling interval (1.96); *p* is the probability that an event will take place; q is equal to 1-p; and p=q=0.5. As a result, the optimal sample size was calculated to consist of at least 384 individuals [16].

In this study participant were asked to complete the survey questionnaires which consisting 10 questions about awareness of waste management. The information of questioned individuals has been represented in Table 1. Responses to the questionnaire were collected, edited and scored. Nominal values were assigned to the items according to scales. Correct answers to questions had an assigned awareness level: 0-2 for "Very Low Awareness"; 2-4 "Low Awareness"; 4-6 "Average Awareness"; 6-8 "Good Awareness", and 8-10 "Very Good Awareness". Analysis of data was performed by the use of Statistical Package for Social Science (SPSS) software. Descriptive statistics such as means and ranges were computed.

Table 1. *Demographic characteristics of surveyed individuals (%)*

Gender	Female		Male		Unknown	
	47.92		50.26		1.82	
Age Groups	> 20	20 – 35	35 – 50	< 50	Unknown	
	13.80	63.54	17.97	2.60	2.08	
Educational Level	Less than diploma	Diploma	Higher national diploma	B.S. degree	M.S degree and higher	Unknown
	23.18	36.72	20.83	16.15	1.3	1.82
Citizenship	Citizen		Non-Citizen		Unknown	
	92.71		5.47		1.82	

3. Result and discussion

3.1. Descriptive result

In this study, five levels were used as a measure of people's awareness. Table 2 displays the percentages, means and standard deviations of the waste management awareness put on five-point scale. Using the percentages, the item-by-item analysis further reveals that only 2.3% of the people have *Very good* awareness about the waste management in their city but 24% have *Very low* awareness. Therefore, evidence from

© 2012 HSci. ISBN 978-989-98032-0-6

the analysis suggests that the participants are not highly aware in waste management. According to data in Table 2, all the mean scores for the items that measure awareness was 2.31 that it shows average of people awareness is low.

Table 2. *Mean and standard deviation of people's level of awareness*

Level	Very low	Low	Average	Good	Very good	Mean	SD
			(%)				
Awareness	24	36.7	26	10.9	2.3	2.31	1.027

3.2. Inferred results

The data obtained from the questionnaire were analyzed by SPSS software and Chi-Square test T-test and Asymptotic Significance value, are used to investigate the probable relationships between the people's awareness about waste management in Robat-Karim city and 1)"people's gender", 2) "People's age", 3) "people's educational level". Obtained Pearson Chi-Square Value and Asymp.Sig., in the chi-square test to evaluate relationships between above-mentioned items has been reported in Table 3. The chi-square analysis presented in Table 3, showed that the calculated 'asymptotic sig.' value or same 'p-value' was equal to 0.88 and 0.32 for people's gender and age and this value is more than 0.05, therefore, there is not a rational relationship between awareness and all the people's gender and age. But the people's educational level has a statistical relationship with their awareness about waste management in study area.

Table 3. *Test of significant relationship between people's awareness*

	Awareness		
	Pearson Chi-Square Value	df	sig.
Gender	1.21	4	0.88
Age	13.79	12	0.32
Education	27.18	16	0.04

* Significant at the 0.05

Table 4. *Test of significant difference in people's awareness*

	Mean	SD	t	Sig.
Gender				
Male	2.34	1.03	58.52	0.00
Female	2.3	1.04		0.00
Age				
Under 20	2.21	0.95	62.80	0.00
20-35	2.4	1.02		0.00
35-50	2.2	1.09		0.00
Over 50	2.0	1.25		0.00
Education				
Less than Diploma	2.07	0.94	43.22	0.00
Diploma	2.34	1.05		0.00
Higher National Diploma	2.28	0.98		0.00
B.S. Degree	2.56	1.05		0.00
M.S Degree and higher	3.80	0.84		0.00

* Significant at the 0.05

T-test is calculated to test the hypothesis of no significant difference in people awareness of waste management by their gender, age and educational level. We found significant difference in the awareness respondents based on people's gender, age and educational level.

© 2012 HSci. ISBN 978-989-98032-0-6

Analysis in Table 4 further suggests that male and female had significantly equal awareness. No significant differences are observed in people's awareness according to age group. In order to find the demographic correlates of the waste management variables of people, some demographic characteristics of the people presumed to possibly have a measure of People in the "M.S degree and higher" level of education have significantly higher awareness of waste management than people in other education level. influence on the awareness of waste management Pearson correlation (r) and Pearson Chi-square Value were calculated. The results obtained are summarized in Table 5.

Table 5. *Correlate between people's background variables and awareness*

	Gender	Age	Education	Awareness
Gender	1			
Age	0.104*	1		
Education	-0.082	-0.048	1	
Awareness	0.022	-0.034	0.175**	1

*Correlation is significant at the 0.05 level (2-tailed).
**Correlation is significant at the 0.01 level (2-tailed).

Data in Table 5 reveals that positive and significant associations exist between awareness of waste management and some of the people's background variables such as gender ($r = 0.022$, $p < 0.05$) and people's education ($r = 0.175$, $p< 0.05$). In addition, the results shows a negative correlation between awareness and age ($r =-0.034$, $p < 0.05$).

4. Conclusions and suggestions

Results obtained from this research showed that public awareness of people who are living in Robat-Karim city of Tehran about waste management is not in the range of acceptable level. On the other hand, they have little awareness about waste management of their city (about 24% and 2.3% of the individuals have very low awareness and very good awareness of waste management, respectively).

It can be concluded that lack of people's awareness about high waste management can be considered as one of the significant issues in this area. Therefore, it is a main task of the related organizations and universities to promote the public awareness regarding waste management in this area. Effective waste management depends upon the cooperation of the population, and local governments should take measures to enhance public awareness of the importance of MSWM, generate a constituency for environmental protection and promote active participation of users and community groups in local waste management.

There are several ways of raising public awareness on waste issues and providing information on how they can be dealt with. Awareness may be increased through information campaigns, guidelines, TV spots, and Media. Another natural medium for information is the Internet. Designing an Internet site which the public can download the waste management plan is easy and not costly.

5. Acknowledgment

The authors wish to express their thanks to Dr. Mohammadreza Alavi Moghaddan in Amirkabir University of Technology, Tehran, for his assistance during study. In addition, we would like to gratefully acknowledge the staff of Robat-Karim Health Center and Water & Sewage Company for their helpful cooperation for collecting of wells samples

6. References

[1] Hoornweg D, Thomas L, Varma K. What a Waste: Solid Waste Management in Asia, Urban Development Sector Unit East Asia and Pacific Region. EASUR 1999.

[2] Köes H. Ö, Ayaz S, Köroğlu B. Waste Management in Turkey: National Regulations and Evaluation of Implementation Results. Turkish Court of Accounts, Performance Audit Report 2007. http://www.sayistay.gov.tr/english_tca/Performance/TCA_Waste_Management_Report.pdf[2012].

[3] Karnataka. Waste Management Status of Karnatak. State of the Environment Report. Waste Management 2003; 133-152.

http://parisaramahiti.kar.nic.in/SoER%20Karnataka%202003.pdf[2012].
[4] Guidelines for Municipal Solid Waste Management in the Mediterranean Region: Environmental education and Awareness Rising 2003. http://www.medcities.org/docs/15%20Environmental%20education.pdf [2012].
[5] Dhaka Ahsania Mission (DAM), Bangladesh, In Collaboration with Asia/Pacific Cultural Centre for UNESCO (ACCU), Japan. Completion Report: Community Empowerment for Waste Management: Piloting of Planet 3 (Package Learning Materials on Environment, "Waste Management"). Dahaka, Bangladesh 2006. http://www.accu.or.jp/esd/planet/planet3/2004_2005/bangla_final_repot.pdf[2012].
[6] European Commission Environment DG. Preparing Waste Management Plan: Guidance Methodological Note. European Topic Centre on Waste and Material Flows 2003.
[7] Omar Squires C. Public Participation in Solid Waste Managementin Small Island Developing States 2006. http://www.caribank.org/uploads/publicationsreports/staffpapers/SquiresSWMpaper.pdf [2012].
[8] Alavi Moghaddam M.R and Delbari A. Evaluation of undergraduate students' awareness regarding solid waste management in environment. J. of Tech. & Edu. 2009; 3(4): 309-314. (In Persian).
[9] Ifegbesan A. Exploring secondary school students' understanding and practices of waste management in Ogun State, Nigeria. International Journal of Environmental &Science Education 2010; 5(2):201-215.
[10] Arba'at H, Tajul Ariffin N and Suriati S. The status on the level of environmental awareness in the concept of sustainable development amongst secondary school students, Procedia Social and Behav. Sci. 2010, 2: 1276-1280
[11] Dolnicar S, Hurlimann A and Grün B. What affects public acceptance of recycled and desalinated water? Wat. Res. 2011; 45: 933-943.
[12] Dewaters J.E. and Powers S.E. Energy literacy of secondary students in New York State (USA): A measure of knowledge, affect, and behavior, Energy Policy 2011; 39: 1699-1710.
[13] Azadegan M.M, Alavi Moghadda M.R, Maknoon R. Public Awareness of Residents of Tehran City (District 18) Concerning Nitrate Pollution of Drinking Water. 9th International Congress on Civil Engineering 2012 May 8-10; Isfahan University of Technology, Isfahan, Iran .
[14] Robat-Karim 2004. http://www.robatkarim.ostanth.ir/index.php [2012] (In Persian).
[15] Hashemi Parast S. M. Probability & Statistics in Engineering & Science. Khajeh Nasir University of Technology publishing; 2006. (In Persian).
[16] Negahban A. A Guide to Research Through Question Forms, SPSS 11.0. Jahad Daneshgahi, University of Tehran publishing; 2005. (In Persian).

DETERMINING THE PRIMARY SCHOOL 7TH AND 8TH GRADE STUDENTS' PERCEPTIONS OF ENVIRONMENT

Ş. Yılmaz[1], B. Timur[2]
[1]*Abant İzzet Baysal University Faculty of Education, Turkey*
[2]*Çanakkale Onsekiz Mart University Faculty of Education, Turkey*
sirinyilmaz87@hotmail.com, *betultmr@gmail.com*

Abstract. *Advances in technology, population growth, countries in the use of natural resources, unconsciously has become an increasing problem, has led to the environment an increase in value. In this way, revealing an increase in the importance given to environmental issues that have caused environmental problems all over the world. For this reason environmental educators state that students at primary level should be increased emphasis on environmental education more responsive to the environment and demonstrate positive behavior and should be more conscious about environmental issues. In relation to increasing environmental problems and behaviors of individuals are also changing the perception of the environment. Individuals are more conscious attitude towards environmental issues. The aim of this study is to determine the 7th and 8th grade students' perceptions about environment. This study is designed as a descriptive survey model. The study sample was selected as good socio-economic levels in the province of Sakarya in two primary schools, the study consist of 7th and 8th grade 67 female, 82 male for a total of 149 primary school students. Random* *sampling was used in this study. To determine students' perceptions towards environment, "Perception Towards Environment Scale" was used which was developed by Karakaya (2101) and its Cronbach's alpha reliability coefficient was calculated = 0.843. The scale consist of 22 items and it's a 5 Likert-type scale. The data obtained were analyzed using SPSS 13.0. Students grade and their perspectives on the environment compared there was a statistically significant difference. 7th grade students perceptions towards was weaker and weaker nature centered than 8th grade students. When gender and attitude scores considered, female students perceptions towards environment was more nature centered than male students. With the type of books students have read scores compared their perspectives on the environment was not a significant difference. As a result of the analysis students perceptions towards environment does not change according to the type of books that they read.*

Keywords: Perceptions Towards Environment, Environmental Education, Primary School Students.

1. INTRODUCTION

Technological developments, population increase, and unconscious use of natural resources have become an ever-growing problem for countries and these have resulted in an increased value given to environment [1, 2]. Environmental problems that have arisen do not remain limited to the area where they develop, but they spread to larger areas with their effects getting stronger in time, in a way that harms the humanity more [3, 4]. Problems that have arisen as such have led to an increase in the importance given to environmental problems all over the world. Air, land, water, forests and all parts of the biosphere are threatened by these environmental problems. Global warming, climate change, ozone layer depletion, damage to the habitats, extinction of species and a decrease in biodiversity are some the existent environmental problems [5]. Increasing environmental problems affect individuals' quality of life and lead to a change in their perceptions of the environment.

Environment educators emphasize that the importance given to environment education in primary schools should increase and that the students should exhibit more sensitive and positive attitudes towards the environment and be more aware of environmental problems [5, 6]. In the face of these ever-growing environmental problems, individuals' interest in and sensitivity to the environment change. Individuals approach environmental problems in a more conscious way.

2. METHODS

2.1. Research Design

The study we carried out is one whose design is screening model. While [7] defines the screening model as a study that aims at revealing a situation that existed in the past or still exists today, [8] define these studies as ones that determine the participants' features such as their views, interests, abilities or attitudes regarding a situation or an event.

2.2. Population and Sample

The population of the study comprises all the primary school 7th and 8th grade students who are receiving education in the primary schools of Serdivan district of Sakarya province whereas the sample only includes primary school 7th and 8th grade students, a total of 149 students with 67 female and 82 male students, who are receiving education in two of these primary schools that were selected because of their high socio-economic levels. In the overall of the study, the sample was determined through simple random sampling. Simple random sampling is a method in which the units selected by giving each sample an equal opportunity are accepted as the sample [8].

2.2. Data Collection Techniques

The purpose of this study is to determine primary school 7th and 8th grade students' viewpoints about the environment. In this study, to determine the students' viewpoints about the environment, "*Attitudes towards the Environment Scale*" that was developed by [9] and whose reliability coefficient is Cronbach Alfa *a=0.843* was used. The scale contains 22 items and was prepared as a five point likert scale. These points are respectively: I totally disagree, I disagree, I am undecided, I agree and I totally agree.

2.3.Data Analysis

The data obtained were analyzed through SPSS 13.0 package program. Frequency values were used to show the students' distribution by grade and gender; the data obtained were interpreted by using independent-samples t-test and one-way ANOVA in the SPSS program. Content analysis was used during the analysis of the qualitative data.

3. FINDINGS AND COMMENTS

In this section, findings obtained as a result of the analysis that was carried out to answer the problem and the sub-problems are given.

Table 1.a. *Descriptive statistics of Attitudes to Environment Scale*

Grade	N	X	S
7	73	78,75	10,41
8	76	84,27	11,28
Total	149	81,45	11,15

When Table 1.a is analyzed, it is seen that the 8th graders' average points (X=84,27) for their attitudes towards the environment are higher than those of 7th graders (X = 78,75).

Table 1.b. *ANOVA Results of the Students' Points for their Attitudes towards the Environment by Grade Level*

Source of variance	Sum of squares	S_d	Mean squares	F
Between grades	1136,196	1	1136,196	9,657
Within grades	17294,771	147	117,652	
Total	18430,966	148		

*p < .05

According to Table 1.b, in the results of the One-Way ANOVA carried out for independent samples, there is a significant difference between the students' grade levels and their points for their attitudes towards the environment F (1, 147)=3,92 , p < .05). As a result of the analysis performed, the students' attitudes towards the environment vary according to the grade level they are at. 7th graders' attitudes towards the environment are weaker and are less nature-centered compared to those of the 8 graders.

Independent t-test was performed in order to determine whether there is a significant difference between the points for attitudes towards the environment and gender.

Table 2. *Independent t- test results of the Students' Points for their Attitudes towards the Environment by Gender*

Gender	N	X	S_s
Female	67	84,38	10,876
Male	82	79,06	10,873
Total	149		

*p < .05

According to Table 2, when all the students are taken into consideration, , a significant difference was found between the students' gender and their points for their attitudes towards the environment according to the "independent t-test" results performed to determine the relationship between the two(p<.005). There is a significant difference between gender and attitudes towards the environment and this significance difference is in favour of female students (X_{Female}=84,38>X_{Male}=79,06). It can be concluded that the female students' attitudes towards the environment are closer to nature-based approaches compared to those of male students.

Table 3.a. *Descriptive Statistics related to the Books that are Read*

Type of book	N	X	S_s
Novel	85	82,24	11,9
History	26	81,07	11,6
Psychology	6	78,66	5,53
Science-Technology	32	80,18	9,26
Total	149	81,45	11,15

According to Table 3, the most preferred book type that the students read is novel while the least preferred one is psychology.

Table 3.b. *ANOVA Results of the Attitudes towards the Environment by the Read Book Type*

Source of variance	Sum of squares	Sd	Mean squares	P
Between types	155,1	3	51,7	0,746
Within types	18275,866	145	126,04	
Total	18430,966	148		

*p < .05

According to Table 3.b, in the results of the One-Way ANOVA for independent samples, no significant difference was found between the students points for their attitudes towards the environment and the type of book they read (F (3, 145) = 2,68, p > .05). As a result of the analysis carried out, the students' attitudes towards the environment do not vary according to the type of book that they read.

4. CONCLUSION AND SUGGESTIONS

In the study we carried out, primary school 7th and 8th grade students' attitudes towards the environment were investigated. In accordance with the findings obtained, it was seen that there is a significant difference between the 7th grade students' average points for their attitudes towards the environment and those of 8 graders, and that 7th graders' attitudes towards the environment are weaker and are less nature-centered compared to those of the 8 graders. The reason why the 8th graders' attitudes towards the environment are more positive could be that, when all the lessons they have taken so far are taken into consideration, they have taken more lessons related to the environment and participated in more activities regarding the environment. [5] says that it is possible to create awareness in students by attaching more importance to environment education, increasing the activities related to the environment and the lessons with environment-related content.

When gender and points for attitudes towards the environment are compared, a significant difference can be seen between the two, and it can be said that the female students have a more positive attitude towards the environment and are closer to nature-centered approaches compared to male students. In her study that she carried out with university students, [9] stated that the female students had a more positive attitude towards the environment and were closer to nature-centered approaches compared to male students. The findings that we obtained are parallel with those of [9].

When the relationship between the students' attitudes towards the environment and the type of book they read was analyzed, it was seen that the most preferred book type that the students read is novel while the least preferred one is psychology; however, no significant difference was found between the students' attitudes towards the environment and the type of book they read. Among the reasons for this, it can be assumed that the books the students prefer to read are not related to the environment or that they do not have any connection with something positive about the environment. In her study that she carried out with university students, [9] emphasized that there was a significant difference between the students' attitudes towards the environment and the type of book they read and that this difference was in favor of students who preferred to read novels.

In accordance with the findings obtained, in order to gain the students receiving education at different grade levels a more positive attitude and approach towards the environment, suggestions below can be made: environment education in class and outside class, doing more activities whose content is related to the environment, integrating these subjects into discussion environments with the purpose of helping to contribute to the students' developing scientific game and critical thinking skills, and directing the students to read books about the environment.

REFERENCES

[1] SoranH, Morgil İ, Yücel S, Atav E, Işık S. Biyoloji öğrencilerinin çevre konularına olan ilgilerinin araştırılması ve kimya öğrencileri ile karşılaştırılması. Hacettepe Üniversitesi Eğitim Fakültesi Dergisi 2000; 18:128 -139.

[2] Barber N, Taylor C, Strick S. Wine consumers' environmental knowledge and attitudes: Influence on willingness to purchase International Journal of Wine Research 2009; 1:59–72.

[3] Bozkurt O, Cansüngü (Koray) Ö. İlköğretim öğrencilerinin çevre eğitiminde sera etkisi ile ilgili kavram yanılgıları. Hacettepe Üniversitesi Eğitim Fakültesi Dergisi 2002; 23: 67-73.

[4] Oweini A, Houri A. Factors Affecting Environmental Knowledge and Attitudes among Lebanese College Students. Applied Environmental Education and Communication 2006; 5: 95–105.

[5] Yılmaz Tüzün Ö, Teksöz Tuncer G, Aydemir M. An investigation on the elementary teachers' knowledge about air pollution issues. Hacettepe Üniversitesi Eğitim Fakültesi Dergisi 2008; 35: 374-385.

[6] Uluçınar Sağır Ş, Aslan O, Cansaran A. The Examination of elementary school students' environmental knowledge and environmental attitudes with respect to the different variables. Elementary Education Online 2008; 7(2), 496-511.

[7] Karasar N. Bilimsel Araştırma Yöntemi. (21. Basım) Ankara: Nobel Yayın Dağıtım; 2010.

[8] Büyüköztürk Ş, Kılıç EK, Akgün ÖE, Karadeniz Ş, Demirel F. Bilimsel

Araştırma Yöntemleri (4. Basım) Ankara: Pegem A Yayıncılık; 2009.
[9] Karakaya Ç. Antroposentrik (insanı merkeze alan) ve nonantroposentrik (insanı merkeze almayan) yaklaşımlara göre eğitim fakültesi son sınıf öğrencilerinin çevreye yönelik bakış açıları. Yayımlanmamış Yüksek Lisans Tezi; 2010: Ondokuz Mayıs Üniversitesi Fen Bilimleri Enstitüsü.

A MODEL SUGGESTION FOR SUSTAINABILITY EDUCATION: ECOLOGICAL NUTRITIONS EDUCATION

O. Özdemir
Muğla University Faculty Of Education
Science Education Department
oozdemir@mu.edu.tr

Abstract. *The present study aims to develop an educational model to be employed in formal education to impart nutritions patterns complying with ecologic cycles to young generations. The model suggested in the present study is designed for students at the period of elementary education. In the model, in which eating habits are associated with ecologic processes, "consistency", "sufficiency" and "efficiency" principles of sustainability are adopted as the basic parameters.*
Consumption (nutritions) education has become one of the most outstanding areas of environment education. However, in environment education processes followed in our country, there is a lack of research and models which may have help to raise people's consumption awareness. Hence, the model suggested in the present study based on ecologic understanding is believed to make great contributions to theoretical and applied works in the field of sustainability education.

Keywords: *Sustainable education, ecological nutrition, ecological nutrition education*

1. Conceptual Basis and Purpose

The uninformed use of food sources on earth has an important contribution to environmental destruction's reaching to an extent which may threaten the sustainability of the life on earth. Therefore, using every type of resource in compliance with the principles of sustainability; "consistency", "sufficiency" and "efficiency", in today's world where environment education has been extended into sustainability education has gained a special importance [1]. However, in formal and informal education processes in our country, environment education and sustainability education are carried out in separate ways; hence, efficiency can not be achieved in both of these educational fields. Therefore, the present study aims to introduce an educational model to be employed in formal education to help students understand the ecologic and socio-economic effects of food production, processing and consumption activities from a systematic viewpoint and to spread eating patterns complying with the principles of sustainability

2. Pedagogic Processes:

a) Modeling of the Nourishment System:

The term "model" frequently used in educational processes is defined as the representation of real objects, situations and processes [2].In the present study, the relationship between ecological cycles and eating patterns is described as follows on the designed "concept-process" model (Figure 1).

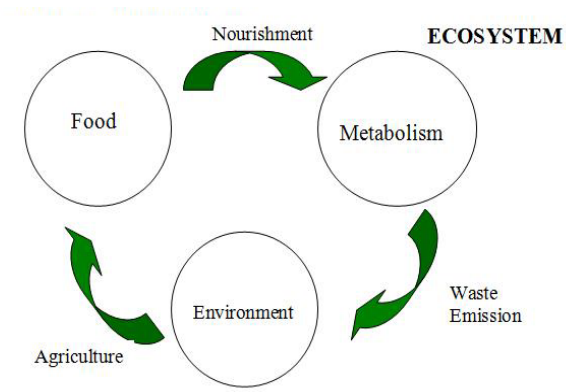


Figure-2. *Nourishment System*

As can be seen in Figure 1, food chain (nourishment systems) extending from the field to the table is an open spiral system consisting of these components "Input", "Process" and "Output". In this system, foods produced in various ways are used by the processes of metabolism and then discharged to the receiving environment as the outputs of the system to be reused. Following deductions can be made in light of this model:

1. Nourishment systems are open systems like ecosystems. The existence and progressing of the

system is determined by the manner of resource use, working processes and reuse of outcomes.
2. Nourishment systems are a part of the ecosystem. As a result, every input to a nourishment system comes from ecosystems, and its outcomes go back to the ecosystems.
3. Therefore, the sustainability of ecosystems depends on the compliance of nourishment systems with the ecosystems.
4. The food resources and outcomes not to be exposed to ecologic recycling lead to chemical accumulation and hence threat the future of ecosystems.
5. In a more general scale, the effects of nourishment systems on human health, environmental health and socio-economy make up a complex system. Hence, something affecting one of them naturally affects the others.

b) Ecologic Nourishment Education Model:
The ecologic nourishment education model developed in the present study is designed in such a way as to include different modules interacting with each other as follows:

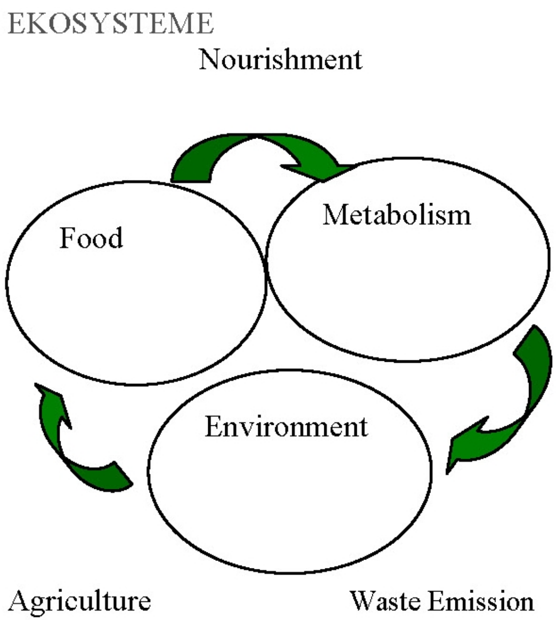


Figure-2. *Nourishment Education Model*

As can be seen from Figure 2, ecologic nourishment education is based on ecology knowledge and understanding. In this respect, first thing to be done is to make general informing about food chain in the ecosystem and ecologic cycle (Module 1), based on this informing, food chain from the field to the table is introduced (Module 2). Then, general information is given about chemical accumulation and deterioration in the food chain (Module 3), and awareness about the multi-dimensional impacts of food preferences are raised (Module 4). In the last phase of the ecologic nutrition education, students are promoted to face their nutritional preferences in relation to their sustainability and "food foot trace" is calculated (Module-5), then students are encouraged to change their current eating habits with those which are more sustainable (Module-6).

3. Results:

In today's world, in general, consumption patterns, and particularly eating preferences are considered to be human activities which are not only important to meet human needs but also important due to their multi-faceted and permanent impacts on the lives of people and societies [3]. Therefore, in the world, though consumption education is integrated with environment education [4], in our country, consumption education and environmental education in formal and informal education are carried out in separate ways. In light of the ecologic nutrition education developed based on systemic approach, examples can be created to be references for other applications that can promote the understanding of the integration between eating patterns and ecologic processes and establish sustainable eating habits.

References

[1] **Özdemir, O.,** Y. Özkan, Ö**.** Özgen (2006). "Biotechnological Foods-Sustainable Development: Sustainable Consumption Education", *Issues on Research on Education,* Ed. Marina-Stefania Giannakaki, Gregory T. Papanikos, Yiannis Pozios & John Kelvin Richards, Atiner, Athens, Greece, ISBN: 960-6672-09-3, p. 303-313
[2] Harrison A.G., & Treagust 2000, Typology of School Science Models. International Journal of Sc. Education**,** 22(9),1011-1026.
[3] Gardner, Gary ve Assadourian, Erik (2004). "Günümüzde Tüketim"_Dünyanın Durumu 2004. Özel Konu: Tüketim Toplumu."Sürdürülebilir Toplum İçin Worldwatch Enstitüsü Raporu" Çeviri: Ayşe Başçuı Sander. Sayfa: 3-21; Safa Tanıtım ve Matbaacılık, İstanbul
[4] Blattner, B. (1998). "Umwelt, Gesundheit und Ernährung." Umweltbildung: theoretische Konzepteempirische Erkenntnisse, praktische Erfahrungen. Ed.:

Beyersdorf, M., Michelsen, G. und Siebert, H. WilhemkAdam, Heusenstarnm, Dortmund.

THE EFFECT OF ECOLOGY BASED ENVIRONMENT EDUCATION ON NATURE PERSPECTIVE OF PARTICIPANTS'

H.G. Ozdilek[1], S.Y. Ozdilek[2], S. Usun[3], E.O. Berberoglu[4]
[1]*Canakkale Onsekiz Mart University Faculty of Engineering & Architecture, Dep. of Environmental Engineering, Turkey*
[2]*Canakkale Onsekiz Mart University Faculty of Sciences and Arts, Dep. of Biology, Turkey*
[3]*Mugla University Faculty of Education, Dep. of Educational Programs and Teaching, Turkey*
[4]*Canakkale Onsekiz Mart University Faculty of Education, Dep. of Science Education, Turkey*
g_ozdilek@yahoo.com, syalcinozdilek@gmail.com, Cahitusun@gmail.com, emelokur17@gmail.com

Many problems related to nature have become because of overexploiting of nature by human. Education is one of the ways of getting rid of these problems. The aim of this study is to determine effect of outdoor education on nature perspective of the participants'. The data is collected over a TUBITAK project the name of which '108B023, Ecology Based Nature Education at Canakkale and Suburb' and 27 people participate in this project. Two-theme questionnaire (awareness and biodiversity) is prepared, and the questionnaire is applied as pretest and posttest. Total scores of pretest and posttest, and total scores of each themes are compared using the Wilcoxon Signed test, and there are statistically differences between scores ($p<.05$).

THE EFFECT OF THE SCIENCE AND TECHNOLOGY COURSE INTEGRATED WITH CARTOONS ON STUDENTS' ACHIEVEMENT AND ATTITUDES

E. Cetin[1], E. Hacieminoglu[1], M. Pehlivan[2]
[1]*Suleyman Demirel University, Turkey*
[2]*Elementary Science Education Necmettin Erbakan University, Turkey*
cetin_3200@hotmail.com, ehacieminoglu@gmail.com, palamutmustafa@yahoo.com

The purpose of this study is to investigate the effect of science and technology course integrated with cartoons on students' achievement and attitudes. Design of this study is pre-test, post-test experimental design. The sample of this study is 64 seventh grade students in one of the public elementary school in Isparta. Control group (n=32) and experimental group (n=32) were randomly determined. Same teacher thought topics in 'Human Being and Environment' unit for both control and experimental group. In both group teacher thought her lesson according to the 5E model of the constructivist approach, in addition to this in experimental group teacher enriched courses with cartoons related to environmental concepts. Children's attitude towards the environment and knowledge scale (CHEAKS) developed by Leeming and Dwyer (1995) was applied to both of the groups before and after application. CHEAKS was translated and adapted in to Turkish by Alp, Ertepinar, Tekkaya ve Yilmaz (2006) and cronbach's alpha coefficient of the was reported as 0.92 in its Turkish version. Data were analyzed by using SPSS program. Independent sample t test results showed that there is no statistically significant difference between control and experimental groups with respect to attitude ($p=.61$) and achievement ($p=.89$) before the application. Paired sample t test was conducted to investigate if there is significant difference between pre-test and post-test scores for experimental and control groups with respect to attitude and achievement. Results showed all significant difference between pre-test and post-test scores for both experimental and control group with respect to attitude and achievement. When it was compared post test scores of experimental and control group, results

revealed statistically significant difference between experimental and control group with respect to achievement (p=.00) and attitude (p=.00).As a conclusion, using cartoons in science courses, will increase the academic achievement and will provide contribution to their attitudes.

Keywords: Cartoon, Environmental Knowledge, Environmental Attitude.

SCHOOL STUDENTS' ATTITUDES AND OPINIONS ABOUT BIODIVERSITY LOSS

D. Soysal, A. Kılınç
Ahi Evran University, Kirsehir, Turkey
soysaldavut@hotmail.com,
akilinc@ahievran.edu.tr

Biodiversity is the diversity of genetical sources, species and ecosystems in water and land environments. There is a fast biodiversity loss (BL) due to the anthropocentric activities in last decades. Therefore, it is crucial to understand individuals' awareness, ideas and attitudes about BL in order to develop permanent solutions. In the present study, primary and secondary school students' ideas and attitudes towards BL were investigated. 'Ideas and Attitudes towards Biodiversity Loss' scale, which was developed using semi-structured interviews and the scales in existing literature, was utilized as data collection tool. 290 students in Ankara (an industrialized city) and 422 students in Kırşehir (a nonindustrialized city) constituted the purposeful sample. In data analysis, it was used descriptive statistics such as percentage and mean as well as inferential statistics such as explaratory and confirmatory factor analysis and Mann-Whitney U tests. The study showed that students possessed high level of concerns regarding BL. The girls were more anxious about BL than boys, whereas more boyes than girls agreed that technological solutions would resolve the problems about BL. In addition, the city factor (industrialized-nonindustrialized) did not exert influence on students' attitudes. Students presented global warming and acid raining as main reasons of BL. The collapses in food chain and natural balance were the main results of BL. They also considered that recyling and planting trees would stop BL.

Keywords: Biodiversity, biodiversity loss, environmental education, students, idea, attitude.

DO THEY REALLY ENVİRONMENTALLY FRİENDLY? STUDENT SCİENCE TEACHERS' SELF-EVALUATİONS ABOUT THEİR PERSONAL PROENVİRONMENTAL BEHAVİOURS

A. Kılınç, Ü. Demiral
Ahi Evran University, Kirsehir, Turkey
akilinc@ahievran.edu.tr,
udemiral@ahievran.edu.tr

There is a concensus about the fact that science teachers' attitudes and behaviours about the environment influence their students' reactions to environmental issues. Therefore, many science teacher training policies around the world target an environmentally friendly teacher generation. However, we believe that most of these policies are based particularly on behaviouristic perspectives and do not present oppurtunities for science teacher educators as to how to reach these learning outcomes (behaviours). In addition, these policies are most commonly produced without the inputs of student science teachers who are main target groups of any science teacher education policy. We have strived to test the success of such a policy which is currently implemented in a Turkish context in the present study. An open-form questionnaire including six parts such as personal information, personal proenvironmental behaviours (PPBs), the benefits of PPBs, the frequency of PPBs, the reasons of exhibiting PPBs, and the factors that would enhance PPBs has been used as a data collection tool in this qualitative research. Totally 30 student science teachers in year 3 at a Turkish university have first written ten PPBs in the blank area in second part and continued to writing their compositions, responding the open-ended questions representing remaining parts. A content analysis approach has been adopted for data analysis. The results about first four parts in the questionnaire would be presented in this presentation. According to preliminary analysis about second part, we can say that 'to protect green areas and try to extend them' (n= 30), 'not to litter' (n=29), 'to save water' (n = 26) and 'to save electricty' (n=24) have been popular PPBs that are presented by student teachers. In addition, 'to protect animals' (n=3) and 'to attend environmental organizations' (n=2) are the PPBs that are considered by least numbers of student teachers. Interestingly, a few participants (n=3) have considered 'not to take alcohol' as a PPB. Furthermore, some participants emphasized the importance of some actions that are not personal behaviours such as 'to filter factory's smoke' (n=7). These results and others would be discussed using existing literature about environmental literacy, cost theory, misconceptions, knowledge types, gender issues and the gap between knowledge and behaviour.

Keywords: proenvironmental behaviours, self-evaluations, student science teachers.

OUTDOOR EDUCATION IN ECO-SCHOOLS PROGRAM: TURKISH PRACTICE

G. Cebesoy[1], I. Civan[1], G. Teksöz[2]
[1]Türkiye Çevre Eğitim Vakfi, Ankara, Turkey
[2]Middle East Technical University, Faculty of Education, Çankaya, Ankara, Turkey
ekookullar@turcev.org.tr, gtuncer@metu.edu.tr

This study targets to discuss outdoor education practice in Turkey as far as environmental education and education for sustainability are concerned. For this target, we have concentrated on the eco-schools program, based on its definition: Eco-schools is a program implemented in elementary and early childhood education levels to develop environmental awareness and to foster education for sustainability. The study, therefore, is based on the eco-school projects implemented throughout Turkey. We have focused on 35 "good" eco-school projects implemented in the elementary level in all over Turkey in the year 2010-2011. "Good"projects, however, have been determined by TÜRÇEV (Environmental Education Foundation - Turkey) based on several features (such as the prevalence, applicability, currency, etc.) of Project Action Plans. After examining 35 good projects, looking for outdoor education activities, we have end up with 31 of them. Among these 31 eco-school projects with outdoor education activities, 8 of them are related to solid wastes, 10 of them are related to energy, 6 of them are related to water, 3 of them are related to biological diversity, 1 of them is related to climate change, 2 of them are related to genetically modified organisms and 1 of them are related to technology and environment. Outdoor activities realized in the context of these projects are categorized into 3 groups, as; a. visiting activities, b. touching the nature activities and c. social activities. Most of the outdoor education activities in eco-school projects are visiting activities; such as visiting a landfill area, water treatment plant, a governmental authority, museums, exhibitions, etc. A few of the projects, however, are the ones require students touch the nature, such as tree planting, bird watching, composting in the school garden. And a small number of outdoor activities in the eco-schools projects are in the form of social performances, such as organizing meetings with the parents to share students' ideas related to environmental problems, participating tree planting activity, organizing photography contest and exhibition, visiting another school, etc. It is inferred as a conclusion that, although outdoor activities seem as a part of the eco-school projects in Turkish eco-schools, they need to be developed to meet the requirements of outdoor education. We therefore, think that we, educators, may feel responsible and organize seminars or in-service training projects to develop teachers' knowledge and practice on outdoor education. This is required for an effective environmental education and education for sustainable development, thus a sustainable future.

THE EFFECT OF NATURE EDUCATION PROGRAM ON ELEMENTARY SCHOOL STUDENTS' ENVIRONMENTAL LITERACY: KNOWLEDGE, AFFECT, COGNITIVE SKILLS AND BEHAVIOR

M. Erdoğan[1], N. Erentay[2], S.G. Çakır[1]
[1]Akdeniz University, Educational Sciences, Antalya, Turkey
[2]Erentay Eğitim Danışmanlık, Ankara, Turkey
mmerdogan@gmail.com, nirentay@gmail.com, glfmcakir@gmail.com

The purpose of this study was to assess elementary school students' environmental knowledge, affect, skills and behavior which are the main components of environmental literacy. The sample consisted of 45 students (25 males, 20 females) studying in 4th through 8th grades and living in Orphanage in Antalya. Various data collection instruments were used for assessing students' different outcomes before and after summer nature education program. The open-ended responses were subjected to content analysis whilst the responses to Likert type scale were subjected to statistical analysis. The results revealed that students' environmental knowledge, environmental sensitivity, intention, environmental attitudes and responsible behaviors significantly increased after summer education program. On the other hand, even though students' cognitive skills increased from pre-test to post-test scores, this increase was not statistically significant.

Keywords: Nature education, environmental literacy, elementary school.

TEACHING SCIENCE THROUGH ENVIRONMENTAL EDUCATION: NO CHILD LEFT INSIDE

S.S. Daudi
Aga Khan Education Services, Pakistan
Clifton, Karachi-75600, Pakistan
Sabihad@msn.com, *sabiha.daudi@akesp.org*

Formal education taught in schools and other diploma granting institutions focuses on providing factual knowledge and mastery of contents in a given period of time. This learning process can be further strengthened if a direct and hands-on approach is used to teach subjects like science and environmental education. Educational research shows that if a direct method is used to teach these subjects, learning is more readily internalized and enhanced. Non formal education through environmental education or experiential education can provide such an opportunity to formal learners.

This interactive presentation focuses on utilizing the outdoors as a channel to teach core subjects such as science and social studies and including environmental education and experiential education as the base to work from. Specific tools and techniques will be shared with the participants in order to make them well versed with the concepts. The presenter will also collect similar experiences and case studies from the participants and develop a short document for the conference organizers to record the findings. This document can later be used by teachers to develop teaching methodologies and lesson plans.

A detailed article will also be submitted for the conference proceedings giving goals, objectives and assessment methods of at least three specific activities on wild life, forests, and pollution linking them to teaching of science using the hands-on approach.

PRESERVICE SCIENCE TEACHERS' ATTITUDES TOWARD RENEWABLE ENERGY

M. Özel[1], K. Bilen[2], A. Sürücü[3]
[1]Nigde University, Nigde, Turkey
Kahramanmaras Sutcu Imam University, Kahramanmaras, Turkey
Pamukkale University, Denizli, Turkey
muratozel@nigde.edu.tr, mozeltr@gmail.com, kadirbilen@gmail.com

Renewable energy is one of the new issues that represent an evolving area of scientific and technological innovations in the twentieth century. The purpose of this study was to investigate preservice science teachers' (PSTs) attitudes toward renewable energy. A total of 200 preservice science teachers were participated to the study. To gather the data, a survey including 39 likert type items was administered to preservice science teachers to investigate the PSTs' attitudes toward renewable energy. The results obtained from this study indicated that, in general, the PSTs attitudes toward renewable energy were negative. Furthermore, it was found that there are some differences in the PSTS' attitudes in terms of classroom, gender and teaching level. Implications for teaching and further research are discussed.

Keywords: preservice science teachers, renewable energy, attitude.

USING OF THE MEANINGFUL FIELD TRIP AT RENEWABLE ENERGY SOURCES TOPIC: APPLICABILITY ON SCIENCE EDUCATION AND EFFECTS OF STUDENTS' LEARNING

H.S. Tortop
Bulent Ecevit University, Eregli Faculty of Education, Science Education Department, 67300, Zonguldak, Turkey
hasansaid@yahoo.com

Nowadays, many countries have given attention to renewable energy resources (RERs) due to economical and ecological aspect. But, utilization of RERs is not enough yet. Education is important factor for increasing of awareness of RERs. Teaching of RERs especially Solar Energy Applications (SEAs) for Turkey, with new learning strategies and as connected with life, is important for realizing expected educational goals. The field trip (FT) is defined as an excursion away from the physical classroom accompanied with teacher. FTs are an important component, or teaching methodology, of an educational program. FTs are usually taken to provide students with opportunities that they do not or cannot receive in the classroom. Meaningful field trip (MFT) is that the field trip has been designed as to 5E learning cycle model by Kisiel (2006). Applications of MFTs activities at SEAs have been carried out by Tortop et.al. (2007) and Tortop (2010, 2012) with primary and secondary school level of students in Research and Application Centre at Renewable Energy Research of Suleyman Demirel University, at Isparta city of Turkey. The aim of this research is to show how effectively conducted the MFT and effects of student's attitude, achievement and so on.

In this study, the MFTs activities were exemplified. And then discussed effects of the MFTs activities on students' achievement, learning RERs and attitudes towards SEAs. According to the MFTs designed on SEAs topic for Solar Chimney Application (SCA), there are five stages. First stage (engagement); teacher asks questions to students about SCA, what is this? And how SCA work? So, students will be curious on SCA. Second stage (exploration); teacher wants to investigate SCA. Third stage (explanation): Students discuss on working principals of SCA. Teachers correct misunderstanding of SCA. This stage, expert of SCA also additionally answer questions of students. Fourth stages (elaboration): Teacher asks to students how will be best working conditions of SCA?, how can be the best application of solar energy production? and they discuss. Fifth stage (evaluation): Teacher assesses knowledge of students on SCA.

In the literature, the MFT activities are very enjoyable and instructive. It provides permanent learning, and it help for students getting project idea at project based learning.

Keywords: The Meaningful Field Trip, 5E Learning Cycle Model, Renewable Energy Sources, Science Education.

ROLE OF THE FAMILY ON ENVIRONMENTAL CONSCIOUSNESS IN CHILDREN

A.H. Güdük
Yalova University, Çınarcık Vocational High School, Department of Child Care and Youth Welfare, Cinarcik, Yalova, TURKEY
ahguduk@hotmail.com

The human life is based on various balances. Of these, the most important one is the balance which the people establish with their social environment. Environment is a stage or a condition where all the creatures exist and carry on their vital activities. Life is a product of the environment where the creatures exist. So, change of the environment by the natural causes or various human interventions has an effect on all the vital activities in that area on an equal basis.

The individuals who are effective about the occurrence of the environmental problems need to be raised their awareness about what they are responsible for to solve these problems. The protection of the environment is only possible by education and awareness-raising of the individuals who affect it. Also, one of the suitable environments for environmental education is family. It is not wrong to say that child' first environment education occurs with the help of intra-family education and observational learning. Environmental consciousness can be considered as a part of general social sense of responsibility in child. Children who are not conscious and not educated about this issue cannot think that the world which he exists will also be used by other individuals later. Information which is obtained from family, social environment and mass communication is as important as education in the school.

In this study, family which plays a great role for children in learning life and children' contribution to environmental education are researched.

Keywords: Child, Family, Environmental Consciousness, Environmental Education.

THE EFFECTS OF SAVE OUR SPECIES (S.O.S.) PROJECT ON PRIMARY SCHOOL STUDENTS' KNOWLEDGE, SKILLS, ATTITUDES AND BEHAVIORS REGARDING THE ENVIRONMENT

N. Erentay[1], M. Erdoğan[2]
[1]*Erentay Education Consulting , Ankara, Turkey*
[2]*Akdeniz University, Antalya, Turkey*
nirentay@gmail.com, mmerdogan@gmail.com

The purpose of the study is to investigate the effects of S.O.S. Project on the development of 4th to 8th grade students' knowledge, attitudes and skills regarding the environment. The participants consisted of 5th to 7th grade students from 28 Primary Schools voluntarily joined in S.O.S. Project from several regions of Turkey. A survey instrument including six parts as (1) Demographic Information Test (9 items), (2) Environmental Knowledge Test (16 items), (3) Scientific Process Skill Test for the Environment (two parts, 9 items), (4) Attitude Questionnaire on Endangered Species (11 items), (5) Attitude Questionnaire for Threatened Environment (9 items) and (6) Behavior Questionnaire on Endangered Species and Threatened Environment (2 items). All tests were administrated to the students at the beginning (pretest) and at the end (posttest) of the Project. The data was collected in 2011-2012 academic year. We are in the process of analyzing the data. The results along with the corresponding discussions will be shared during the presentation

Keywords: SOS Project, knowledge, skills, attitude and students.

STUDENT VIEWS ABOUT GARDEN BASED EDUCATION MODEL WITH AGRICULTURAL PRACTICE

N. Somuncu Demir[1], İ. Dökme[2]
[1]Abant İzzet Baysal University, Turkey
[2]Gazi University, Turkey
ncsomuncu@gmail.com,
ilbilgedokme@gazi.edu.tr

Elementary school students who attend schools with formal learning environments want to live an experience in authentic occasions where they apply their knowledge in theory, develop research skills and they are motivated on the basis of society. Especially researches which is studied in the agriculture, food and field of natural resources are kind of opportunity to acquainted with the nature of real life. In this context, environment and agriculture which may be considered closely with each other are intertwined two concepts because of the harbor common variable dynamics which is often affecting. Today, many researchers consider that the environmental problems correlate with wrong agricultural practices. So they make a consensus on the base of sustainability paradigm with the implementation of agricultural and environmental education programs in order to create awareness and sensitivity. At this point in our country is very high agricultural potential but in this field has minute amount studies. So the purpose of this study which thought to fill the gap is examine the effect of the garden based education model which is enriched with sustainable agricultural practice on secondary school students environmental awareness. The research methods are mixed method where quantitave and qualitative data collection methods are used together. In this study only qualitative parts was covered. The participants of this research included 18 elementary students who were 7th grade in Gazi Osman Paşa Elementary School which is located in the center of Tokat. According to research findings, it was found out that the application of agricultural activities has a positive effect on student sustainable environmental attitudes and awareness. They state that in the practice process they feel happy so they movie the agricultural applications to their families.

A STUDY OF PRE-SCHOOL CHILDREN'S PERCEPTION OF THE SCHOOLYARD THROUGH THEIR DRAWINGS

G. Salı[1], A. Köksal Akyol[2], G. Baran[2]
Bozok University, Faculty of Education, Turkey
Ankara University, Faculty of Health Sciences, Turkey
gunes.sali@gmail.com, koksalaysel@gmail.com, barangln@gmail.com

Einstein described the environment as "everything that is not me". At early childhood, the environment is almost important for children. The schoolyards of preschool institutions, which support the development of children, are places where they play various games outdoors, using different play elements. However, it has been observed that the backyards of many preschools do not have appropriate developmental properties or they are inadequate to meet the expectations of children. At this point, determining the existing elements in the preschool playgrounds and the elements that children would dream of having is considered important. Thus, the study aimed to examine the similarities and differences between actual schoolyards and children's dream schoolyards by making use of their drawings.
The study group of the research is composed of 182 children attending independent kindergartens and preschool classes of elementary schools in the province of Yozgat. The study used descriptive survey/screening model and the data were collected by means of "Personal Information Form", "Children's Drawings of Their Schoolyards", and "Children's Drawings of Their Dream Schoolyards". In the drawings, the elements of the playgrounds were grouped as fixed play elements, movable play elements, plants, animals, human figures and imaginary elements. To analyse the data, Cramer's V and Chi Square tests were used. The results of the research showed that fixed play elements, movable play elements and human figures in the drawings of the actual schoolyards changed according to the school types children attended ($p<.05$). The degree of this relation was determined to be ($V=.527$), ($V=.240$), ($V=.211$), respectively. Furthermore, it was determined that the plants and animals in the drawings of children's dream schoolyards changed by their

gender ($p<.05$), and the degree of this relationship was found as ($V=.214$), ($V=.188$), respectively. Depending on the results obtained, some recommendations were made.

Keywords: Environment, pre-school education, schoolyard/playground, children's drawings.

EDUCATION FOR SUSTAINABLE DEVELOPMENT: DEFINITION AND APPLICATIONS

B. Yılmaz-Yendi
Middle East Technical University, Ankara, Turkey
Giresun University, Giresun, Turkey
ybahar@metu.edu.tr

As a concept, sustainable development (SD) is relatively recent, both in policy discourse and everyday language, appearing first in Stockholm World Submit on Environment in 1972. It was popularized in a report entitled *Our Common Future* released by the United Nations (UN) in 1987, the so-called Brundtland report (World Commission on Environment and Development [WCED], 1987). Since 1970s, international organizations, governments, municipal authorities, political parties, businesses, labor unions, and non-governmental organizations increasingly have used the terms sustainability and sustainable development (SD). The concept of SD is not unproblematic. This is a growing body of diverse literature on the subject (Jóhannesson, Norðdahl, Óskarsdóttir, Pálsdóttir, & Pétursdóttir, 2011). Fergus and Rowney (2005) point out that the 'meaning of the term has become vague, ambiguous, undefined, and often contradictory'.
Beside, education for sustainable development (ESD) calls for a paradigm shift in education from 'teaching' to 'learning' (Östman, 2010), from transmission to transaction or even transformation. It combines different worldviews and different teaching and learning approaches. Many countries have achieved incorporating ESD into their formal education systems. The fact is that formal education alone does not carry the responsibility for ESD. The non-formal education sector (e.g., nature centers, non-governmental organizations, public health educators, and agricultural extension agents) and the informal education sector (e.g., local television, newspaper and radio) must work in tandem with the formal education sector to educate people in all generations and walks of life (Liu & Constable, 2010).
aThis study attempts to review the historical development of sustainable development and education for sustainable development, teaching and learning of sustainable development in different contexts, and also differences between environmental education and education for sustainable development. It also aims to give examples to some successful applications of ESD in different countries. It is thought that this review study will give important information to people interested in ESD and also helps people gain different viewpoints related to ESD.

Keywords: Sustainable development, education for sustainable development, environmental education.

BRINGING SCIENCE, ART AND NATURE TOGETHER: STUDENTS LEARN TO STEWARD THE EARTH THROUGH S.O.S. PROJECT

N. Erentay
Erentay Education Consulting, 06531, Ankara, Turkey
nirentay@gmail.com

The Save Our Species Project (S.O.S. Project) is an international environmental project focused on endangered species and their local habitats. It is carried out by primary school children through using scientific processes both in schools and on regular field trips to natural areas during the academic year.
The S.O.S Project, targets children aged 9-12 and aims to encourage them to take action to save endangered species and threatened habitats in the vicinity of their schools. All of the studied endangered species are in wetlands or aquatic areas and water quality testing has been used by the students to analyze these habitats.
As well as encouraging children to use scientific processes like questioning, observing, testing, collecting, analyzing and interpreting data obtained in the field and discovering the interrelationships between the elements of the natural world, the S.O.S. Project also aims to

raise childrens' awareness and concern for the problems our environment faces globally. Through the project we hope to grow young environmentalists who will take action and have a say in environmental policies in the present and the future.

A pilot study of the Project was first initiated with a group of 5th grade volunteer students in a Turkish primary school during the 2005-2006 academic year and it has been extended with the participation of several schools in Turkey, Europe and USA since then.

In the 2011-2012 academic year, twenty eight primary schools from several parts of Turkey along with one primary school from Maryland, USA, were involved in the project.

Within the context of the S.O.S. Project, a goal, that has been continuously developed, is to gather the students around the theme of scientifically studying endangered species and their habitats, sharing the data among partner schools, and thus drawing their attention to the significance of taking responsible action globally towards the environment. Through the S.O.S Project, students learn to use their skills in researching the answers to the question of how their local habitat can be enhanced to improve the living conditions of the studied species. The contents of flexible activity plans constructed for the S.O.S. Project and field data are actively shared and discussed by the collaboration of participant schools involved in the project.

The aim of this paper is to present a summary of ongoing developments regarding the S.O.S. Project, share samples of hands on activities that have been implemented, field data and records based on students' findings in nature as part of project's curriculum.

Keywords: Endangered species, threatened habitats, water quality, scientific processes.

THE EFFECT OF ONLINE AND CLASROOM ARGUMENTATION APPLICATION ON THE LEVEL OF PRE SERVİCE SCIENCE TEACHERS' ENVIRONMETAL SCIENCE KNOWLEDGE

P. Fettahlioğlu, M. Aydoğdu
Gazi University Gazi Faculty of Education, Department of Science Education, K-block room B-04, 06500 Teknikokullar Ankara/Turkey
pinardnz@gmail.com, musayd@gazi.edu.tr

The purpose of this study was to examine the effect of online and classroom argumentation applications for development of junior pre service science teachers' environmental knowledge. The study was based upon one group pretest-posttest design. The sample of the study was consist of 34, 3th grade students studying in Gazi University Gazi Faculty of Education science education department in the fall term of 2011-2012 academic year. The data collection tool was the environmental science test developed by the researchers. The test was prepared based upon issues of environmental science in literature and the gains targeted in the environmental science course program for the 3th grade students prepared by institution of higher education. Environmental science test was appliciated to 4th pre service science teachers in total 521, studying in 43 different state universities. These 4th pre service science teachers were determined by using stratified sampling method. The test compromised by 45 five choice articles with selectivity ranging between .22 and .42. As a result of the analyses of the test the KR-20 reliability and standard deviation of the test were determined as .68 and 5.6 respectively. The statistical significance between the pre-and post-test scores of the experimental group was determined by paired samples t-test. The experimental study took 13 weeks. The first week involved the acquaintance with the students and briefing them with the study. In the second week there was an educational plan related to the application of the argumentation application was prepared and applied in a three hour period. In the third week environmental science test was applicated to pre service science teachers as a pre test. The study was started in the fourth week. The study took nine weeks three hours a week. In the thirteenth

week, the students were subjected to test as a post test. The study revealed that there was a significant increase in favor of post-test grades of the students.

Keywords: Teacher Training, Environmental Education, Argumentation.

ENVIRONMENTAL EDUCATION PROJECTS IN SECONDARY BIOLOGY COURSES

E.A. Köksal
Elementary Science Education Department, Niğde University, Turkey

The knowledge gained in the courses related to environmental education at school is effective when the relationship between other courses is established. Since everything is connected with each other in life, at school an interdisciplinary approach should be adopted. For this need, various teaching-learning approaches should be required. One of these different approaches is project-based learning.

Studies showed that the form of assessment drives learning and demonstrated that when used accordingly these activities improve the quality of students' learning level. Therefore, an alternative approaches are adopted in the renewed curriculum instead of the traditional approaches to assessment.

Project-based learning appears to be project, which is one of alternative assessment and evaluation approaches. Project is an examination of what the students do in this process.

Due to the above-mentioned features, project works are appropriate to be used frequently as both a method and measurement technique. However, we encounter the studies related to environmental projects in the research studies of Morgil and her colleagues at the higher education level in our country. They found that the students who prepare environmental projects developed their understanding of environmental knowledge and increased their environmental awareness, and developed environmental attitudes and behaviours.

Due to the advantages of projects on environmental knowledge, awareness, attitudes, and behaviour, it is worthwhile to evaluate project works in Turkish formal education levels. When doing this, secondary biology program was selected because it aims to develop environmentally responsible behaviours and environmentally literate persons.

In order to evaluate the environmental education projects in Turkish biology text-books case study methodology which is suitable to the nature of the problem was used in this study. The evaluation was done with several checklist developed in parallel to the studies related to environmental education, project-based teaching-learning, and project assessment. The first checklist was used to determine on the subject of the project. The second checklist was used to assess the type of the project (whether it is a design, experimental or research project, and whether it is subject related, open-ended, template, or structured). The last checklist was used to determine the assessment of the project and measurement. And this evaluation was done with the help of measurement and evaluation literature.

Document analysis was used in this study to analyse biology text- and program- books, and the writings related to environmental education projects was examined through descriptive analysis.

According to the findings, although environmental subjects are very wide and can also be related to other subjects, the environmental education projects were limited to the unit traditionally considered as environmental related (at the 11th grade for example there was no project given in the unit of Plant Biology), it is likely that this point of view decreased the number of environmental education projects. The projects were mostly found to be in search and find type and in structured form. And the projects were suggested to be evaluated through an analytic rubric. This rubric is found at the end of the books and applicable to all kinds of projects.

Since environmental education is interdisciplinary, there should be a revision of current biology subjects and some biology topics should be related to environmental education.

The type of the projects should be more inquiry oriented and student-centred. If we want our students to make science we should give them the opportunity of hands-on science. To ask students to study an environment will arouse students' curiosity, and convince students that biology is indeed everywhere.

Although the evaluation criteria of the projects are seen as adequate, some extra instruments should be included into the evaluation process by considering the length of the project and the need to student scaffolding, for example project preparation phase should be assessed separately. Project work is a process and students learn differently from their studies, a portfolio assessment should be implemented in this process along with the project evaluation. This will make project evaluation more formative.

Keywords: Environmental education, project, secondary education, biology, Turkey.

HANDS-ON ACTIVITIES / EXPERIMENTS IN LEARNING AND TEACHING

© 2012 HSci. ISBN 978-989-98032-0-6

 ISBN 978-989-98032-0-6

IBSE EXPERIMENTS

J. Trna, E. Trnova
Masaryk University, Brno, Czech Republic,
trna@ped.muni.cz, trnova@ped.muni.cz

Abstract. *Experiments play a crucial role in inquiry-based science education (IBSE), especially in motivation of students. Experiments have to be organically included in IBSE. The objective of this study is to determine roles of experiments in IBSE and to create taxonomy of IBSE experiments. Experiments have different roles and characteristics in the four levels of IBSE: confirmation, structured, guided and open inquiry. Science teachers' professional competence to use experiments in IBSE is an important part of their pre-service and especially in-service training. In European project PROFILES we develop and use science teacher training methods how to implement experiments in IBSE.*

Keywords: Experiment, IBSE, motivation, teacher training.

1. Introduction

Experiments are one of the most important elements of science teaching/learning. Researches ([8], [9]) show that experiments strongly motivate students all ages and different levels of giftedness. It often happens that the motivating potential is not utilized. The result of the experiment implementation is only momentary interest of students that quickly passes without any learning outcomes. Some teachers therefore reduce the amount of experiments. Because of a low number of lessons in curriculum for chemistry or physics experiments are considered ineffective. It is a mistake to give up experiments, but it is necessary to choose an appropriate type carefully and think about its implementation in lessons. This way we can not only encourage students´ interest, but also achieve the acquisition of required knowledge, understanding and skills.

Simple experiments are very important. The simplicity of the experiment lies in the transparent presentation of a natural phenomenon. This simplicity is associated with the use of material from everyday life, which promotes understanding of the phenomenon and allows the student to perform experiments. This way the student can be involved actively in understanding the matter in correspondence with constructivist pedagogical-psychological theories. A constructivist approach to learning sciences is regarded by the majority of researches as more effective than a transmissive one. A longitudinal study of students' "knowledge without understanding" terminated in finding that this "cognitive illness" is the consequence of teaching approaches which do not respect the nature of knowledge and skills acquisition. The motivation and creating a set of concrete experiences of the future knowledge and skills are underestimated in traditional teaching. These problems are solved in inquiry-based science education (hereinafter IBSE).

2. Inquiry-based science education (IBSE)

IBSE as an innovative method is based on an instructional learner-centred approach and integrates theory and practice using inquiry, develops knowledge and skills for a solution to a defined problem. Students are supposed to solve the problem, conduct self-directed learning and co-operate in teams to make their own connection, creation and organization for future application in similar problems. This differs from didactic, lecture-tutorial, teacher-centred approach which focuses only on transmission of knowledge from teacher to students. Teachers in IBSE lessons motivate students to solve problems independently and competently. This call for inquiry-based learning comes from the recognition that science is essentially a question-driven, open-ended process and that students must have personal experience with scientific inquiry to understand this fundamental aspect of science [4]. Moreover, inquiry activities provide learners with a valuable context how to acquire, clarify, and apply an understanding of science concepts. As research results ([2], [7]) show IBSE brings the required competences to society, it is effective and not only increases students´ interest in studying science, but also stimulates teachers´ motivation. It is an effective method for students of all types: from the weakest to the smartest (including the gifted ones), boys and girls, students of all ages.

3. Roles of experiments in IBSE

Experiments play a crucial role in IBSE. Implementation of experiments is necessary for students' inquiry because it brings the possibility to interconnect theory and practice. Students can acquire both hands-on and minds-on experiments.

According to researches, all participants in education recognize the important role of

© 2012 HSci. ISBN 978-989-98032-0-6

experiments. Within the project PROFILES, we implemented a Delphi study [1] where the issue of experimentation was commented by students, science education students at university, trainee science teachers, practised science teachers, trainee science teacher educators, science educators and scientists. Respondents assessed students' motivation in lessons from two perspectives. First, they presented their idea of the significance of experimentation in the part: "The Idea of Experimentation Priorities", where they answered the question "Which priorities should experimentation has in science education?" They expressed their view of reality and their actual experience with experimentation in lessons in the part "The Views of the Real State Experimentation in Teaching", where they answered the question "To what extent is experimentation realized in current science education?" The following tables are the results of this research (See Tables 1 and 2).

All monitored groups believe experimentation should become an integral part of lessons. Interestingly, students (out of all the monitored groups) had the most answers in the lowest priority area when expressing ideas about inclusion of experiments in teaching. Based on additional controlled interviews, we believe that it is connected to poor implementation of experiments in teaching. Therefore, it is essential for teachers to manage not only experimentation, but also correct integration of experiments into teaching.

Table 1. *Experimentation - priorities*

Which priority should experimentation has in science education? *VLP (very low priority), LP (low priority), RLP (rather low priority), RHP (rather high priority), HP (high priority), VHP (very high priority)*						
	VLP %	**LP %**	**RLP %**	**RHP %**	**HP %**	**VHP %**
Students (n=56)	0	4	13	15	41	27
Science education students at university (n=23)	0	0	0	11	56	33
Trainee science teachers (n=24)	0	0	0	0	25	75
Practised science teachers (n=30)	0	0	0	18	55	27
Trainee science teacher educators (n=16)	0	0	0	17	50	33
Science educators (n=28)	0	0	13	5	36	46
Scientists (n=25)	0	4	0	16	40	40

Table 2. *Experimentation - real state*

To what extent is experimentation realized in current science education? *VLE (to a very low extent), LE (to a low extent), RLE (to a rather low extent), RHE (to a rather high extent), HE (to a high extent), VHE (to a very high extent)*						
	VLE %	**LE %**	**RLE %**	**RHE %**	**HE %**	**VHE%**
Students (n=56)	9	18	18	38	13	4
Science education students at university (n=23)	0	33	33	23	0	11
Trainee science teachers (n=24)	0	0	100	0	0	0
Practised science teachers (n=30)	9	19	27	45	0	0
Trainee science teacher educators (n=16)	0	17	32	17	17	17
Science educators (n=28)	12	22	47	12	7	0
Scientists (n=25)	8	36	28	20	8	0

Students also reported that they were presented mostly demonstration experiments, but they prefer their own initiative. Surprisingly, scientists and science educators, as the only representatives of teachers, when expressing ideas about inclusion of experiments, chose one of the options in the low priority area. Trainee science teachers assess the real situation of experimenting the most negatively. All of them expressed their opinion that experiments are included in lessons in a limited number. It is apparent that all groups give experimentation higher priority than it is given in real

© 2012 HSci. ISBN 978-989-98032-0-6

teaching/learning. When drawing conclusions, we realize this is only a small sample of respondents, but in accordance with the theory of the Delphi study, respondents were selected intentionally and verification of the results runs in three steps. Further findings confirm the above-mentioned data. In the final phase of the project PROFILES research results comparing 22 European countries, where the project has been implemented, will be available.

4. Characteristics of experiments in levels of IBSE

Very important students´ activity in all four levels of IBSE is experimentation. Implementation of experiments is crucial for inquiry. Experiments have to be organically included in certain IBSE, what is the main task for science teachers. It is important to use experiments in corresponding IBSE levels. We present characteristics of individual IBSE four levels experiments and examples of the implementation of experiments ([10], [11]).

4.1. Experiments of confirmation inquiry

This level is the first step in inquiry. Students have to learn how to realize inquiry. They should gain practice in experimental skills and specific inquiry skills, such as data collecting, recording, and analysing. Students carry out confirmation experiments following teacher's detailed instructions (often in worksheets) and under his/her direct supervision. The results of experiments are known for students in advance. According the name of inquiry students use experiments to confirm or verify nature laws.

- *Example of experiments of confirmation inquiry:* **Friction 1**.

Students put a paper box without a lid on a horizontal table. There is a string attached to the front part of the box. Students pour sand into the box gradually (at least three times) and by pulling the string they verify the friction force, which prevents the box from motion and grows with the increasing mass of the box. The second part of the experiment is to verify the dependency of friction force on surface roughness of the box bottom and the surface. Step by step students pull the empty box on surfaces of different roughness: plastic wrap, sheet of paper, textile cloth, polystyrene board, abrasive paper (see Figure 1), etc. Students fill in a worksheet with detailed instructions and a table naming the materials of the surfaces. Students check by behaviour of the body and the size of friction force. On this basis, the relevant theory is confirmed experimentally.

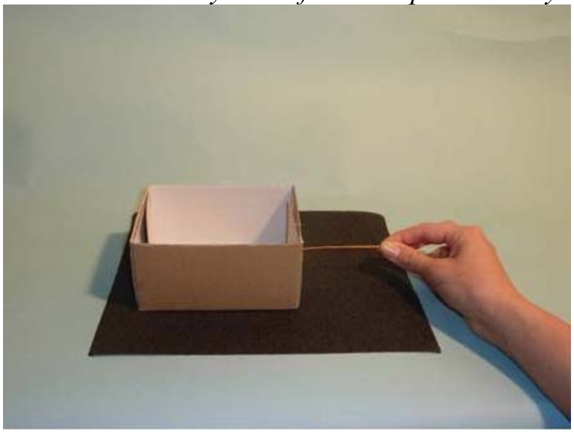


Figure 1. *Friction of a paper box (abrasive paper)*

4.2. Experiments of structured inquiry

Students´ independence is strengthened in the second level of inquiry. The teacher significantly affects the students' inquiry by asking guiding questions and by determining the way of inquiry, students express their creativity in discovering nature laws. The teacher determines the procedure of structured experiments. Unlike the first level, students do not know the results of experimentation, but they have to discover them. Students generate an explanation of solved problem supported by the evidence they have collected using of experimentation.

- *Example of experiments of structured inquiry:* **Friction 2**.

Students discover how quantities of phenomena affect the size of the friction force. They are the size of the interface between the body and the surface, mass of the body and roughness of the interface. In the first part of the experiment the student pulls a wooden cuboid along a horizontal table with constant velocity. The cuboid is attached by a string and is pulled by a dynamometer. The experiment is repeated so that the cuboid is gradually placed on all the three different faces. It was found out that the size of the friction force does not change. In the second part of the experiment a weight is placed on the drawn cuboid, the weight is heavier in the repeated experiment (see Figure 2). The measured friction force is increased with the enlarged mass of the weights. In the third part of the experiment the cuboid is drawn on surfaces with different roughness. The friction force changes with the changing roughness of the interface. In the end it is possible to combine mass and roughness of the interface. Students

© 2012 HSci. ISBN 978-989-98032-0-6

record the behaviour of the body into prepared tables in a worksheet. The final analysis of the bodies leads to the conclusion that their behaviour depends on their mass and roughness of the interface. The aim of this experiment is that the students themselves discover by applicable law.

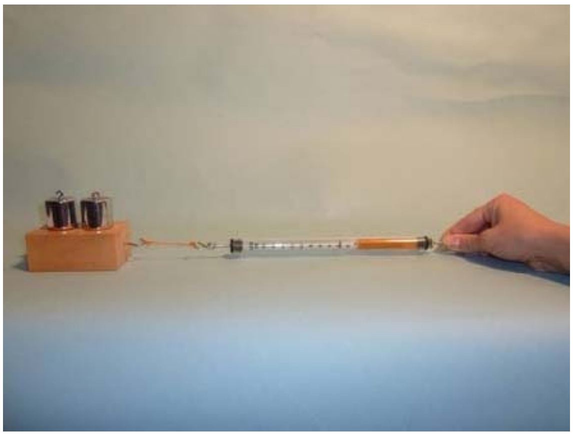


Figure 2. *Wooden cuboid and friction*

4.3. Experiments of guided inquiry

In agreement with the name of the third level, the role of the teacher is significantly changing. The teacher is not a leader of inquiry, but he/she is a "guide of inquiry". He/she only gives and/or cooperates with students in formulation of the research questions, gives advice on planning of experimentation. Students design the procedure of guided experiments to test their questions and the resulting explanations. Outcomes of experimentation are better when students have had a lot of opportunities to learn and practice experimentation.

- *Example of experiments of structured inquiry:* **Friction 3.**

Teachers ask students only a research question. Students do not receive solution procedures and experiments. A common research question might be: "Find the factors and their laws in the behaviour of the body, moving on the surface." Students should seek their own experiments and needed equipment. They discover what quantities influence the size of friction force, if a body is moving on the surface and what is the connection between them: size of interface, mass, roughness (see Figures 3 and 4) etc.

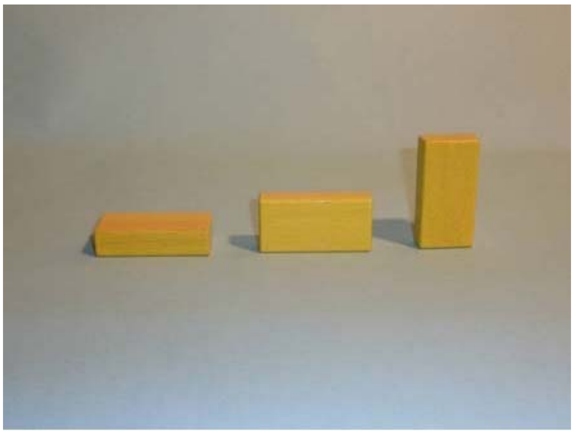


Figure 3. *Three different faces of body*

Figure 4. *Bodies of different mass*

4.4. Experiments of open inquiry

At the fourth level students work independently. Experiments require a high level of scientific reasoning and experimental skills. It is necessary to pass previous levels for acquisition of demanded skills and knowledge. Students should be able to derive questions, design and carry out investigations with experimentation, record and analyse data and draw conclusions from the evidence they have collected [3]. Students form their own research questions, methods and process of research and they carry out open experiments on their own. Open experiments are especially suitable for development of gifted students.

- *Example of experiments of structured inquiry:* **Friction 4.**

Students are almost completely independent. The teacher acts as an implementing partner/consultant. Students are not supposed to specify the research question and experiments explicitly. There are suitable experiments, which reflect a set of phenomena. These include: looking for methods of reducing friction by air

 ISBN 978-989-98032-0-6

cushions (see Figure 5). Students solve problems of useful and harmful friction or friction in transportation, they discover laws of shear and rolling friction and static and dynamic friction. They always derive the results from experiments.

Figure 5. *Body movement on an air cushion*

5. Implementation of IBSE into science teacher training

Teachers' professional development is very important for improving the quality of science teaching. The experience shows no innovation will be sustained unless systematic and ongoing professional development of science teachers is provided to support the changes required in the instruction [5]. Teacher's pedagogical content knowledge (PCK) is created in a long-term and complicated process, therefore it is necessary to start with the preparation for IBSE in pre-service training and continue in in-service training.

Teachers must be thoroughly familiar with IBSE to be able to apply the principles of this teaching on experimentation. To make IBSE experiments effective, it is essential for teachers to acquire some professional competence and specific pedagogy skills. They need to be able to determine what level of IBSE experiments can be used, what knowledge and skills should their students acquire using of experimentation. It is therefore essential to integrate this method into the teacher education programme and continuous professional development (CPD).

Teacher training for implementation of IBSE experiments in education must be complex. It is important to realize that it is necessary to pay attention to several aspects: proper presentation of scientific phenomena, technically flawless experiment implementation, and selection of an appropriate IBSE level and optimal didactic integration of IBSE experiments in teaching. The most attention is paid only to the first two aspects. For IBSE experiments it is very important to keep all the aspects in mind, if IBSE experiments are to fulfil their educational role. The issue of IBSE experiments will be solved in a complex way in the project PROFILES.

Project PROFILES (Professional Reflection-Oriented Focus on Inquiry-Based Learning and Education through Science) is a European project that aims to support teachers in innovation of teaching/learning [6]. Project deals with implementation of IBSE in instruction that could become a common part of school practice. The PROFILES project includes a set of specific educational modules which offer IBSE experiments prepared by experts and verified by teachers experienced in teaching.

6. Conclusions

IBSE is a way which may be taken to increase knowledge and skills of the students in science. Experiments play a crucial role in IBSE because they are beneficial to promoting students´ interest and participation in science activities. The project PROFILES offers such experiments.

Although science school experiments have great educational potential, teachers are not able to benefit from them fully. Therefore it is necessary to search and develop innovative educational methods and techniques including IBSE. It is necessary to implement these new ideas in science teacher training immediately.

We have been living in the time when preparation of individual learning paths for each student has become a hot topic. Therefore, in the future, we will focus on research of experiments in education of students with special educational needs, including gifted students.

7. Acknowledgements

The study initiated within the project “PROFILES: Professional Reflection-Oriented Focus on Inquiry-based Learning and Education though Science“(FP7-SCIENCE-IN-SOCIETY-2010-1, 266589) and the Czech project „Special Needs of Pupils in Context with Framework Educational Program for Primary Education“(MSM0021622443).

8. References

[1] Bolte C. A Conceptual Framework for the Enhancement of Popularity and Relevance of Science Education for Scientific Literacy, based on Stakeholders’ Views by Means of a

Curricular Delphi Study in Chemistry. Science Education International 2008; 19(3): 331-350.
[2] Darling-Hammond L, Barron B, Pearson PD, Schoenfeld AH, Stage EK, Zimmerman TD, Cervetti GN, Tilson J. Powerful Learning: What We Know About Teaching for Understanding. San Francisco: John Wiley & Sons Inc., by Jossey-Bass, a Wiley imprint; 2008. Edutopedia. [12/31/2001]
[3] Hofstein A, Navon O, Kipnis M, Mamlok-Naaman R. Developing Students Ability to Ask More and Better Questions Resulting from Inquiry-Type Chem. Laboratories. Journal of Res. in Sc. Teach. 2005; 18: 791-806.
[4] Linn MC, Songer NB, Eylon BS. Shifts and convergences in science learning and instruction. In: Calfee R and Berliner D, editors, Handbook of Educational Psychology. New York: Macmillan; 1996.
[5] Osborne J, Dillon J. Science Education in Europe: Critical Reflections. London: The Nuffield Foundation; 2008. http://hub.mspnet.org/index.cfm/15065 [15/1/2012]
[6] PROFILES. http://www.profiles-project.eu/cms_profiles/ [15/8/2012]
[7] Rocard M, Cesrmley P, Jorde D, Lenzen D, Walberg-Herniksson H, Hemmo V. Science education NOW: A Renewed Pedagogy for the Future of Europe. Brussels, Belgium: Office for Official Publications of the European Communities; 2007. http://ec.europa.eu/research/science-society/document_library/pdf_06/report-rocard-on-science-education_en.pdf [15/1/2012]
[8] Solomon J. Teaching Children in the Laboratory. London: Croom Helm; 1980.
[9] Trna J. Motivation and Hands-on Experiments. In: Selected Papers on Hands-on Science. Braga, Portugal: Associacio Hands-on Science Network, Vila Verde, Portugal; 2008. p. 221-230.
[10] Trna J. Využití IBSE ve výuce fyziky. In: Veletrh nápadů učitelů fyziky 16. Olomouc, Czech Republic. Olomouc: UP Olomouc; 2011. p. 237-245.
[11] Trnova E, Trna J. Hands-on experimental activities in inquiry-based science education. In: Proceedings book of the joint international conference MPTL'16 - HSCi 2011; Ljubljana, Slovenia. Ljubljana: University of Ljubljana; 2011. p. 293-298.

PLAYING WITH WATER AND PHOTOVOLTAICS: A SERIOUS GAME AT THE DEVELOPING WORLD

J. Diz-Bugarin[1], M. Rodriguez-Paz[2]
[1]*IES Escolas Proval, Av. Portugal 171, E36350 Nigran (Spain)*
[2]*IES Valadares, Av. Clara Campoamor s/n, E36315 Vigo (Spain)*
javier.diz@edu.xunta.es, montserpaz@edu.xunta.es

Abstract. *This paper presents the process of design and realization of an educational experience about the use of photovoltaic energy to provide water for human and agricultural use. The experience has been made on occasion of the declaration of 2012 by United Nations as International Year of Sustainable Energy for All. The paper explains the materials used and the activities that have been carried out for students of different levels and public in general.*

Keywords: Photovoltaic Energy, Water Supply, Education.

1. Introduction

The Alhambra of Granada (Fig. 1) is considered one of the marvels of the ancient world. Since its construction many centuries ago, billions of litres of water came from nearby mountains of Sierra Nevada (where snow lasts almost until summer days) to feed its numerous fountains, pools and water channels. And without a litre of gas, oil or coal, only powered by solar energy. Besides its architectural and artistic value, the Alhambra should also achieve the title of Sustainable Marvel of the World.

As another example, the Roman Empire can be considered a Zero-Emission Civilization, since it was only powered by renewable sources like sun, wind, biomass and bee wax or vegetable oil for lighting. Fig. 2 shows a “renewable lamp” known as *lucerna* at Merida and a saltwork (Salinae Museum, Vigo, Spain). Structures like the well known *Acueducto de Segovia* (Spain) are good examples of sustainable hydraulic engineering, but many other examples can be easily found around the world.

Figure 1. *Alhambra (Granada, Spain)*

Figure 2. *Roman Lucerna and Saltworks*

Modern technology should take example of these ancient developments that in many cases are still in use. But in another cases modern technology can provide better solutions to improve the life of persons, like photovoltaic lighting and water pumping in desert areas where there are no mountains or rivers. This paper presents an educational experience that shows the relationship between solar energy, water supply and sustainable development on occasion of the declaration of 2012 by United Nations as International Year of Sustainable Energy for All [1]. The experience has been developed in three stages: the first part is a presentation in which students learn more about the problem of water supply in the world, the second part consists of an explanation of the parts of a solar water system: solar panel, pump, charger-battery, tank. The last part is a solar photovoltaic fountain designed to explain and test in a funny manner concepts of radiation intensity, the importance of angles of incidence, potential energy, water pressure and flow and many others.

2. The presentation

The first part of the activity was a presentation about the problem of water supply in the world and the health consequences of the use of contaminated sources. Audiovisual materials have been used, like a video by Oxfam about Ethiopia [2], a document from WHO with information about water diseases [3] and some images from Wikipedia of bacterias like E. Coli and V. Cholerae [4]. Students felt very impressed by the living conditions of millions children around the world and the huge efforts they make to have fresh water.

3. The solar pumping system

The second part of the activity was a demonstration of a solar pumping system with a 100W photovoltaic panel, a 12V electric pump and a set of pipes and tanks to show how water can be extracted from the ground using solar energy.

Figure 3. *Shurflo 2088 water pump*

Figure 4. *The solar pumping set*

We have chosen a Shurflo pump model 2088-443-144 [5]. This pump (Fig. 3) can be easily adapted to 12V solar systems and has a long operating life. It can be directly connected to a solar panel or a battery for use at night or in cloudy days. To achieve a good performance a 100W solar panel should be used like Photowatt PW6-123 [6]. A lead-acid 7Ah battery can be

© 2012 HSci. ISBN 978-989-98032-0-6

used instead of heavy batteries of real solar systems. For this experience the pipes have been simulated with a garden hose and the well and tank with two plastic containers, one of them at ground level and the other placed at a higher level (over a table or stepladder). Fig. 4 shows the whole set of elements of the solar system, and Fig.5 the system ready for transportation.

Figure 5. *Packed for transportation*

4. The solar fountain

The third part of the activity was a game in which students had to achieve the maximum height of water in a fountain with a small photovoltaic panel.

The fountain has been designed specifically for this experience. In this case a low power pump has been chosen to allow the use of a small photovoltaic panel. Bilge pumps of the type used in small ships were a good choice, and among them we selected the model Rule 500 [7]. This pump has a maximum power of 25W, but can operate with much less power. Nautical pumps have the extra advantage that can be used with salt water and the game can be performed at beach in summer.

A small photovoltaic panel like Atersa A20P [8] is a good option. Its reduced dimensions and weight allow children to move it easily to position it towards the sun.

An important design factor is the relationship between the electrical power of the panel and the pump. To get a proper operation in different weather conditions, the power of the panel should be 1 to 2 times higher than the pump power. In extreme cases a higher power panel can be used, for example the activity has been successfully realized at Chano Piñeiro School (Gondomar, Spain) in a rainy day using a 100W Photowatt panel and the Rule-500 25W pump.

Figure 6. *Structure with pump and hoses*

Figure 7. *Pump and connections*

Figure 8. *Fountain and 3 years old solar researcher at work*

The fountain has been made with garden hoses and standard (and cheap) sprinklers. They were mounted on a structure made of pvc pipe, but it could also be done with wood, metal or any other material available. Fig. 6 shows the structure with the pump and hoses, Fig. 7 shows a detail of the pump connection and Fig. 8 shows a view of the complete fountain with an inflatable pool that contains and collects the small quantity of water

needed for operation.
There is no need of regulator or battery, but in case of bad weather a battery can be used to power the fountain. Fig. 9 shows the complete system folded and ready for transportation.

Figure 9. *Fountain packaged for transportation*

5. Activities

Figure 10. *Experience at Ceip Chano Piñeiro*

Several activities have been made during the months of may and june: an activity at IES Valadares (Vigo) with students of last courses of secondary school, an activity at CEIP Barrantes (Tomiño) with children between 6-10 years old, an activity at CEIP Chano Piñeiro (Gondomar) for children between 8-10 years old and an exhibition during the "Xornadas Solares Val Miñor" at IES Escolas Proval with students of higher levels and public in general. Fig. 10, 11 and 12 show these activities. In all cases the students kept very interested in the problem of water in the world, and the solar fountain was a center of attraction and an interesting hands-on experience.

Figure 11. *Activity at CEIP Barrantes*

Figure 12. *Exhibition at IES Escolas Proval*

6. Acknowledgements
The authors wish to thank teachers and students at IES Escolas Proval, IES Valadares, CEIP Barrantes and CEIP Chano Piñeiro for their cooperation to the success of these activities. Also to Prof. Pedro Serrano (UTFSM, Chile) and Prof. Celestino Ruivo (U. Algarve, Portugal) for their interesting conference and workshop during the activity "Xornadas Solares do Val Miñor 2012".

7. References

[1] UN, International Year of Sustainable Energy for All, 2012. http://www.un.org/en/events/sustainableenergyforall/ [06/16/2012]
[2] Oxfam, Etiopia el derecho al agua potable, 2012. http://www.intermonoxfam.org/es/multimedia/video/etiopia-derecho-al-agua-potable [06/16/2012]

[3] WHO, Water-Sanitation-Health, 2012. http://www.who.int/water_sanitation_health/WSHFact-Spanish.pdf [06/16/2012]
[4] Wikipedia, Vibrio Cholerae, 2012. http://es.wikipedia.org/wiki/Vibrio_cholerae [06/16/2012]
[5] Shurflo, Solar Pumps, 2012. http://legacy.shurflo.com/pages/new_industrial/Industrial/gen_industrial/genind_doc_sum/2088-443-144.html [06/16/2012]
[6] Photowatt, Solar panel PW6-123, 2012. http://www.photowatt.com/documents/produits/PW6-123.pdf [06/16/2012]
[7] Rule 500 Bilge Pump, 2012. http://www.xylemflowcontrol.com/marine-and-rv/rule-electric-submersible-pumps/rule-500.htm [06/16/2012]
[8] Atersa A20P photovoltaic panel, 2012. http://www.atersa.com/datosproductos.asp?param=4 [06/16/2012]

A ROBOTIC IRRIGATION SYSTEM: MOTIVATING BASIC SCHOOL STUDENTS TO SCIENCE

Z. Esteves, M.F.M. Costa
Departamento de Física, Universidade do Minho Campus de Gualtar, 4710-057 Braga, Portugal.
zita.esteves@gmail.com, mfcosta@fisica.uminho.pt

Abstract. *The active involvement of our students, from early ages, in the study of science requires a constant motivational effort. Robotics is an actual subject rather appealing to our youngsters. On the other hand interdisciplinary approaches are possible in different science subjects using robots or robotics systems or concepts. In the frames of the 2nd Portuguese "Hands-on Science" science fair a group of basic school students was suggested to develop a science fair project using a robotic kit. In this communication we will present our approach and how the students developed their activities and the results achieved. The student's motivation to work by themselves on their spare time, their enthusiasm, commitment, success and also the difficulties faced are analyzed. We will show that projects such as this one allow the positive involvement and interaction of students with science. Even heterogeneous groups can work successfully with this kind science fair projects.*

Keywords: Hands-on, robotics, science fair.

1. Introduction:

The active involvement of students in the learning process trough hands-on activities is one of the most effective methods to motivate and engage students on science learning [1]. On present days it is already recognized that even in informal environments students can developed skills that allow them to establish a relationship between cognitive, affective and social knowledge [2].

One way to involve students into science and to teach them problem solving skills is by developing Science Fair' projects. This kind of activities involve actively the students on their learning process resulting in scientific relevant results that furthermore can be shared with other students that will learn with it [3]. A good involvement of the student in this kind of activities may lead to a sound career choice on a science field [4] but only if the project is of students interest [5].

In the same lines learning through robotics projects also reveals students potential at a large range of ages [6]. It can be used to stimulate and engage students to school, but it can also be used to teach concepts [7] and develop different kind of skills that can be useful to students development [6,7].

2. 2nd Science Fair Hands-on Science

At the beginning of the school year of 2011-2012, the students of Colégio do Minho were invited to participate at the 2nd Hands-on Science Science Fair. Students had to develop a project in an investigative perspective on a field of their choice. The project was to be developed by students on their spare time.

In this communication we will describe the process that a heterogeneous group of students from 8th grade (ages between 13 – 14 years old) followed to develop an interdisciplinary project involving robotics physics and biology. The project was developed autonomously on student's spare time with only minor guidance.

3. The project description

When the idea to participate on the science fair was presented the student's enthusiasm was immediate. However some vivid discussion arose on the project subject to be chosen.

The group of students whose work is reported here started with the idea of building a car moved by solar energy. However only one of the

© 2012 HSci. ISBN 978-989-98032-0-6

members was excited with the idea and after two weeks they started given up on their project. They were then advised to perform more research and to find a common field of interest. A common area of interest merged almost immediately for the four students: robotics.
This specific group was constituted of four boys with ages between 13 and 14 years old. But the most interesting was the fact that these four boys despite belonging to the same class they usually have different interest, different postures in classes and very different learning rhythms. One of the students of the group was one of the best student's of the class and the other two were students with major learning difficulties. Interestingly the student that immediately revealed himself as the leader was one of the less motivated in classes (including at science classes). The most important common characteristics was the fact that they all wanted to develop a project based on robotics despite none of them had any previous experience on the field.

Figure 1. *Students preparing their project*

They started to work during weekends and during their lunch time at school, all by themselves. The only help they had was by providing them the material and a space at school where they could work by themselves.
They started to build the robots trying to construct different structures to understand more about the Lego Mindstorm robotic system they employed. They also learned robot programming by themselves.
After three months, the students already had made some progress. However something was missing: a real objective for their science fair project - challenge of finding an application of their robots.
After a few ideas they establish as their primordial goal to build a robotic irrigation system (as can be seen on Figure 1).
The soil to be irrigated was placed on wooden base made of 3 corridors. The robot moved forwards and backwards on the central corridor and, on the back of the robot, they built the irrigation system. For that, they put two bottles of water linked by straws and fixed two larger straws to the bottles, one for each corridor. One of the straws had larger holes to allow the irrigation of some vegetables that needed a larger quantity of water. The holes on the other straw were smaller hey planted flowers that needed less water.

Figure 2. *The irrigation system*

The irrigation system only worked if they remove the cork of the bottle. However, they quickly understand that they needed a larger water deposit, and also to increase the pressure at the straws. They try to use a larger bottle but the stability of the robot was compromised. Therefore a second bottle was connected to the first. This bottle was used as a reserve and was only used when the first bottle was low on water (Figure 2).
The students revealed a large enthusiasm on construction of the robot and the irrigation system. However at first they didn't showed interest on understanding the physics principles that explain the operation of their irrigation system neither the specific knowledge associated to the plants/legumes they were to water and that select for their garden. Some time was need for them to realize that they have to perform more research in order to improve their project… They were encouraged to speak with science teachers

and understand little more about the different kind of plants and flowers and the necessities of each one.
After the project finished the students were encouraged to present their project to their colleagues also ear possible questions and doubts and to practice their presentation at the fair.
At the science fair their work was very successfully presented. Visitors revealed interest on seeing and learn about their project. They were even interviewed by a national TV news station, which made them very proud. Despite all the success from the feedback of colleague's and visitors they end up realizing that they could have explored more the physics and the biology aspects related to their project improving it.

4. The impact on students

The involvement of this group of students in their project brought several advantages. One of the most important was the fact that spite being such a heterogeneous group they were able to resolve all their conflicts and work together. It was extremely interesting to see this group of students change their lunch time habits, which they usually used to play with their friends, and started to work on their project on a closed room in a much focused way. They also worked on weekend and holydays at home with the help of their parents.
It was important to notice that these students were able to learn new science concepts related to their projects. However, in this case, the most important was the enthusiasm they showed during physics classes, specially, the "leader" that until then never before participated voluntarily in the classes and was constantly distracted.
The motivation was so large that the students already asked to participate on next year' science fair edition and wanted to begin setting up a robotics club at their school.

5. Conclusions

The involvement of students with hands-on activities such as robotics on the development of projects to participate at science fairs allows them to gain important competencies and positively change their attitude towards science and the school. They acquire skills on material handling and other techniques very useful for their day life and to science classes. They gain the ability to do presentations to the general public and to discuss science. They learn how to work and handle group conflicts.
The simple visit to a science fair can engage students on concept learning as they see projects developed by their pears. This further which motivates them to a more active involvement in their learning process.

6. Acknowledgements

This work was partially supported by the project Pri-Sci-Net funded from the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement no. 266647.

7. References

[1] B. Q. Robertson, "How can hands-on science teach long-lasting understanding?," *Science and Children*, pp. 52-53, 2000.
[2] D. Hodson, "Time for action: science education for an alternative future," *International Journal of Science Education*, vol. 25, no. 6, pp. 645-670, 2003.
[3] Z. Esteves, A. Cabral, and M.F.M. Costa, "Informal Learning at School. Science Fairs in Basic Schools," *International Journal on Hands-on Science*, vol. 1, no. 1646–8937, pp. 23-27, 2008.
[4] G. M. Bowen and J. L. Bencze, "Print Media Representations of Science Fairs," *Canadian Journal of Science, Mathematics and Technology Education*, vol. 9, no. 2, pp. 100-116, Apr. 2009.
[5] M. Byko, "Kid geniuses: Fame, fortune, and science fairs," *Jom*, vol. 56, no. 9, pp. 13-16, Sep. 2004.
[6] C. Ribeiro, C. Coutinho, and M.F.M. Costa, "Robowiki: Resources for educational robotics," in *Proceedings of the 8th International Conference Hands-on Science*, 2011, pp. 362-371.
[7] J. A. . Oliveira, "Robótica e educação: aproximações piagetianas numa tese de doutorado," in *XI Seminário Internacional de Educação Tecnológica*, 2004.

 ISBN 978-989-98032-0-6

FROM THE EYES OF BOARDING DISTRICT SCHOOL STUDENTS: HANDS ON SCIENCE, SCIENCE AND TECHNOLOGY LESSON

Ş. Yilmaz[1], B. Timur[2]
[1]*Abant İzzet Baysal University Faculty of Education, Turkey*
[2]*Çanakkale Onsekiz Mart University Faculty of Education, Turkey*
sirinyilmaz87@hotmail.com, betultmr@gmail.com

Abstract. *By the new science and technology teaching program, constructivist approach; which is student centered, makes students active in learning, based on hands on activities, makes them construct new information by themselves rather than taking it, directs students to questioning and search, internalizes the process evaluation approach and depends on new teaching methods, was approved. In Turkish education system, there are Boarding District Schools (BDS) which are giving importance not only educational activities but also real life activities. In schools in rural areas, there are some problems like material deficiency, student-teacher communication deficiency, and insufficient financial support. The aim of this study is to reveal the opinions of the elementary students in BDS about the science and technology activities. In the study, quality descriptive methods were used. Sample of the study is composed of 19 students which are 6th, 7th or 8th grade students in a BDS in Elazığ during the 2011-2012 academic year. In the study, interview questions developed by the researchers to detect the views of the students about science and technology course were used. According to the findings, it was found that the best loved course is science and technology and the reason is that the science and technology course includes experiments and funny processes. In students' dreams, in a science and technology course, they dream themselves active and teaching is activity based and teacher has the role of guide. The students have positive views about the teachers' role of guide, teachers' feedbacks and guidance. In addition, it was concluded that the students watch the TV programs including scientific activities and these programs help them to review the knowledge and transfer it into real life. Under the light of these results the teachers in Boarding District Schools should give much importance to activities and experiments, and the financial support should be increased to overcome the material deficiency problem.*

Keywords: Science and Technology Course, Science and Technology Activities, Boarding District Schools.

1. Introduction

In our age, the rapidity of the developments in technology, economy, science and society is well reflected in the field of education [1]. Developed countries have been improving and changing their educational programs by integrating the recent theories put forward in education and the developments in science and technology [2]. Accordingly, it is very important that every individual be brought up as being science and technology literate [1, 2]. In this regard, Ministry of Education in Turkey has changed the education programs at all levels by using the contemporary approaches as base since 2005 [2]. Within the vision of the reformed science and technology lesson program, the purpose is to rise the students as science and technology literate no matter what individual differences they have [4]. In parallel with the changed program, the teacher-centered approached has been abandoned and a constructivist approach, which is student-centered and makes the students active in the teaching – learning process, which is based on experimental learning, where students are not in a position to receive information but rather construct knowledge themselves in their minds, which leads students to research and question things, which is based on the philosophy of process-based assessment and which employs new and alternative instructional methods and techniques, has been adopted. In this approach which has been adopted as the base, that the teacher is a guide and that the students are active, participating in the process, researching, questioning and making inferences are in the foreground. As for the lesson processes, they have come to be more active and fun with the participation of the students, and they are turning into environments where teacher- student and student-student interactions are more positive. In teaching- learning processes, what is emphasized is the role of newly-learned information in daily life, which is away from the pure knowledge approach, and the importance of activity-based learning processes [2, 1, 5, 6, 7, 8, 9].

It has been observed that some problems are encountered during the practice stages of these activity-based lesson processes which are emphasized in the science and technology lesson program. These problems vary according to the area, the teacher or the school conditions [1, 10]. For example, during the implementation of the activities in science and technology lessons,

© 2012 HSci. ISBN 978-989-98032-0-6

problems, such as the school's socio- economic level, social and cultural environment, lack of material resulting from the insufficient financial support, lack of know-how related to the laboratory materials, the fact that the student-centered approach has not been fully adopted and that the activities are only carried out by the teacher, are encountered [1].

In our educational system, there exist Boarding District Schools (BDS), which is a type of school that embodies not only educational activities but also activities related to real life. BDSs are schools that were founded with the purpose of meeting the students' needs for the eight-year education program, for those who have come to the age of compulsory education, in residential areas where the population is low and dispersed (villages, hamlets, koms, nomad camping sites), and the teaching- learning environments of these schools constitute the whole living space of their students [11].

Activities carried out in science and technology lessons should not be limited to the classroom environment, but they should be related to the daily life [10, 8, 12]. In addition, in an effective science education, it is of utmost importance that the activities are performed in laboratories, school gardens or in a place relevant to the subject at hand and that the teachers have the role of a guide [3, 8, 9, 13, 5].

Many science teachers emphasize that the activity-based science education in primary schools is helping the students to form a more effective and meaningful learning in improving their research and questioning skills. Together with this, it is stated that the activities carried out contribute greatly to the students' cognitive development [10].

One of the problems encountered in the primary schools in rural areas is the lack of materials required while doing the activity. That the school is not financially supported causes science teachers, who have been negatively affected by this problem, not to allocate enough time for science education and to develop negative attitudes. Having little financial support and being away from the opportunities in cities lead to teachers' not being able to implement the program fully and lack of laboratories and materials [14, 15].. Studies carried out reveal that some of the affective characteristics of the teachers working in BDSs prevent the students from actively participating in the education process and the lessons. It is observed that, when the education process is taken into consideration together with the area where these schools are located, infrastructure opportunities and the socio-economic level, it is affected by these variables. This difference negatively affects the activities that are part of the teaching- learning process. Despite all these negative conditions mentioned above, that the teacher- student ratio is low in schools in rural areas makes the in-class and mutual interaction more positive and enables the learning processes to be more fun for students [10, 16, 3, 9].

Çeken (2011) emphasizes that there is a significant difference at the levels of activities carried out according to school types, and states that the quality of the activities, laboratory environments, material use and quality sometimes vary in different schools.

Due to the conditions mentioned above and many more, it is crucial that the students' opinions regarding the regional differences and the activities performed in science and technology lessons be taken. The purpose of this study is to reveal the possible attitudes towards the activities carried out in science and technology lessons, to determine the existing problems in the teaching-learning process, and to shed light to the students' level of being able to relate the learning process and science and technology to daily life.

2. Method

2.1. Study Design

This is a qualitative descriptive study. Qualitative descriptive studies are the ones not looking for a relationship or a difference, but trying to determine what is what. Accordingly, descriptive studies both serve the descriptive purpose of science and provide views for the purpose of producing new ideas for future studies. Descriptive studies are the ones that try to describe things as they are [17, 18].

2.2. Population and Sample

The sample of the study comprises 19 primary school students who receive education at the 6th, 7th and 8th grades of a BDS in Elazığ province during the 2011-2012 academic year.

2.3. Data Collection Techniques

In this study, written interview questions that were developed by the researchers were used in order to determine the primary school students' opinions about the science and technology lesson.

2.4. Data Analysis

In the data analysis of this study, descriptive analysis was used. In descriptive analysis, the collected data are summarized according to the pre-set themes and then they are interpreted (Yıldırım and Şimşek, 2008).

3. Findings and comments

In this section, findings related to the views of primary school secondary stage students receiving education at BDS on the activities carried out in science and technology lessons. For each question addressed to the students, findings that were obtained from the participants are presented in tables below.

Item 2.a: " Which lesson do you like most?''

Students' answers related to item 2a are presented in Table 1.

Table 1. *Analysis results of the participants answers for Item 2.a*

Most favorite lessons	Frequency
Science and Technology	11
Mathematics	3
Social Studies	2
Turkish	2
English	1
Arts	1
Physical Education	1
Revolution History	1
Total	22

When Table 1 is analyzed, it can be seen that the participants' most favorite lessons are science and technology (f=11) and mathematics (f=3). It is also observed that social studies, Turkish, English, arts, physical education and revolution history respectively are among the most favorite lessons.

Item 2.b: ''Why, if the participant likes it, does s/he like science and technology lesson? Why, if not, doesn't s/he like science and technology lesson?''

Students' answers related to item 2.b are presented in Table 2.

Table 2. *Analysis results of the participants answers for Item 2.b*

The reason for liking science and technology	*f*	The reason for not liking science and technology	*F*	Not stated
Experiment-based	5	Not enjoyable enough	4	1
Fun process	3	Subjects' not being attractive	3	
Relation to the daily life	3	Subjects difficult to understand	3	
Activity-based	2			
Easy understandability	2			
Increasing self-confidence	2			
Enjoyable/ Active teacher	1			
Possibility of concretization	1			
Learning new things	1			
Attractive subjects	1			

When Table 2 is analyzed, the students' reasons for liking or not liking science and technology lesson can be seen. Among the students' reasons for liking science and technology, the reasons stating that science and technology lesson is experiment- based, has an enjoyable process and can be related to daily life can be seen. As for the reasons why the students don't like science and technology, it can be seen that the reasons are that science and technology lesson is not enjoyable enough, does not have attractive

© 2012 HSci. ISBN 978-989-98032-0-6

subjects and includes subjects that are difficult to understand.

Item 3: ‘‘Can you tell me about a science lesson that you enjoyed most?’’

Students’ answers related to item 3 are presented in Table 3.

Table 3. *Analysis results of the participants answers for Item 3*

The most enjoyed science lesson	Frequency
Enjoyable process	9
Activity-based	8
Relation to daily life	7
Doing experiments	5
Concretized subjects	4
Scientific game/drama activities	3
Active participation	2
Learning by doing	2
Scientific discussion	1
Enjoyable teacher	1

When Table 3 is analyzed, it can be seen that a science and technology lesson which the students most enjoyed is one that is in an enjoyable process, is activity-based, is related to daily life and includes doing experiments. In addition to these features, it can also be observed that the students like it when the subjects are taught by concretizing them, and they enjoy science and technology lessons that are implemented through scientific game/ drama activities.

Item 4: ‘‘What is a science lesson like in your imagination? What kind of activity are doing in this lesson? How is this activity taking place? What is your role and the role of the teacher and the students?’’

Students’ answers related to item 3 are presented in Table 4.

Table 4. *Analysis results of the participants answers for Item 4*

Science and Technology lesson in your imagination	Frequency
Experiment-based	11
Teacher as a guide	11
Active participation in the process	9
Use of technology	4
Not sticking to the course book	3
Use of visual materials	3
Enjoyable process	2
Having the lesson in the lab	2
Safe laboratory environment	2
Drama	2
A study environment similar to that of scientists	1
Learning environment according to the content	1
Field trip and examination	1

When Table 4 is analyzed, it can be concluded that a science lesson in the imagination of the students is one in which the lesson is implemented through activities and the teacher is a guide in the process while the students are active participating individuals in this science and technology lesson. In addition, this lesson, the students imagine, is implemented without sticking to the course book and is carried out through the use of visuals and technology.

Item 5: ‘‘Do you like it when the teacher is in the role of a guide during the activities? Why?’’

Students’ answers related to item 5 are presented in Table 5.

Table 5. *Analysis results of the participants answers for Item 5*

Yes	The reason	f	No	The reason	f
19	Receiving feedback	12			
	Teacher as a guide or assistant in the process	11			
	Enjoyable process	5			
	Gaining awareness	2			
	Providing a safe environment	1			

When Table 5 is analyzed, it can be seen that all the students like it when the teacher is in the role of a guide during the activities. Moreover, it can also be concluded that the students also like it

© 2012 HSci. ISBN 978-989-98032-0-6

when the teacher gives them feedback and acts as a guide/assistant during the activity stage. In addition, it can be seen that the teacher's having the role of a guide both makes the process more enjoyable and gains the students awareness and makes the learning environment safer.

Item 6: ''What kind of difficulties do you face with while doing the activities?''

Students' answers related to item 6 are presented in Table 6.

Table 6. *Analysis results of the participants answers for Item 6*

Difficulties faced with	Frequency
Lack of material	7
I don't face any difficulties	5
Lack of knowledge on how to use the materials	3
Experiments' not being explained clearly enough	3
Students' talking in the lesson	1
Excessive worry	1

When Table 6 is analyzed, it can be seen that among the difficulties encountered by the students during the activities are lack of material, lack of knowledge on how to use the materials and experiments' not being explained clearly enough

Item 7: ''While doing the activities, can you relate the results of them to the real life?''

Students' answers related to item 7 are presented in Table 7.

Table 7. *Analysis results of the participants answers for Item 7*

Being able to relate to real life	Frequency
yes	17
no	1
sometimes	1

When Table 7 is analyzed, it can be seen that most of the students (f=17) can relate the results that are obtained during the activity stage to real life whereas one student stated that s/he cannot do this and another student stated that s/he could do it only sometimes.

Item 8: ''How do you think a science lesson based on activities should be like?''

Students' answers related to item 8 are presented in Table 8.

Table 8. *Analysis results of the participants answers for Item 8*

How do you think a science lesson based on activities should be like?	Frequency
Student-centered	9
Activity-based	6
Teacher as a guide	5
Experiment-based	3
Having visual aids	2
With emphasis on scientific knowledge	2
Learning environment according to the subject at hand	2
In a safe environment	2
Not stated	2
Field trip	1
Researching student	1
Feedback is necessary	1
Enjoyable process	1
Hands-on experiments	1
Suitable to the students' cognitive level	1
High-quality activities	1

When Table 8 is analyzed, it is seen that a science lesson based on activities, from the students' perspective, is one that is student-centered, activity-based and that has the teacher as a guide to the students. Furthermore, it can be seen that a science lesson that the students imagine of includes a process that contains visual aids, a learning environment suited to the content, with emphasis on scientific knowledge and activities that match the students' cognitive level.

Item 9: ''Do you ever watch scientific TV programs that include activities? Do you think watching such programs contribute to you in any way? ''

Students' answers related to item 9 are presented in Table 9.

Table 9. *Analysis results of the participants answers for Item 9*

Watching scientific TV programs	Yes/ Contribution	*f*	No (*f*)
	Relating to the real life/ Information transfer	8	5

Support for prior knowledge	2
Revision	2
Possibility of learning through visual aids	2
No explanation	2
Gaining the ability for scientific discussion	1

When Table 9 is analyzed, the students' answers regarding the item about their watching TV programs that include activities and the possible contribution of it can be seen. According to the results obtained, scientific TV programs that contain activities contribute to the students in terms of relating what they learn to real life, constructing prior knowledge for future learning, revising what they know, and helping the students whose visual intelligence is high learn more easily.

4. Conclusıon and suggestıons

In the study we carried out, the features of an effective and enjoyable science and technology lesson from the perspective of primary school 6th, 7th and 8th grade students receiving education at BDS were investigated. As a result of the analyses carried out, it was observed that the students' most favorite school subjects were science and technology, mathematics and Turkish. When the students are asked about the reasons why they liked science and technology most, the reasons are that the lesson is based on experimenting, that the learning process is enjoyable and that what is learned in class can be related to daily life. Yılmaz and Timur (2012), in their studies in which they investigated the primary school secondary stage students' attitudes towards science and technology lesson, emphasized that the students' most favorite subjects were science and technology and mathematics, and that these had enjoyable processes. The results that we obtained are parallel with those of Yılmaz and Timur (2012).

When the students' views about a science and technology lesson in their imagination were analyzed, it can be seen that in the process of such a lesson, the teacher is a guide and the students are active and researching all the time. Yılmaz and Timur (2012), in their studies in which they investigated the primary school secondary stage students' attitudes towards science and technology lesson, stated that a science and technology lesson that the students imagined of was based on experiments and activities, it was fun and the teacher was a guide. The results that we obtained are compatible with those of Yılmaz and Timur (2012).

That the teacher has the role of a guide in science and technology lessons is liked by the students and it was concluded that the students respond positively to the teacher's giving feedback, assisting the process and providing the safety of the learning environment. Pederson and McCurdy (1990), in the studies they carried out, emphasized that the teacher should be a guide in the learning process and should direct the students.

It can be seen that among the difficulties encountered most by the students during the activities are lack of material and lack of knowledge on how to use the materials. In their studies, Buluş-Kırıkkaya (2008) emphasized the lack of materials for activities and laboratory conditions in primary schools. Likewise, Tekbıyık and Akdeniz (2008), Çeken (2011), and Türe and Karaküçük (2011) [19] mentioned the lack of materials for activities and laboratory conditions, and put forward that the schools were not provided with sufficient financial support.

When the students were asked about the features of an effective science and technology lesson, it is seen that it is a lesson based on activities, that is student-centered, and that has the teacher as a guide during the process. In their studies, Hadfield and Lillibridge (1990), and Yılmaz and Timur (2012) claimed that an effective science lesson should be under the teacher's guidance, be based on activities and be implemented in an enjoyable way.

When the students were asked whether they watched TV programs that include activities and if these contributed to them in any way, it was seen that they watched such programs and, according to their answers, these programs contributed to the students in terms of gaining them skills such as relating what they learn to real life and transferring their knowledge to daily life.

In accordance with the results obtained, it can be suggested that a science and technology lesson should be implemented in an environment that has a process which gives the teacher the role of

© 2012 HSci. ISBN 978-989-98032-0-6

a guide, is student-centered, gives the students roles as researching and questioning individuals and utilizes technological equipment and visual elements. It can also be suggested, depending on the obtained student views, that the lessons should not only be held in class or the laboratory but also in school gardens, in the fields or other different places when necessary. It can be suggested that necessary financial and material support should be provided to BDSs that are far from the city centers and that cannot make use of the available opportunities. Also, it can be suggested that the teachers working in BDSs should allocate more time for activities and experiments during the learning process, relate the subjects to daily life by concretizing them, bringing the subjects to a level where students can understand, and allot more time to scientific discussions and games.

5. References

[1] Kurtuluş N, Çavdar O. Teachers' and students' views toward the activities of the primary science and technology curriculum. Necatibey Faculty of Education Electronic Journal of Science and Mathematics Education (EFMED) 2011; 5(1): 1-23.

[2] Doğan Y. Acceptance level of constructivist learning activities recommended by the science and technology curriculum. Kastamonu Education Journal 2012; 20(1): 167-186.

[3] Pedersen JE, McCurdy DW. The effects of hands-on minds-on teaching experiences on attitudes of pre-service elementary teachers. The Annual Meeting of the National Association for Research in Science Teaching (Atlanta, GA, April 8-11, 1990). ED317437. Retrieved July 17, 2012, from ERIC databases.

[4] MEB. (2006). İlköğretim Fen ve Teknoloji dersi Öğretim Programı ve Kılavuzu. Ankara, 10–13.

[5] Yılmaz Ş, Timur B. Investigation of primary education 6th, 7th and 8th grade students' attitudes towards science and technology lesson. The Online Journal of New Horizons in Education 2012; 2(3).

[6] Radford D, DeTure, L, Doran RLA. preliminary assessment of science process skills achievement of preservice elementary teachers. The Annual Meeting of theNational Association for Research in Science Teaching (Boston, MA, March 1992). ED345145. Retrieved July 17, 2012, from ERIC databases.

[7] Vorsino WS. Improving the effectiveness of science laboratory instruction for elementary students through the use of a process approach for change. (1992). Yayımlanmamış Yüksek Lisans Tezi. Nova Üniversitesi: ABD.

[8] Bell R. Whole-class inquiry: Science. Learning & Leading with Technology 2005; May.

[9] Shimizu, K. Teachers' emphasis on inquiry science and prevailing instructional method. The Annual Meeting of the National Association for Research in Science Teaching; 1997. *ED405213*. Retrieved July 17, 2012, from ERIC databases.

[10] Haldfield O, Lillibridge F. (1991). A hands-on approach to the improvement of rural elementary teacher confidence in science and mathematics. The Annual National Rural
Small Schools Conference (Nashville, TN, March 18,1991). *ED334082.* Retrieved July 17, 2012, from ERIC databases.

[11] MEB. (2008). Yatılı İlköğretim Bölge Okulları Yönetici Kılavuzu. Ankara: MEB.

[12] Sinclair RC, Johnson M. Investigating plants: Hands-on, low cost laboratory exercises in plant science. 1996. *ED408172.* Retrieved July 17, 2012, from ERIC databases.

[13] Wang R. Learning chemistry in laboratory settings: A hands-on curriculum for non-science majors. 1996. The National Meeting of the American Chemical Society. *ED399189.* Retrieved July 17, 2012, from ERIC databases.

[14] Buluş Kırıkkaya E. İlköğretim okullarındaki fen öğretmenlerinin fen ve teknoloji programına ilişkin görüşleri. Türk Fen Eğitimi Dergisi (TUFED) 2008; 6(1).

[15] Tekbıyık A, Akdeniz AR. Teachers' views about adoption and application of primary science and technology curriculum. Necatibey Faculty of Education Electronic Journal of Science

© 2012 HSci. ISBN 978-989-98032-0-6

and Mathematics Education (EFMED) 2008; 2(2): 23-37.

[16] Çeken R. "Bu benim eserim" öğrenci projelerinin okul türü bakımından değerlendirilmesi. Mehmet Akif Ersoy Üniversitesi Eğitim Fakültesi Dergisi 2011; 22, 1-14.

[17] Erkuş A. (2009). Davranış Bilimleri İçin Bilimsel Araştırma Süreci. (2. Baskı). Ankara: Seçkin Yayıncılık.

[18] Karasar,N. (2010). Bilimsel Araştırma Yöntemi. (21. Basım) Ankara: Nobel Yayın Dağıtım.

[19] Türe E, Karaküçük SA. Study of education environments in terms of physical/spatial variables in regional primary boarding schools. Ankara University, Journal of Faculty of Educational Sciences 2011; 44(2), 165-199.

INVESTIGATING STUDENTS' ATTITUDES TOWARDS TO EXPERIMENTS WHICH CAN BE DONE WITH READILY AVAILABLE MATERIALS

N. Hırça, A. Volkan Yüzüak
Bartın University Primary Science Education Department, Bartın, Turkey
dr.hirca@gmail.com

Abstract. *Although Science and Technology curriculum has been emphasized that students learn science concepts and construct their own learning actively in laboratories, science teachers don't do experiments due to lack of laboratory equipments. The aim of this research is to advocate that students' science process skills also can be developed with hands on science experiment. This research took place over 7 weeks, and included 28 prospective science teachers in 2011-2012 academic year. One group pre-test and post-test design of pre-experimental was used to achieve the objectives of the study. A scale of attitude towards doing experiment using readily available materials and open-ended questions were used as data collection tools. As a result, students stated that these applications would be beneficial for them when they begin to teach in schools without laboratory equipments and effected on their various skills, although such practices changed their attitudes towards conducting experiments negatively*

Keywords: Attitude, Hands on science, readily available materials, science experiment.

1. Introduction

Revised Science and Technology curriculum was developed based on constructivist learning approach which defends that individuals can construct their own learning [1,2,3]. It also advices using activities which include inquiry, questioning, problem solving, decision making process so that students learn and develop their Science Process Skills [4]. Education places and materials are important in most of the science teaching methods and techniques [5]. It is known by everybody that, students learn science concepts actively in laboratories. Studies show that instructors cannot do laboratory experiments due to lack of materials [6]. This research also advocates that students can learn and develop Science Process Skills with readily available materials.

2. Material and Method

The intervention took place over 7 weeks, and included 28 prospective science teachers (18 girls and 10 boys) in 2011-2012 academic year. One group pre-test and post-test design of pre-experimental was used to achieve the objectives of the study. Experiments were conducted and designed by researchers. In this process, conducted experiments, respectively, as follow:

a. Mass measurement,
b. Velocity and acceleration,
c. Newton's laws and Atwood machine,
d. Simple harmonic motion,
e. Potential energy,
f. Centripetal force,
g. Coefficient of friction measurement.

As data collection tools, a scale of attitude towards activities and semi-structured interviews which include open-ended questions were used.

3. Findings

Independent t test results of students' achievement scores were given below:

Table 1. *Students' achievement scores*

Test	N	X	SS	Sd	t	p
pre	28	36.80	2.92	28	3.099	0,006
post	28	32.28	6.25	28		

Students' opinions after their experiences about applications were given in table 2:

© 2012 HSci. ISBN 978-989-98032-0-6

Table 2. *Students' opinions about applications*

Students' opinions	f	%
I have difficulties in finding enough material	17	59
These experiments has increased my creativity and ability for problem-solving skill, despite I had trouble finding material	13	45
Although we able to conduct experiments with readily available materials, I prefer to use laboratory equipment	10	34
I could not set up experiment with readily available materials, thus I could not see the benefit.	8	28
These applications greatly increased my experience of conducting experiment with readily available materials. I'll definitely put into practice when I will be a teacher.	5	17
I noticed several benefits of conducting experiments with readily available materials	4	14

4. Discussion and Conclusion

The purpose of this paper was to advocate that students' science process skills also can be developed with hands on science experiment. It was found that despite of using readily available materials changed students' attitudes towards conducting experiments negatively; they stated that applications developed their various skills. Furthermore, they indicated that these activities will be beneficial for them, if they work at a school without laboratory.

Another interesting result of the research is that; although aim of the study was to do experiments with readily available materials, students' complained that they did not reach materials. The reason of this finding may be that, most of the students arrived to the city for first time and did not adapt the city life. However using materials can be reached easily such as ruler, rope, pulleys, and rubber. This finding is parallel to the findings of Yiğit and Akdeniz that students have problems with responsibility [7].

9. References

[1] Milli Eğitim Bakanlığı (MEB). İlköğretim fen ve teknoloji dersi 4., 5., 6., 7. ve 8. sınıflar öğretim programı. Ankara 2005; MEB Yayınevi.

[2] Brooks, J. G. ve Brooks, M. G. (1999). In Search far Understanding the Casefor Constructivist Classrooms 1999; Alexandria, Virginia: ASCD

[3] Nunes, M. B. ve McPherson, M. Constructivism vs. Ohjectivism: Where is Difference for Designers of e-Learning Environments? 2003; The 3rd IEEE International Conference on Advanced Learning Technologies.

[4] Anagün, Ş., ve Yaşar, Ş. İlköğretim Beşinci Sınıf Fen ve Teknoloji Dersinde Bilimsel Süreç Becerilerinin Geliştirilmesi. İlköğretim Online 2009; 8(3), 843-865, [Online]: http://ilkogretim-online.org.tr.

[5] Aşkar, P., Paykoç, F., Korkut, F., Olkun, S., Yangın, B., & Çakıroğlu, J. Yeni öğretim programlarını inceleme ve değerlendirme raporu 2005.

[6] Böyük, U., Demir, S., ve Erol, M. Fen ve Teknoloji Dersi Öğretmenlerinin Laboratuvar Çalışmalarına Yönelik Yeterlik Görüşlerinin Farklı Değişkenlere Göre İncelenmesi, TÜBAV Bilim Dergisi 2010; 3(4), 342-349.

[7] Yiğit, N. ve Akdeniz, A.R. Fen Bilgisi Laboratuarı Dersinde Kazanılan Davranışların Öğrenci Özellikleri Açısından Değerlendirilmesi. V. Ulusal Fen Bilimleri ve Matematik Eğitimi Kongresi 2002; 16-18 Eylül ODTÜ Ankara.

DETERMINING PRE-SERVICE SCIENCE TEACHERS' SELF-EFFICACY BELIEFS ABOUT INQUIRY BASED SCIENCE

B. Timur, Z. Çavuşu

Çanakkale Onsekiz Mart University, Faculty of Education, Elementary Education, Department of Science Education, Çanakkale, Turkey

betultmr@gmail.com, zafercavuslu@gmail.com

Abstract. *In Turkey there has been a passage from teacher-based education to student-based education with the education reform realized in the year 2004. As a result of these reforms new methods and techniques have started to be used such as "research and inquiry based learning". This study is carried out on 564 Science and Technology Education Faculty*

© 2012 HSci. ISBN 978-989-98032-0-6

students in 6 Universities, the Research Based Science Teaching (RBST) Scale has been used which has been translated into Turkish by Akçay and İnaltekin and which is taken from the Teaching Science as Inquiry (TSI) Instrument by Smolleck. As a result of analysis of the collected data, it was observed that the opinions on inquiry based learning differ with gender while they do not differ between different classrooms

Keywords: Science, Inquiry, Science and Technology, Inquiry Based Learning.

1. Introduction

Today economical and scientific developments have an enormous effect on our lives. Economical development depends on scientific and technological development. Rising of scientific literacy may lead a society to a stronger future. The science lessons are becoming more important every day and the societies are trying to improve the quality of science teaching [17]. In 2004 with the education reform realized in Turkey behavioral learning was abandoned and cognitive and constructivist approach has been adopted. International and EU criteria have been taken into account and a more economical and more democratic education has been targeted. Teacher based education was replaced with student based education [16].

The constructivist approach is a scientific theory based on observing the learning skills of persons. In this approach persons are experiencing their knowledge on nature and on themselves by using this knowledge in their lives and then using this experience by constructing it in the further knowledge they obtain. The newly obtained knowledge has to be agreeable with the old knowledge, it should renew the old knowledge or the knowledge is expected to be deleted completely. The individual has to question, inquire, discover and determine the knowledge he/she has had before [7]. In the constructivist approach learning is an inherent process. The individual digests the knowledge actively and constitutes the respective behavior [9]. The students compare and combine the new knowledge with their existing knowledge [8].

In the constructivist approach active science education with participation is prioritized. The students discover the knowledge while conducting their activities in a free environment. Learning by discovering or problem based education method is preferred. In this system where the teacher serves as a guide, the students try to solve problems freely. They form their scientific opinions realizing experiments, observations and research [6]. The activities in science education should not be thought of as a method to keep students busy. Each activity makes the students more curious and helps them comprehend nature more comprehensively. More respect is shown to the students as persons and as those learning [15].

Inquiry based learning is a method of inquiring and finding answers in order to get to know the nature. It involves experimenting, measuring, observing, developing hypothesis. Everything included in a scientific process is also included in inquiry based learning. It is systematic and it makes it possible for us to find the knowledge within the process [11].

Inquiry based learning is seen as an important method that will improve the quality of science education. Especially since the second half of the 20th century science education and inquiry are seen as an inseparable whole [5]. Science education is by its nature questioning. Since each individual's perception is different, learning process is particular to the individual. Students can verify their knowledge with the inquiry method. Inquiry based learning gives the opportunity to use all knowledge that is acquired [3]. Inquiry based learning gives the opportunity to solve problems by using the knowledge obtained in classroom in practical life. In studies carried out in Turkey, it was seen that inquiry based learning was not practiced much. It is important to show how inquiry based learning affect scientific process skills, interest in the lessons and thoughts on the scientists [20]. Traditional education hinders the development of feelings of curiosity and research in the students. The students lose the ability to ask questions as they pass to the next grades [19].

In inquiry based learning the student is part of the process. While in traditional learning the students are in a passive position, in inquiry based learning they are active. The student who participates actively in the learning process has a positive attitude to science. A student who works like a scientist is interested in the lesson and trusts the knowledge he/she has acquired. The students see asking questions and finding solutions as a normal behavior [12]. They discover the concepts, climb up the steps of the scientific process and they are able to comment on the data obtained like an expert [4].

Traditional teaching sees a teacher as a person transferring knowledge without going beyond the information included in the textbook; however in inquiry based learning the role of the teacher in learning has changed completely. In this changing system, the teacher is an observer in the process. The task of the teacher is not to give knowledge but to guide the process (Sardilli, 1998). The teacher sets the target and makes the planning but it is the student who decides how to go the way. The task of the teacher in this process is to solve the problems, to answer the questions coming from the students, to intervene where necessary and to develop the critical thinking and cooperative learning skills of the students using this method (Alvarado and Herr, 2003).

1.1 Purpose of Study

The purpose of this study is to examine the opinions of prospective Science and Technology teachers about inquiry based learning.

1.2 Research Based Science Teaching Scale (RBST)

The original of the survey translated into Turkish by Akçay and İnaltekin (2011) has been introduced in the literature by Smolleck (2004). 6 articles have been excluded from the RBST as a result of a factor analysis. The correlation value of the 63 articles changed between .46-.71. Cronbach alpha internal consistency values were .79, .76, .74, .69 respectively, test-retest reliability coefficient was calculated as .70, .73, .68 and .66. With these results the “Research Based Science Teaching Scale” is a valid and reliable assessment instrument [2].

2. Method

In this study carried out with survey method, the “Research Based Science Teaching (RBST)” scale which has been adapted to Turkish by Akçay and İnaltekin (2011) was used and applied on the sample group and analysis of the data obtained is presented below.

2.1. Sample Group

This study is the abovementioned scale has been applied on 564 prospective science and technology teacher candidates studying in six public universities in Turkey in the spring semester of the 2011-2012 academic year. In the sample group there are 160 men with the percentage of 28,4 and 404 women with the percentage of 71,6.

3. Findings

In this section the results of the*, t-test* and *ANOVA* have been given which are the statistical processing of the data obtained by using the Research Based Science Teaching (RBST) scale. The average of the female prospective teacher candidates is found to be higher than the male prospective teacher candidates. We have to examine the sample group t-test table in order to understand if this is meaningful statistically An independent sample group t-test has been carried out in order to understand if there is a meaningful difference between the opinions of the prospective science and technology teachers on inquiry based learning and gender. According to the results of the t-test there is a meaningful difference between the opinions on inquiry based learning based on gender ($p=,016$; $p<,05$). Accordingly it can be stated that the opinions of the female prospective teachers on inquiry based learning are more positive than that of the male prospective teachers. When we check the sub-dimensions of the RBST scale it is seen that the female prospective teachers have more positive opinions on inquiry based learning than male prospective teachers in guide sub-dimension ($p=,011$; $p<,05$) in opportunity sub-dimension ($p=,014$; $p<,05$) and in evidence sub-dimension ($p=,022$; $p<,05$). In explanation sub-dimension on the other hand it can be stated that there is no difference with gender ($p=,095$; $p>,05$).

An ANOVA test has been carried out in order to understand if there is a meaningful difference between the opinions of prospective science and technology teachers on inquiry based learning with the classrooms they belong to. As a result of the analysis carried out it cannot be said that there is a meaningful difference between the opinions of prospective science and technology teachers on inquiry based learning with the classrooms they belong to ($p=,095$;$p>,05$). When we check the sub-dimensions of the RBST scale there is a meaningful difference between the opinions of prospective teachers on inquiry based learning with the classrooms they are in ($p=,037$; $p<,05$); however in explanation sub-dimension ($p=,186$; $p>,05$) in opportunity sub-dimension ($p=,088$; $p>,05$) and in guide sub-dimension ($p=,283$; $p>,05$) it can be said that the opinions do not change according to the classroom.

© 2012 HSci. ISBN 978-989-98032-0-6

4. Discussion and Conclusion

In this study carried out on prospective teachers, the relationship between the opinions on inquiry based learning and gender and the classroom the prospective teachers study in has been examined. In the study carried out on 564 students from six public universities it has been found that the opinions on inquiry based learning differed with gender and that female prospective teachers had more positive opinions. While the results of some former studies regarding this show that there is a difference between men and women [13] there are also studies showing there is no difference between men and women [1, 10, 21]. It can be said that the fact that the place of women in the society is changing is playing a big role in their coming to the forefront academically and in their participation to business life. Changing traditional social structure will result in increasing number of women with confidence and more positive thinking.

When the relationship between the opinions on inquiry based learning and the classrooms the prospective teachers belong to is examined, it can be said that there is no differentiation. This result is parallel to former studies regarding the same [14]. On the other hand there is differentiation between the opinions of the prospective teachers on inquiry based learning with the classrooms they belong to on evidence sub-dimension. As the prospective teachers pass to upper grades they have more self-confidence and they trust themselves in showing evidence of their knowledge.

References

[1] Akbaş, A and Çelikkaleli, Ö. (2006). Examination of Science Teaching Self-Sufficiency Beliefs of Prospective Primary School Teachers according to Gender, Type of Education and Universities. Mersin University Education Faculty Journal, 2(1), 98-110.

[2] Akçay, H and İnaltekin, T. (2011) "Adaptation of Research Based Science Teaching Scale to Turkish: Validity and Reliability Study, Trakya University Education Faculty Journal 2.(1):157-185

[3] Alouf, L.J. and Bentley M.J. (2003) Assessing The Impact of Inquiry-Based Science Teaching in Professional Development Activities, PK-12. A Paper Presented at the 2003 Annual Meeting Of The Association of Teacher Educators.

[4] Alvarado, A.E and Herr P.R. (2003). Inquiry-Based Learning: Using Everyday Objects. California: Corwin Press.

[5] Anderson, R., D. (2002). Reforming Science Teaching: What Research says about Inquiry. Journal of Science Teacher Education, 13 (1), 1-12.

[6] Bağcı-Kılıç, G. (2001). Constructivist Science Education. Education Sciences in Theory and Practice 1.(1):9-22

[7] Brooks, J.G. & Brooks, M.G. (1999). In search of understanding: The Case for constructivist classrooms. Alexandria, VA: Association for Supervision and Curriculum Development.

[8] Deryakulu, D. (2000). Constructivist learning, Democracy in Classroom. Şimşek, A. (Ed.). Ankara: Eğitim-Sen Publications.

[9] Fidan, N. (1986). Learning and teaching at school. Ankara: Kadıoğlu Matbaası.

[10] Gerçek, C., Yılmaz, M., Köseoğlu, P. and Soran, H. (2006). Self-sufficiency beliefs of biology prospective teachers in teaching Ankara University Education Sciences Faculty Journal, 39 (1), 57–73.

[11] Hebrank, M., (2000) Why Inquiry-Based Teaching and Learning in the Middle School Science Classroom? Center for Inquiry-Based Learning, Dept. of Biology, Duke University.

[12] Hinrichsen, J. AND Jarrett, D., (1999) Science Inquiry for the Classroom A Literature Review Northwest Regional Educational Laboratory

[13] Jones, M.G. and Wheatley, J. (1990). Gender differences in teacher-student interactions in science classrooms. Journal of Research in Science Teach., 27(9), 861-874.

[14] Kahyaoğlu, M. and Yangın, S. (2007). Opinions of Prospective Primary School Teachers on their Occupational Self-sufficiency, Kastamonu Education Journal, 15(1), 73-84.

[15] Kaptan, F. and Korkmaz, H. (2000). Constructivism theory and science education. Modern Education

[16] Kutlu, Ö. (2005). Examination of new primary school programs regarding evaluation of student success, Symposium on Evaluating New Primary School Programs, Kayseri: Erciyes University 1.(1);64-71

 ISBN 978-989-98032-0-6

[17] Ortakuz. Y, (2006) "Effect of Inquiry Based Learning on Students interrelating Science-Technology-Society-Environment relationship" Postgraduate Thesis, Marmara University, Education Sciences Institute, Istanbul

[18] Sardilli, S. L. (1998). The Use of a Web Site to Disperse Information on Discovery-Based Learning in Elementary Science Education. Marist College. ED 436 365.

[19] Stopsky, F. (2005) A Teacher' s Handbook To Inquiry Learning 1201 Ideas To Stimulate Inquiry Five Corners Press Vermont

[20] Yaşar, Ş. and Duban, N. (2009). Student opinions on inquiry based learning approach. İlköğretim Online 8(2), 457-475,[Online]: http://ilkogretim-online.org.tr

[21] Yaman, S., Cansüngü, Ö., and Altunçekiç, A. (2004). A study on examining the self-sufficiency beliefs of prospective science teachers. Turkish Education Sciences Journal, 2(3), 355-364.

HOW EARTH AND THE MOON INTERACT

H. Zuhtu Okulu, A. Oguz-Unver
Faculty of Education, Department of Science Education, Mugla University, Turkey
ayseoguz@mu.edu.tr, *hokulu48@gmail.com*

Abstract. *People always seek what they look at in the sky. Because of the Sun-Earth-Moon relative movements, we can observe amazing events and phenomena. Sometimes these events can be hard to understand for the children. Main problem of these topics is our earthbound location in the Universe. Thus the objective of this activity is to explain the Sun-Earth-Moon relative movements using a special model, animations and simulations. By using just a special model and animations describing day and night cycle, the phases of the moon, why the same side of the moon always faces the Earth, Lunar eclipse, solar eclipse, and the reasons for the seasons makes this activity unique. The study was carried out with pre-service science teachers (N=63). A scale consisting of five open-ended questions was used as data collection tool before and after the activities. The results suggested that using the special Sun-Earth-Moon model, animations and simulations are considerably helpful to understand "Phases of the Moon" "The reason of the same side of the moon always facing the Earth" "Solar and Lunar Eclipses" and "The Seasons".*

Keywords: Day and Night Cycle, the Phases of the Moon, Solar and Lunar Eclipses, the Seasons the Sun-Earth-Moon Model, Animations and Simulations.

1. Introduction

Although astronomical observations are thought to be as old as humanity, the beginning time of it is not known exactly. Nomadic people used the constellations for finding their directions in pre-historical times. Many civilizations in history oriented their temples and cities according to astronomical phenomena. Similarly, sky was clock and calendar for ancient people. For instance, the Cro Magnon people made bone engravings 30,000 years ago which is thought to describe the phases of the Moon. These calendars are the oldest astronomical document that is older than writing [1-2-3].

Human maintain to observe the sky and astronomical phenomena throughout the ages like their oldest ancestor. These observations, which emerge from the sense of curiosity and the needs for surviving, have caused to tremendous accumulation of knowledge. So people have tried to understand the basic observed phenomena with using this knowledge [1]. But they have difficulty to understand some astronomical phenomena. At this point creating models is the way that is referred mostly especially for comprehending the huge and the farther celestial bodies' motions. Because of the models' facilitating to explain the encountered in daily life phenomena such as how day and night occur, the phases of the Moon, the reason of the always the same side of the Moon facing the Earth, the eclipses and the seasons, they have became an efficient astronomical tool. On the other hand scientific background roles a critical key for understanding how these basic phenomena occur.

Day and Night Cycle

The Earth has many motions. One of these motions is spinning on its own axis. This event causes day and night. The side of the Earth, which rays of light from the sun reaches, is day. Similarly darkness side of the Earth, which is turned away from the sun, is night. The Earth carries out one full turn on its axis every 24 hours. So night and day follow each other constantly [3-4].

© 2012 HSci. ISBN 978-989-98032-0-6

The Phases of the Moon

The Moon is the Earth's satellite and nearest neighbor in space. It revolves in a counterclockwise orbit around the Earth. This causes the cycle of Lunar phases. The phases appear as change amount of the Moon's lighted surface by the Sun that we observe from the Earth. The names of the Lunar phases are "New", "Crescent Waxing", "First Quarter Waxing", "Gibbous Waxing", "Full", "Gibbous Waning", "Third Quarter Waning" and "Crescent Waning". For instance, when the Moon lies approximately opposite the Sun in the sky, the side of the Moon toward the Earth fully lit and it is called "Full" [1-5].

The Same Side of the Moon

The Moon rotates its own axis and orbits around the Earth. The once orbiting takes 27.3 day. The Moon's rotation period is exactly equal to its orbital period around the Earth which is called as *synchronous rotation*. So the same side of the Moon always faces the Earth. The Earth's gravity causes this locking of the Moon spin to its orbital motion [1].

Solar and Lunar Eclipses

One of the most fascinated astronomical phenomena is eclipse. An eclipse occurs the Sun, the Moon and the Earth lie on a straight line. Thus there are two eclipses: Solar and Lunar.
A Solar eclipse happens when the moon lie exactly between the Earth and the Sun. The Moon blocks our view of the Sun and its shadow strikes the Earth during Solar eclipse. This phenomenon happens when the Moon is New.
A Lunar eclipse happens when the Earth lies exactly between the Sun and the Moon. The Earth's shadow strikes the Moon during Lunar eclipse. This phenomenon happens when the Moon is Full.
Eclipses are rare because the Moon's orbit around the Earth is tilted by about 5 degree with respect to the Earth's orbit around the Sun [1-2].

The Seasons

The seasons occur because of the slant in the Earth's axis and its orbiting motion around the Sun. The slant is 23.5◦. During the period June 21–September 23, when the northern hemisphere is inclined toward the sun, rays of sunlight hit the regions of the Earth that are even the farthest from the equator [6].

Even though these basic astronomical phenomena have scientific explanations, they could be difficult to understand for some students because of celestial bodies' huge size and being so far from the Earth. And the insufficient three-dimensional thinking skills of students could be another reason [1-7].
Thus students may have some alternative concepts about basic astronomical phenomena such as "it becomes night because the Sun goes behind the mountains." [8-9], "the shadow of the Earth causes phases of the Moon." [8] and "the summer occurs when the Earth is closest to the sun and winter when it is farthest away." [10].
Rich learning environments are quite effective for remedying alternative concepts. Atwood and Atwood [11] emphasized that using models for teaching day and night cycle and the seasons enhance the level of students' explaining about these topics. Besides, it is understood that three-dimensional computer modeling used for teaching is the efficient instruction tool for students' comprehending the seasons and the phases of the Moon [12-13].
Concordantly, the purpose of this study is to teach the how day and night occur, the phases of the moon, reason of the always the same side of the Moon facing the Earth, eclipses and the seasons by using the Sun-Earth-Moon model integrated with animations and simulations to pre-service science teachers. Also the study can be carried out with primary students.

2. Method

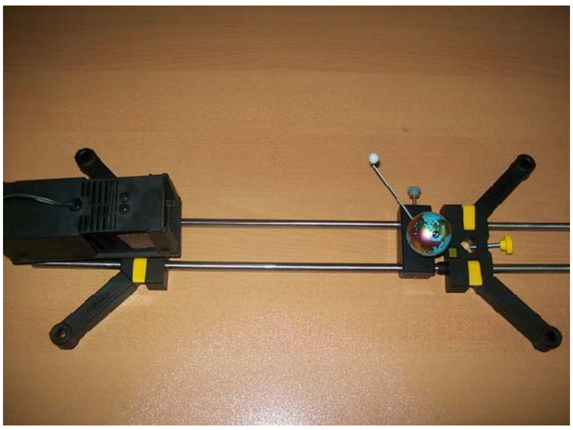


Figure 1. *The Sun-Earth-Moon model*

The study was carried out with the third grade pre-service science teachers (N=63) who study in a university on west part of Turkey in the 2011-2012 academic year.

© 2012 HSci. ISBN 978-989-98032-0-6

A tool that is developed for determining the effectiveness of the activity was applied to pre-service science teachers as pre-test and post-test. The questions which place in the tool were gathered from the current literature [14-15-16].
Validity of the tool was provided with referring to science and physic education experts' opinions. The tool consists of five open-ended questions about day and night cycle, the phases of the Moon, same side of the Moon, Solar and Lunar eclipses and the seasons. Also it is asked to students to include their drawing while they are answering the questions.
A special model (See Figure 1), animations and simulations were used for describing day and night cycle, the phases of the Moon, why the same side of the moon always facing the Earth, Solar eclipse, Lunar eclipse, and the reasons of the seasons.
The process of implementation of the activity is shown below.
All students were asked to fill out a pre-test before the activities. And then the Sun-Earth-Moon model is presented to student with emphasizing size and distance of the real celestial object.

Day and Night Cycle

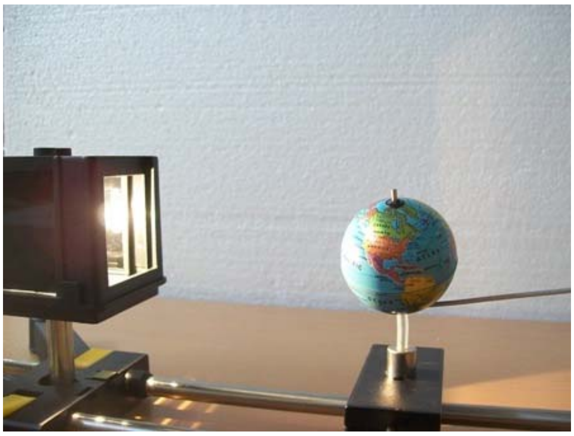


Figure 2. *Day and night cycle*

Stellarium which is an astronomy simulation program is started. The Sun-Earth-Moon model is set up. "What causes day and night?" is asked to students. And then students' responses are listened by one by. After this, The Earth turns slowly around its axis. The students try to work out where it is day and night in which direction the globe is correctly turned (clockwise or anticlockwise) and different locations on the Earth is adjusted in the simulation. The students see what the time it is in their own home town and in various countries in the world [4].

The Phases of the Moon

Beginning of the activity, It is asked to student "Why do we see the different phases of the moon?". Then students' responses are listened by one by. After this, the Earth-Moon model turns in the month so that it is inclined towards the Sun. In this activity, the Moon is to be so turned that no shadow of it is cast on the Earth. The Moon turns around the Earth. It is asked to students "When is it full moon, when half moon and when new moon?". A phase of the Moon animation is shown after the student's answers [4].

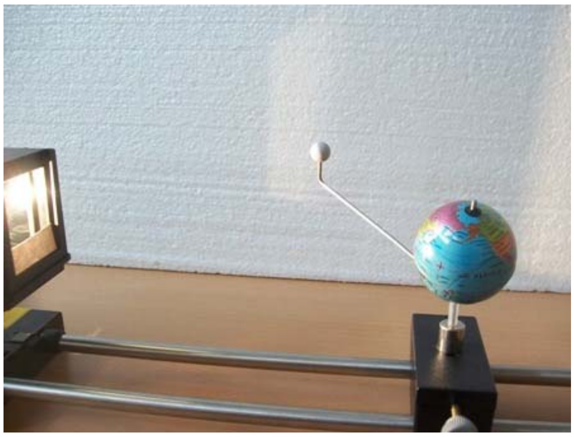


Figure 3. *The phases of the Moon*

The Same Side of the Moon

It is asked to students "Why do we always see the same face of the moon?". They argue their ideas on the model. After this activity "Same side of the Moon" animation is shown to the students.

Solar and Lunar Eclipses

Figure 4. *Lunar eclipse*

It is asked to students “How does a Lunar eclipse occur?” And “How does a Solar eclipse occur?”. And then students’ responses are listened by one by. After this, the Earth-Moon model turns so in the mount that the Earth is inclined to the side and the Moon can cast its shadow on the Earth. The Moon turns around the Earth again. The students should find out here when an eclipse of the Moon occurs and when an eclipse of the Sun. After the activity Solar and Lunar eclipses animations is shown the students [4].

The Seasons

The moon turns to the back as it is not needed in this activity. An ellipse draws on the table. A candle put on the ellipse. The Earth model moves around on this ellipse. The students should find out here which seasons occur for different positions of Earth. Same activity makes using with a drawing circle. It is asked to student “How does the season affect this case?”. And then students’ responses are listened by one by. After this, the duration of staying up The Sun in the sky at different seasons is visualized with using Stellarium programme and then this is reinforced with the animation about the seasons.

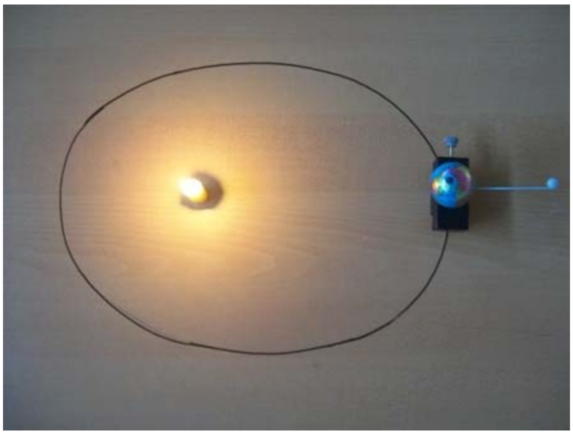


Figure 5. *The seasons*

All students were asked to fill out a post-test after the activity. The data were evaluated with qualitative analysis. For determining criteria of the assessment, literature was reviewed and experts’ opinion was referred [1-17]. The data were gathered from the participants analyzed with descriptive statistics (frequency and percent).

3. Results

The findings obtained from the study are presented below.

Table 1. *Descriptive statistics of the pre-test (N=63)*

Concept	Scientific explanation		Non-Scientific explanation		Unanswered	
	f	%	f	%	f	%
Day and Night Cycle	50	79,4	11	17,4	2	3,2
Phases of the Moon	5	7,9	57	90,5	1	1,6
Same side of Moon	9	14,3	45	71,4	9	14,3
Solar eclipse	18	28,6	35	55,6	10	15,8
Lunar eclipse	16	25,4	40	63,5	7	11,1
The seasons	9	14,3	52	82,5	2	3,2

Table 1 shows that % 79,4 of the students explained day and night cycle in a scientific way before the activities. But only %7,9 of them answered the phases of the Moon and %14,3 of them explained the reason of the same side of the Moon seen from the Earth scientifically in pre-test. Also, % 55,6 of them explained Solar eclipses and % 63,5 of them explained Lunar eclipses with non-scientific explanations in pre-test. Finally, the seasons was explained in a non-scientific way by % 82,5 of them before the activities.

Table 2. *Descriptive statistics of the post-test (N=63)*

Concept	Scientific explanation		Non-Scientific explanation		Unanswered	
	f	%	f	%	f	%
Day and Night Cycle	61	96,8	1	1,6	1	1,6
Phases of the Moon	30	47,6	32	50,8	1	1,6
Same side of Moon	38	60,3	24	38,1	1	1,6
Solar eclipse	41	65,1	21	33,3	1	1,6
Lunar eclipse	41	65,1	21	33,3	1	1,6
The seasons	41	65,1	21	33,3	1	1,6

According to Table 2, day and night cycle was explained scientifically by % 96,8 of the student in post-test. And %47,6 of the them explained the phases of the moon in a scientific way after the activities. Also Solar eclipses, Lunar eclipses and the seasons were explained scientifically by %65,1 of them in post-test. Lastly, the reason of

 ISBN 978-989-98032-0-6

the same side of the Moon seen from the Earth was answered by %60,3 of them with scientific explanations after the activities.

4. Discussion

As a result of this research, using the special Sun-Earth-Moon model, animations and simulations are considerably helpful to understand the basic astronomical phenomena. Especially, the topics that the phases of the moon, always the same side of the Moon seen from the Earth, how the eclipses and the seasons occur are learned by the students effectively. These findings are consistent with Atwood and Atwood [11], who concluded that short-term introduction with using models is highly effective to remedy pre-service elementary teachers' alternative conceptions of the causes of day and night and seasons. Also a number of studies [12-13] show that similarities with the current study such as computer simulations and animations deals with basic concepts of astronomy are effective for teaching astronomy.

5. Conclusion

This activity offers direct interaction to student with the Sun, the Earth and the moon relative movements. And it is also helps students make observations and discuss about everyday phenomena with ignoring our earthbound location in the Universe. So the Sun-Earth-Moon model integrated with animations and simulations is helpful to students comprehending the basic astronomical phenomena. Furthermore, drawings of the celestial phenomena such as solar eclipse improve the student's using scientific justifications while they explain the celestial events. On the other hand the feedback from the students confirms that they found the activity both interesting and useful.

6. References

[1] Explorations an Introduction to Astronomy. Arny TT. Mosby-Year Book; 1994.

[2] Fundamental Astronomy. Karttunen H, Kröger P, Oja H, Poutanen M, Donner KJ. Springer; 1996.

[3] The Physical Universe an Introduction to Astronomy. Shu FH. University Science Books; 1982.

[4] TESS Beginner Student and Demonstration Experiments: Light, Air, Earth. Iwanek S, Kutzborski W. PHYWE; 2008.

[5] Teaching Science as Investigations Modeling Inquiry Through Learning Cycle Lessons. Moyer RH, Hackett JK, Everett SA. Pearson Merrill Prentice Hall; 2007.

[6] Project Learning Tree Environmental Education Pre K-8 Activity Guide. American Forest Foundation. PLT; 2002.

[7] Zeilik M, Schau C, Mattern N. Misconceptions and Their Change in University-Level Astronomy Courses. The Physics Teacher 1998; 36(2): 104-107.

[8] Baxter JH. Children's Understanding of Familiar Astronomical Events. International Journal of Science Education 1989; 11: 502–513.

[9] Vosniadou S, Brewer WF. Mental Models of the Day/Night Cycle. Cognitive Science 1994; 18(1): 123–183.

[10] Dunlop J. How Children Observe the Universe. Publications of the Astronomical Society of Australia 2000; 17: 194–206.

[11] Atwood RK, Atwood VA. Effects of Instruction on Preservice Elementary Teachers' Conceptions of the Causes of Night and Day and the Seasons. Journal of Science Teacher Education 1997; 8(1): 1-13.

[12] Bell RL, Trundle KC. The Use of a Computer Simulation to Promote Scientific Conceptions of Moon Phases. Journal of Research In Science Teaching 2008; 45(3): 346–372.

[13] Kuçukozer H. Korkusuz E. Kuçukozer A. Yurumezoglu K. The Effect of 3D Computer Modeling and Observation-Based Instruction on the Conceptual Change Regarding Basic Concepts of Astronomy in Elementary School Students. Astronomy Education Review 2009; 8(1).

[14] Martinez Pena B, ve Gil Quilez MJ. The Importance of Images in Astronomy Education. International Journal of Science Education 2001; 23(11): 1125–1135.

[15] Trumper R. Teaching Future Teachers Basic Astronomy Concepts Sun-Earth-Moon Relative Movements at a Time of Reform in Science Education. Research in Science and Technological Education 2006; 24(1): 85-109.

[16] Ogan Bekiroglu F. Effects of Model-Based Teaching on Pre-Service Physics Teachers' Conceptions of the Moon, Moon Phases, and Other Lunar Phenomena. International

Journal of Science Education 2007; 29(5): 555–593.
[17] Liseler Için Astronomi ve Uzay Bilimleri Ders Kitabı. Aslan Z, Aydin C, Demircan O, Derman E, Kirbiyik H. Tekişik Yayincilik; 1994.

2ND PORTUGUESE SCIENCE FAIR "HANDS-ON SCIENCE"

Z. Esteves, M.F.M. Costa
Departamento de Física, Universidade do Minho
Campus de Gualtar, 4710-057 Braga, Portugal
zita.esteves@gmail.com,
mfcosta@fisica.uminho.pt

Abstract. *Sciences fairs are activities with great pedagogical potential, in particular when in some way connect to the school in-classroom teaching/learning activities. Two year ago the Science Fair "Hands-on Science" was established focus on upper basic and secondary school levels. In May 2011 the second edition of the hands-on science network science fair was organized, in Braga, Portugal.*
In this communication we intend to show the evolution experienced in organizing this event over the last two years, school' teachers' and students' response and the impact it had. We will discuss the goals and the strategies employed, the challenges faced and the solution found. The replies to questionnaires prepared for both students and teachers allowed us to assess our initiative and draw conclusion that will be presented herein. An increase on students and teachers satisfaction was observed and we were able to study the influence of recent curricular changes on the development of the science projects.
We will review how the work was carried out in different schools and suggest methods to include these activities in a school daily context.

Keywords: Hands-on, science fairs.

1. Introduction

It is common for students to feel that the content they learn in school has no application in real life making the development of science classes often rather complicate for the teacher and student [1,2]. Students should feel motivate to learn and to achieve their objectives [1]. It is the teacher's role to find the better way to engage students. The most important isn't what to teach, but how to teach and what kind of activities to select for helping students [2].

Current studies reveals that the learning process should not only focus on classroom activities [3]. Therefore we want to explore an activity that could help students and teachers to achieve a larger success in the learning of sciences: Science Fairs.

Science fairs are cultural and pedagogical activities, based on hands-on activities. Students have the opportunity to research and develop science project that thereafter will be displayed and discussed with pears and visitors and that are normally evaluated by adult judges [4]. It requires and effectively involves the students actively on their learning process, and, when on developing their scientific projects they learn science and learn how to make science. This scientific productions also can be expose to other people to see and learn with it [5]. Students develop skills that can be useful for their life as students and future careers related with science [3].

2. The 2nd Science Fair organization

During the school year of 2010-2011, the first edition of the science fair was organized [6]. Taking into account the wide acceptance by teachers, participating students, and visitors, it was decided to continue with the initiative.

As for the first edition the science fair announcement was made at the beginning of the school year by e-mail to schools and teachers publicized at the science fair website and also on the website of the University of Minho.

The registration was to be done in two phases: the first when students manifested their willingness to participate giving an idea on the number of participants and a general indication about the project that each group was planning to develop; and a second phase, closer to the date of the science fair, where students gave to the Science Fair organizers the final information about their work and their presentation needs such as workspace, electricity, water supply,...

The fair was aimed at students from the 5th to 12th grade (aged 10 to 18 years) from regular or professional education and was divided into 3 age categories: 5th and 6th grades, 7th to 9th grades and from 10th to 12th grades.

The main goal was for students to develop a scientific project in any field. Several factors were evaluated, such as scientific rigor, quality of presentation, originality, and interdisciplinarity.

© 2012 HSci. ISBN 978-989-98032-0-6

On the day of the fair, all participants received a certificate and a t-shirt. It was also assigned a 1st, 2nd, and 3rd prizes along with honorable mentions. It is important to stress that these awards and honorable mentions were only symbolic since the goal is to challenge students to learn as much as possible, while having fun, and not to compete for major prizes.

3. The evolution of the fair participation

The science fair has evolved positively, on the number of participants, visitors and in the quality and diversity of projects presented.
On Table 1 it is possible to see how the number of responsible teachers from projects, the number of projects and the number of participants evolved.

Table 1. *Resume from participation on the two editions of the fair*

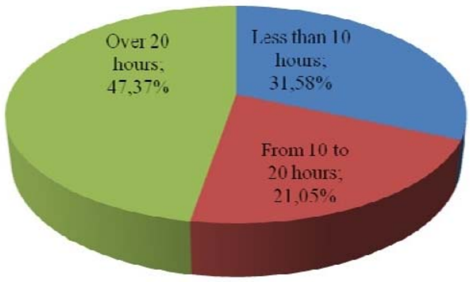
	1st edition	2nd edition
Nº of schools	8	9
Nº responsible teachers	9	14
Nº of projects	38	58
Nº of participants	131	178

Despite the number of schools remained approximately equal, the number of teachers responsible for the projects increased. That means that some of the colleagues that already participated on the first edition urged other teachers from their school to also participate. This means that a wider spread of this event will quickly translate into greater acceptance and participation.
During the year, 5 teachers in charge of 4 different schools chose not to participate. One didn´t present a plausible argument, two failing to finish the project and the remaining 2 teachers who had already participated in the previous year, just did not to participate for economic reasons, since participation involved the payment of the travel expenses in one of the cases. Similar problems occurred in the 1st edition of this event.

4. Teacher's opinion

To better understand the evolution of this event, at the end of each edition the same questionnaire was distributed to the responsible teachers.
One of the facts to be aware was how much time was available to help students and in what circumstances it was done.

Observing the Figure 3 it is possible to see that, in second edition, teachers had more available time than in the first edition. On **¡Error! No se encuentra el origen de la referencia.**, we can see how teachers managed their time to help students. In a general way, teachers involved their subjects on the development of their projects. Most interesting was the fact that teachers of physics and chemistry were the most active, followed by biology, but in less number. The appearance of other subjects beyond these seemed to be only occasional. Therefore, now it is necessary to wait for the 3rd edition to see if this trend continuous or if teachers from others subjects started to participated, even if in collaboration with other fields.



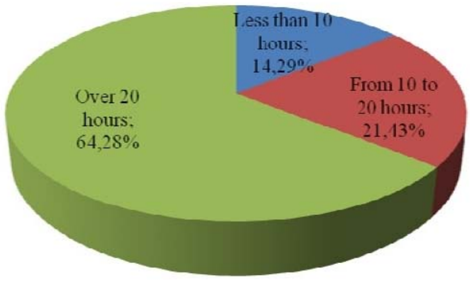


Figure 3. *Time available from teachers to help students on 1st (top plot) and 2nd (bottom plot) edition of the science fair*

During the first edition, a subject called project area, was inserted into the Portuguese curriculum. This "subject" without a mandatory curriculum aimed to teach students to develop projects, and as you can see, several teachers (16%) chose to develop science fair projects to this science fair. With the extinction of this "subject", teachers seemed to start focusing more on science clubs or other projects (others) developed by schools that allowed the inclusion of participation in the science fair. However, this work done by teachers and students is still fairly

© 2012 HSci. ISBN 978-989-98032-0-6

supported by other teachers, students and members of the school board.
The fact that these projects are being developed in classes, has led to an increase in the number of teachers who have this work as an evaluation in their subject.
It is important to note that this seems to happen more often with 12th grade students (last year before university) in the subjects of physics, chemistry and biology. However, these subjects are optional, chosen by students and their main objective is to stimulate students to careers that involved them and prepare them for college education in the field. In addition, the themes of these students were quite diverse, not appearing to have been the imposition of themes. In other words, these students had the freedom of choice, which is important for their motivation.

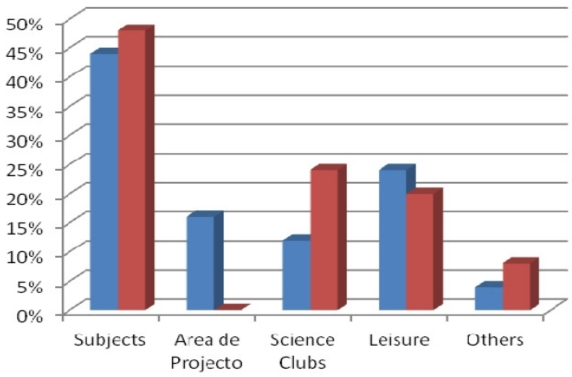


Figure 2. *Places where teachers helped their students (left bar – 1st edition; right bar – 2nd edition)*

A case to refer was of a school with students from the 7th grade (first year of physics and chemistry on their curriculum), where all their projects were based on a theme related with the physics and chemistry curriculum. But even there students participated and seemed motivated. However, the similarity between the projects did not allowed any of them to stand out. The same fact happens on the 1st edition with some groups from 10th grades, where all the groups developed projects related with renewable energies.
For the work done by the students, in general, in the two editions, teachers believed that the students worked with a lot of enthusiasm, commitment, imagination, rigor and autonomy. However, the imagination, rigor and autonomy are aspects that can still be improved.
Teachers say that the students' participation in this project has brought some benefits to the discipline which focused on his work, but that the benefits were even more general. Participation in these science fairs, allowed developing skills beyond those that would be necessary only for their subject.
Thus, this is a type of activity that all teachers say they will continue to work. And insert the development of scientific projects in the classroom is a possibility for 75.76% of the teachers surveyed. The other teachers, despite recognizing the benefits of the activity, say it is not possible to include these projects in the classroom due to the large extension of the curriculum. It should be noted that even for teachers that consider feasible the inclusion of science fair projects in the classroom, consider the curriculum too extensive, and need the coordination with teachers from other fields and the school community in general.

5. Student's opinion

When questioned about the reasons that led them to participate in this activity, the students, in the two editions, gave us several answers, being the most predominant, the fact that they like science, as it is possible to see on Figure 4.

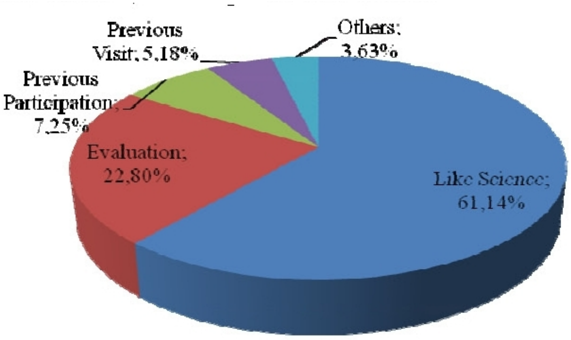


Figure 4. *Reasons for student's participation*

22,80% of the students presented as a motive the fact that their participation counts to their evaluation. However, from these students only 13,47% gave it as the only reason. The others factors were the previous participation or visit to others fairs, including the first edition of this science fair. The other answers were essentially related with the fact that students felted a curiosity and wanted to experiment.
Despite the reasons for students participation, at the end of the fair, 96,4% of them left with the desire to repeat the experience. This means that from a universe of 309 students only 7 said that they didn't want to repeat and 4 didn´t answered.
To know under what conditions the students worked, we questioned about the duration of

© 2012 HSci. ISBN 978-989-98032-0-6

project development, as seen in

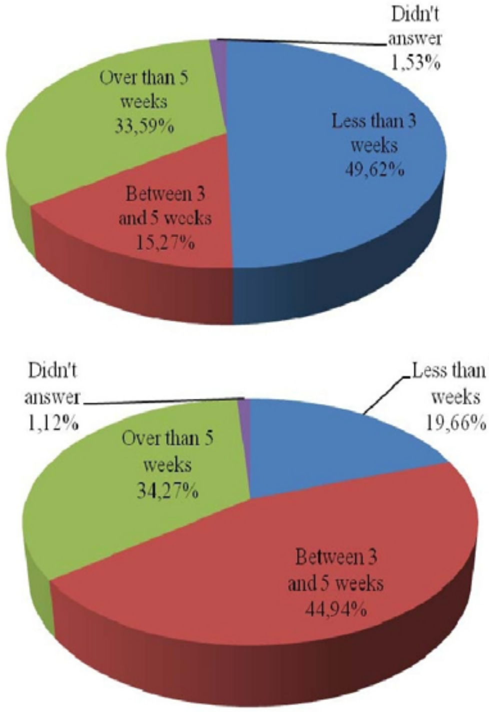


Figure **5**. With this information it is possible to see a significant increase on the time spent by students, and these projects are being done throughout the school year.

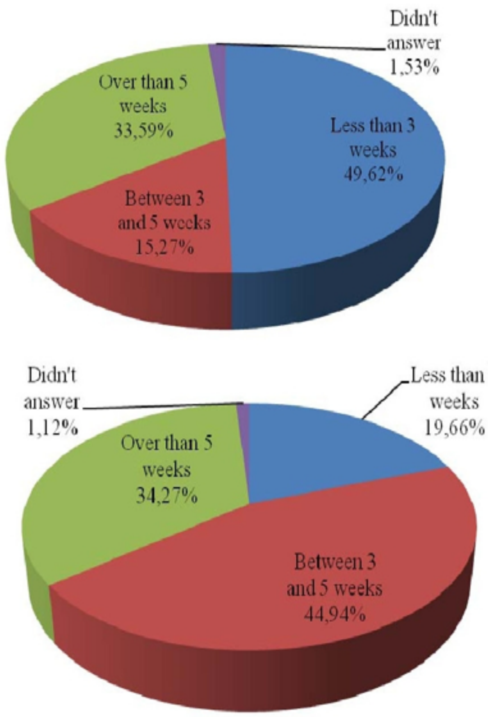


Figure 5. *Time schedule for student's to develop their projects, during the 1st (top plot) and the 2nd edition (bottom plot)*

In Figure 6 we can see the places where students worked more for science fair projects. A large percentage of students worked at school, during class, in both editions, in agreement with the answer given by the teachers. The same way we can see that there are no major changes regarding the number of students who worked at home or in their free time at school. However, it is interesting to see that the number of students that decided to spend their spare time working is quite high.

Finally, it was decided to figure out who these young scientists relied for help in developing the project. The

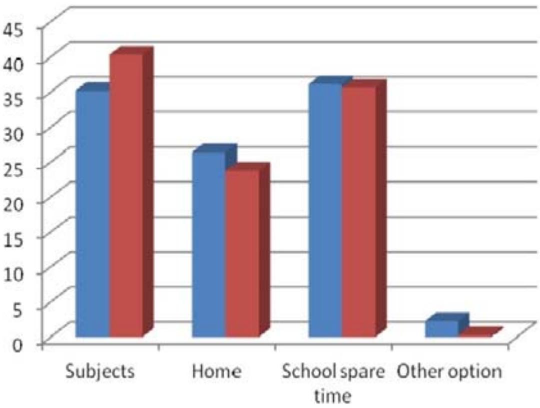


Figure **7** proved what was said previously. Teachers of physics and chemistry seemed to be more involved, and their involvement increased significantly. Then comes biology teachers, geology, and the remaining subjects appeared punctually.

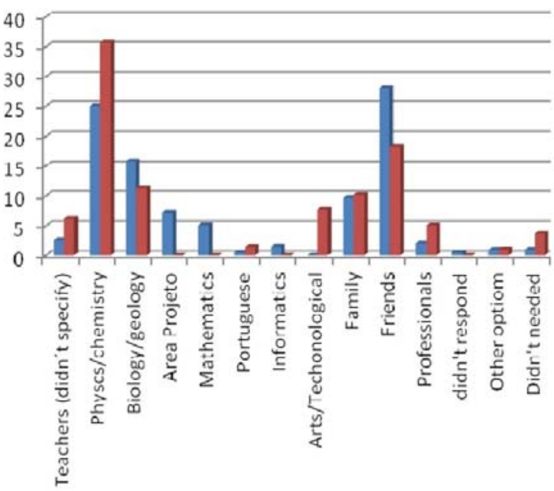


Figure 6. *Places were students work to their project, in percentage (left bar – 1st edition; right bar – 2nd edition)*

© 2012 HSci. ISBN 978-989-98032-0-6

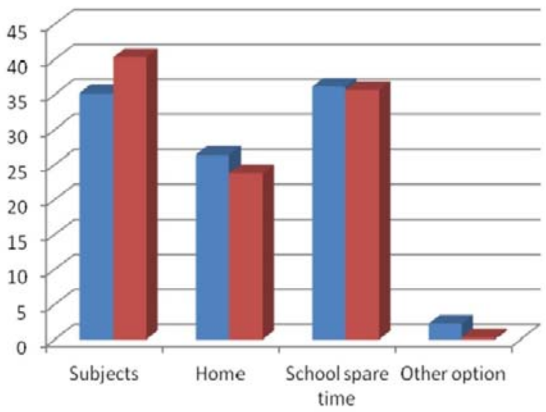


Figure 7. *Aid provided to students throughout the two editions, in percentage ((left bar – 1st edition; right bar – 2nd edition)*

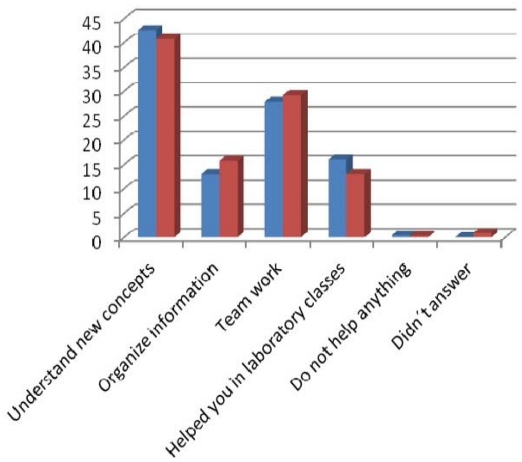


Figure 8. *Benefits for participating in the science fair, in percentage (left bar – 1st edition; right bar – 2nd edition)*

After the help of teachers from various subjects, friends seem to be the most requested help. However, still sees a demand of family members for help in developing the project, as well as the demand for specialists in the field of work.

The last question was to understand what students though about the development of science projects, as it is possible to see in Figure 8. The answers on the two editions were very similar. The most mentioned by students is that it helped them to understand some new concepts. That means that it is really possible to use this kind of projects to teach concepts or to help students to understand them. One important aspect of this activity was to help them to work in team. This can be proven, given the previous answers that reveal that, apart from working in the context of the classroom, these students have provided much free time at home and at school.

Finally, some of the students referred that these activities also helped them to learn to select and organize information and to handle lab materials, skills that can be useful in classes, especially in laboratory.

6. The 3rd Science Fair Hands-on Science

Our research work on Science Fairs will be further continued. 3rd edition will follow the same characteristics of the previous ones with a change on the location. This time, it will be organized in a school at the coastal town of Viana do Castelo. The Fair will be organized with the help of the school community, including older students. The students that will not want to present a project will be co-responsible for the science fair organization.

We will follow with this study and try to observe the evolution of the fair and the opinion of teachers and students and to verify if trends herein reported remains.

7. Conclusions

These two years of science fairs clearly enabled us to conclude that this is an activity welcomed by teachers and students allowing the effective development of various valuable skills competencies and knowledge, at a procedural conceptual and attitudinal level.

Despite the extension of programs leading to a lack of time for the development of a scientific project, teachers and students seem to be able to find a way to successfully incorporate it in the context of the classroom. There is a greater involvement of both, students and teacher, in trying to make the learning/teaching experience successful, even if it means working extra during leisure time both at school and at home.

8. Acknowledgements

This work was partially supported by the project Pri-Sci-Net funded from the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement no. 266647.

9. References

[1] H. Westbroek, K. Klaassen, A. Bulte, and A. Pilot, "Providing Students with a Sense of Purpose by Adapting a Professional Practice," *International Journal of Science Education*, vol. 32, no. 5, pp. 603-627, Mar. 2010.

[2] A. Salisbury, "Mechanisms for popularizing science through formal and

informal education," *International Journal of Mathematical Education in Science and Technology*, vol. 18, no. 4, pp. 535-545, Jul. 1987.

[3] A. M. A. Corsini and E. S. N. N. Araújo, "Feira de Ciênccias como Espaço Não Formal de Ensino: Um Estudo com Alunos e Professores do Ensino Fundamental," in *VI Encontro Nacional de Pesquisa em Educação e Ciências*, 2007.

[4] M. Grote, "Teacher Opinions Concerning Science Projects and Science Fairs," *Ohio Journal of Science (Ohio Academy of Science)*, no. January, 1995.

[5] Z. Esteves, A. Cabral, and M.F.M. Costa, "Informal Learning at School. Science Fairs in Basic Schools," *International Journal on Hands-on Science*, vol. 1, no. 1646–8937, pp. 23-27, 2008.

[6] Z. Esteves and M.F.M. Costa, "1st Hands-on Science Science Fair," in *Proceeding book of the joint international conference MPTL '16 - HSCI 2011*, 2011, pp. 204-211.

USING COMBUSTION OF GUNPOWDER FOR TEACHING LAW OF THE MINIMUM: A DEMOSTRATION EXPERIMENT

C. Tüysüz, B. Yildirim, O. Karahan
Mustafa Kemal University, Education Faculty, Elementary Education Dept., Hatay, Turkey
ctuysuz@mku.edu.tr, byildirim@mku.edu.tr, osman_karahan_23@hotmail.com

Abstract. *For synthesizing a specific chemical product, substances must mixed with a certain ratio. Providing this ratio is particularly important for compounds which produced by living things because they grow up with synthesizing these compounds. According to "law of the minimum" living things especially plants grow depending on the limited resources. In this study, focused on for teaching of this law using combustion of gunpowder can be used. Gunpowder is a mixture of different substances in a specific ratio. Lacks of any substances restrict the violence of combustion. Therefore gunpowder can be used for teaching the law of the minimum.*

Keywords: Combustion of gunpowder, demonstration experiment, Law of the minimum.

1. Introduction

A synthesis reaction is a process that leads to synthesize a new substance by combining certain amounts of two or more substances and losing their characteristics. In general, synthesis reactions formulates as "aA + bB →cC". A and B represent to reactants which may be an element such as Fe, O_2 or a compound such as CO_2 and H_2O. C represent to product which made by reacting of A and B. Products are components in synthesis reactions. While some reactions such as organic reactions form different products which are formed by different combinations of reactants, many reactions form only a single product. To produce this type product, substance be used with the types and amounts of substances in the product. A person, who wants to get a particular product, must use the substances which will include in the product at the beginning of the reaction with the same proportion. For example, if a person wants to synthesize H_2O by using H_2 and O_2, hydrogen should be used twice as the number of molecules of oxygen. An excess of any substance over this ratio will not be used because of the depletion of other substance. In reactions which have many reactants, all substances that over the optimum rate, don't react and remain.

In similar to the example above, iron (Fe) and sulfur (S) reacts to form FeS. Because all the coefficients are one, an iron atom reacts with a sulfur atom to form a molecule of FeS. If only one atom of Fe is present, only one molecule of FeS can be formed, no matter how many atoms of S are present; and likewise if only one atom of S is present, only one molecule of FeS can be formed, no matter how many atoms of Fe are present We suppose that "u", "v" and "w" are specific reactive values of A, B and C respectively and uA, vB and wC are necessary for the formation of a unit of X. If pA, qB and rC react, the amount of X formed is depending to the smallest of the fractions p/u, q/v and r/w [1].

An example of complex synthesis reactions which use many reactants to form desired products is biochemical reactions take place in the biological environments. From Protista to Plantae all species forms the biochemical structures which necessary for live, produce energy or growing. All living creatures have to get all components of these biochemical structures from the outside. Plants get minerals required for the growing from the soil. Each of these minerals take part in plant growing, so plants cannot grow on the soils lacks at least one of these minerals. If there is quite a lot from each of these minerals, the plant grows very fast; however, the growth rate in each case is not unlimited. One of the scientific expressions related to the effect of sources to development of the living things especially plants is "law of the minimum". According to this rule, growth of a plant is limited by the scarcest resource. The basis of this rule get involved in Carl Sprengel's article in 1828 but it was described in detail by Justus von Liebig in 1840. So this rule is named as "Liebig's rule", "Sprengel - Liebig law" or "law of the minimum" [2], [3].

Plants get seven essential minerals from the soil. These are sulfur(S), phosphorus (P), nitrogen (N), potassium (K), calcium (Ca), magnesium (Mg) and iron (Fe). If αS, βP, γN, δK, εCa, λMg, and θFe are required for a unit amount of in some particular plant, and if aS, bP, cN, dK, eCa, fMg, and gFe are present in a particular soil in available form, the maximum amount of growing depends on the smallest of the fractions a/α, b/β, c/γ, d/δ, e/ε, f/λ, and g/θ [1]. For plants the limiting factor may not only minerals but also water, carbon dioxide, amount of illumination etc. According to Cade et al. [4] any one of these factors can potentially limit growth, but at any time only one factor limits growing [5].

2. Gunpowder and its combustion

Gunpowder is a mixture of three ingredients: potassium nitrate, sulfur and charcoal. The sulfur and charcoal act as fuels, while the potassium nitrate acts as oxidizer. By themselves, charcoal and sulfur will burn, albeit very slowly. The addition of an oxidizer such as KNO_3 greatly speeds up the burn rate of the fuel, resulting in an explosive reaction. Optimum ratio of these three ingredients for gunpowder is %75 KNO_3, % 15 C and % 10 S by weight [6].

When ingredients are mixed with the optimum rate, all of them used up and the reaction takes place in the most violent manner. If this ratio are changed one or two substances may not completely reacts and reaction take places in low-violent. For example if KNO_3 is decreased the reaction occurs slowly, and a part of the fuel does not burn or burn very slowly. If KNO_3 is increased or one of the fuels is decreased, too much oxygen is produced than enough to fuels and reaction occurs suddenly but low violent. Missing ingredient of gunpowder is limiting factor that limit the violence of reaction, no matter the amount of excess ingredient.

2.1. Using combustion of gunpowder for teaching law of the minimum

Gunpowder is a substance that burns depending on the components rate. The lack of one of its components reduces the reaction efficiency. Substance under the optimum ratio limits the reaction. Due to combustion of gunpowder is an event occurring quickly, the effect of ingredient's ratio on intensity of reaction can be observed easily. Additionally the amounts of the residue help to see how the changing in the amount of substances affects the reaction efficiency. So combustion of gunpowder may be used for the teaching law of the minimum. In this study demonstration experiment method is preferred. The target group is high school students (grade 9-12), college students, teacher candidates and teachers. Number of participants is up to twenty.

3. Materials

For this experiment a metal-coated or marble table, 750 g Potassium Nitrate, 150 g sulfur, 100 g charcoal and a lighters or matches required are required. Keeping a fire extinguisher is beneficial.

4. Risk and Security Codes

People conducting or watching the experiment must take into account following risk and security codes.

R2, R3, R5, R7, R10, R20, R30, R34
S1/2, S3/7, S7/8, S14.9, S16, S17, S21, S23.5
S36/37/39, S41, S43.1

For descriptions of these codes, please look at http://www.safcglobal.com/help-welcome/risk-and-safety-statements/risk-and-safety.html

5. Method

Three ingredients mentioned are mixed in different proportions. Each mixture must be equal (about 20 g). Each of the mixtures burns and we see that each of them light in different intensity. Some mixtures don't occur at full performance and remain the residues. The reaction occurs depending on the ingredient that was provided in at least.

6. Result and discussion

Due to combustion of gunpowder is an event occurring quickly, the effect of ingredient's ratio on intensity of reaction can be observed easily. Additionally the amounts of the residue help to see how the changing in the amount of substances affects the reaction efficiency. It can be observed easily that reducing any component of gunpowder how acts limiting effect on the reaction rate. So combustion of gunpowder may be used for the teaching law of the minimum.

7. References

[1] Hooker HD. Liebig's Law of the Minimum Relation General Biological Problems. Science 1917; 46: 197-204.

[2] Gorban AN, Pokidysheva LI, Smirnova EV, Tyukina TA. Law of the Minimum Paradoxes. Bulletin of Mathematical Biology 2011; 73(9): 2013-2044.

[3] HK, GD. “Liebig’s Law” Dictionary of Theories 2002; 311.

[4] Cade BS, Terrell JW, Schroeder RL. Estimating Effects of Limiting Factors with Regression Quantiles. Ecology 1999; 80: 311-323.

[5] Hiddink JG, Kaiser MJ. Implications of Liebig’s Law of the Minimum for the Use of Ecological Indicators Based on Abundance. Ecography 2005; 28: 264–271.

[6] Onyelowe KC. Rock Blasting and Aggregate Production with Gunpowder as An Explosive. International Journal of Structronics & Mechatronics 2012; 1(1): 45-51.

CAN HANDS ON SCIENCE EXPERIMENTS DEVELOP STUDENTS SCIENTIFIC PROCESS SKILL? A MODEST PROPOSAL FOR SCIENCE TEACHERS

N. Hırça
Bartın University Primary Science Education Department, Bartın, Turkey
dr.hirca@gmail.com

Abstract. *Although laboratory experiments provide students considerably learning science and develop their scientific process skills, most of experienced teachers have difficulties in doing experiment or they prefer not to conduct experiment due to having adequate laboratory equipment. The aim of this article is to present hands on science experiment which includes low cost material for teachers from primary school to up to get their students to improve students’ scientific process skills such as formulating models, constructing tables of data and graphs, identifying and controlling variables skills that recognized by science and technology program. It is recommended that science teachers, when they need, should prepare science experiment syllabus that includes low cost materials for improving their students Science Process Skills.*

Keywords: Experiment, Hands on Science, Scientific Process Skill, Student, Teacher.

1. Introduction

In science education, everyone knows that laboratory experiments provide students considerably learning science and develops their scientific process skills (SPS) [1,2]. Modern experimental physics uses very sophisticated and expensive apparatus, for the most part, in large research institutes and laboratories. But, several studies indicated that some schools don’t have laboratory and adequate laboratory equipment. Thus most of experienced teachers have difficulties in doing experiment or they prefer not to do experiment due to lack of specific equipment [3,4].

Hands-on science is an effective way for students to get first-hand experience in scientific methodologies. Moreover Turkish science and technology curriculum and several studies point out that science teachers could conduct science experiments with low cost material or children’s toys instead of laboratory equipment [5,6,7]. However teachers who are really sophisticated in their occupational field can’t use low cost material for doing experiments appropriately [3,4,8]. So, science teachers have to know how to conduct science experiment with low cost materials or/and toys unlike they couldn’t reach adequate laboratory equipment in their school. The aim of this article is to present hands on science experiment which includes low cost material for teachers to get students to improve their scientific process skills.

2. Material and Method

In this section, a process of planning and conducting a sample experiment is presented for teachers for developing their students’ SPS. In this experiment, students deepen their understanding of the uses of the simple design equal-arm balance as they place a variety of objects in the pails and observe and compare the results.

© 2012 HSci. ISBN 978-989-98032-0-6

As we know, mass measurement is a fundamental skill in most physical sciences, including biology, chemistry, and earth science. Students must be familiar with mass measurement and properties in order to understand practical and theoretical topics in science. In conclusion, students will also find out how much they can trust their balance in answering questions.

Hypothesis: Predict about the individual weights of each object in the pair, as well as which object will be heavier and by how much.

Materials: Wooden or plastic ruler, coins, stones, bottle caps, tightrope, paper clips (Hint: paper clip to nearest 1 g, mass of 1 kuruş is 2.2 g (kuruş is Turkish coin), mass of 5 kuruş is equal to 2,9 g, 25 kuruş is equal to 4 g, 50 kuruş is equal to 6,8 g)

Procedures: Take a wood or plastic ruler and make a hole in the center of it. Make two weighing pans from bottle caps and tie them to ruler. First of all, move the rider (sensitivity) to the left and right when the cups are clean and empty for balance.

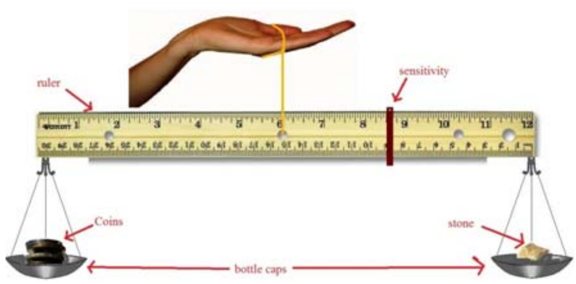


Figure 1. *Measuring mass of stone equaling to coins*

Use coins instead of masses. Measure the stone's mass when it is equal to coins. Put the stone in right cap and for balancing, put the coins in left caps one by one and calculate the mass of stone five times to get a good average value.

Recording data: Record these calculations in your data sheet below:

Massing number	Balance reading	Massing number 2	Balance reading
1		1	
2		2	
3		3	
4		4	
5		5	

Compare and discuss your data with your friends in your lab group.

Mathematical operation: An important aspect of doing experiment in physics is learning to take accurate measurements and to have an estimate of the error involved in making such measurements. You took five measurements of the same quantity for calculating the standard deviation. Now, calculate the average of your measurements and the difference between each of the measurements from the average. Sum the squares of the differences and divide by the number of measurements. Take the square root and this is your standard deviation. In equation form this method looks like:

$$\sigma = \sqrt{\frac{\sum_i (a_i - \bar{a})^2}{n}},$$

where, σ is the standard deviation, a is a measurement, $\bar{a}$ is the average of the measurements and n is the number of measurements made.

Conclusion: What is your standard deviation? Why did you calculate same object in several times? Do you believe in accurate measurement?

3. Discussion and Conclusion

Nowadays in Turkish education faculties, some courses were has been implemented to familiarize prospective teachers with linking Hands on science activities. It is expected that these course should be developed to conduct science/physics experiments which able to improve some SPS such as formulating models, constructing tables of data and graphs, identifying and controlling variables skills as science and technology program recognized. In that time teacher candidates, when they need, can prepare science experiment syllabus include low cost materials instead of laboratory equipment for improving their students Science Process Skills. To sum up, teachers must be recognized the science process skills because they design activities for teaching these skills to their students [9].

4. References

[1] Ausubel, D.P. Educational Psychology: A Cognitive View. New York: Holt, Rinehart & Winston; 1968.

 ISBN 978-989-98032-0-6

[2] Karamustafaoğlu, S. Improving the Science Process Skills Ability of Science Teachers Using I Diagrams, Eurasian Journal of Physics and Chemistry Education 2011; 3(1), 26-38.
[3] Ayas, A., Çepni, S. and Akdeniz, A. R. Fen Bilimlerinde Laboratuvarın Yeri ve Önemi I, Çağdaş Eğitim Dergisi 1994; 19, 21-25.
[4] Böyük, U., Demir, S., and Erol, M. Fen ve Teknoloji Dersi Öğretmenlerinin Laboratuvar Çalışmalarına Yönelik Yeterlik Görüşlerinin Farklı Değişkenlere Göre İncelenmesi, TÜBAV Bilim Dergisi 2010; 3(4), 342-349,
[5] Milli Eğitim Bakanlığı (MEB). İlköğretim fen ve teknoloji dersi 4., 5., 6., 7. ve 8. sınıflar öğretim programı. Ankara 2005; MEB Yayınevi.
[6] Ateş, Ö., and Eryılmaz, A. Effectiveness of hands-on and minds-on activities on students' achievement and attitudes towards physics. Asia-Pacific Forum on Science Learning and Teaching, 2011; 12(1), 6
[7] Uzal, G., Erdem, A., Önen, F. and Gürdal, A. Basit araç gereçlerle yapılan fen deneyleri konusunda öğretmen görüşleri ve gerçekleştirilen hizmetiçi eğitimin değerlendirilmesi. Necatibey Eğitim Fakültesi Elektronik Fen ve Matematik Eğitimi Dergisi 2010 4(1), 64-84.
[8] Önen, F. and Çömek, A. Öğretmen adaylarının gözüyle basit araç-gereçlerle yapılan fen deneyleri. Batı Anadolu Eğitim Bilimleri Dergisi 2011; 3 (1), 45-72
[9] Jaus, H. H. The effects of integrated science process skill instruction on changing teacher achievement and planning practices. Journal of Research in Science Teaching 1975; 12, 439-447.

AN OUTDOOR HYDROBIOLOGY ACTIVITY'S EFFECT ON STUDENTS' AFFECTIVE PERSPECTIVE, CASE STUDY: CANAKKALE, SCIENCE CAMP

E. Okur, Y. Güder, B. Sezer, Ş. Yalçin-Özdilek
Canakkale Onsekiz Mart University, Faculty of Education, Canakkale, Turkey
emelokur17@gmail.com, yusufguder17@gmail.com, burcinsezerr@gmail.com, syalcinozdilek@gmail.com

Learning research usually focuses on the cognitive area while the affective learning area is ignored. However, nowadays affective concepts such as empathy have become recognised. The aim of this research is to determine the affective perspective of pupils to an outdoor hydrobiology activity. A form designed to elicit the students' opinions is given to them after each activity asking them to fill it out. The forms are evaluated by discourse analysis. It is found that the students learn best by handling the specimens found in the stream. The activity is considered to be interesting and enjoyable, and a change in the students' perspective on stream life has occurred.

Keywords: Outdoor education, haptic learning, science camp, hydrobiology.

ENERGY HUNTERS: HOME INSULATİON SHOW FOR A SUSTAİNABLE LİFE HANDS-ON WORKSHOP

O.B. Arslanoğlu
EĞLEN BİLİM Eğlenceli Bilim Etkinlikleri
ENJOY SCIENCE Scientific Entertainment Activities
onurberk@gmail.com

Thermal insulation is the reduction of heat transfer between objects in thermal contact or in range of radiative influence. Heat transfer is the transfer ofthermal energy between objects of differing temperature. The means to stem heat flow may be especially engineered methods or processes, as well as suitable static objects and materials.

Part of achieving energy efficiency is using good insulation. The definition of good insulation, from an environmental stand-point, should include insulation made from recycled materials that does not contain chemical irritants like formaldehyde. “Energy Hunters: Home Insulation Show for a Sustainable Life” workshop is prepared for primary school pupils of age between 7 – 12. Workshop is designed as is a day-time TV-style show all insulation and saving energy in the home. Warmly presented by friendly hosts. The show encourages the pupils try out different energy-saving initiatives, and turns the issue of domestic energy use into an exciting challenge. First, by the help of a quiz show, all pupil groups collect some score and then spending that score brings different types of insulating materials. All applications in this activity are carried on by the pupils.

WHAT DO CHILDREN KNOW ABOUT THEIR BODY PARTS: WHAT WOULD DO IF THERE IS A LACK?

H. Uysal[1], B Akman[2]
[1]*Nigde Universitesi Eğitim Fakültesi, Turkey*
[2]*Hacettepe Universitesi Eğitim Fakültesi, Turkey*
bakman@hacettepe.edu.tr, huysal@nigde.edu.tr

The aim of the study is to gain childrens’ information about lack of body parts. 46 children who are 60 to 72 months old take place. This study is conducted at two kindergartens which depend to Ministry of Education in Nigde, Turkey. A question list which has names of 35 body parts is used as a data collection tool. Children ask to tell that what would do if we haven’t x (a body part). Also a researcher make an interview with teachers that what/how they teach about organs. Then data which get from children are analyzed and obtain frequency distribution. As a result most of the children tell him/her doesn’t know anything about nape, skin and elbows. Some children mention the importance of the organs. However some children express that don’t know anything. The results discussed under the light of other studies.

Keywords: preschool age, organs, body knowledge.

A REVIEW OF RESEARCH ON HANDS-ON PRACTICES IN SCIENCE CLASSROOMS IN TURKEY

M. Özel, M. Erdoğan
Niğde University, Niğde, Turkey
Akdeniz University, Antalya, Turkey
muratozel@nigde.edu.tr, mozeltr@gmail.com, mmerdogan@gmail.com

This study aims to collect and analyze the research on hands-on practices in relation to science education in Turkey undertaken over the years 2000-2011. For systematic analysis, selected data-bases (e.g. ULAKBIM, EBSCOhost), refereed journals, master and PhD thesis were examined across five pre-determined criteria. The criteria determined for the study were; (1) studies sampling subject in various levels – students, graduates and teachers in Turkey, (2) studies designed as interventional study (e.g. experimental), (3) studies published in selected sources, (4) studies undertaken over the years 2000 – 2011 and (5) studies involving hands-on practices and laboratory instruction in science classroom. The examination of the selected resources resulted in 14 studies to be in line with pre-determined criteria. The selected studies were further subjected to content analysis to present the trends and to synthesize the common findings of the selected studies. Analysis of the selected studies was undertaken in five steps. These steps were (1) conducting a search of determined keywords in the selected sources and gathering the studies; (2) using a coding form, so called article index card; (3) excerpting the relevant information from the studies, (4) constructing table by considering this information, and (5) analyzing, interpreting and summarizing the results. The analysis in five steps revealed that the studies focused upon the effects of hands-on and laboratory practices on five outcome variables; achievement, anxiety, attitude, and science process skills. Furthermore, significant effect was reported in all selected interventional studies though some of the studies indicated that hands-on and laboratory activities fail to change students’ attitudes toward science. In general, the careful analysis of the effects of intervention pointed out that hands-on practices and laboratory activities in these selected studies contributed to development of participants’

conceptual understanding associated with science topics.

Keywords: hands-on practices, laboratory activities, content analysis, Turkey.

HANDS-ON MICROSCALE EXPERIMENT IN ENVIRONMENTAL CHEMISTRY

S.P. Kamat[1], S. Torres[2]
[1]*Department of Chemistry, Goa University, Goa 403 206 India*
[2]*Department of Chemistry, Carmel College for Women, Nuvem, Goa 403601, India*
shrivkamat@yahoo.com, saviatorres@yahoo.com

Chemistry is an experimental science and hence hands-on activities and demonstrations form the most critical element of instruction in chemical education. It is the vehicle by which students get a true insight into the scientific/chemical process. It is also the most remembered and visible aspect of science. Therefore, experiments, activities and demonstrations must be designed and developed that motivate, challenge and excite students. This has posed serious challenges to science educators to devise and execute activities and demonstrations especially at the school level. During the past 20 years, we have developed several activities, experiments and kits using microscale techniques at all levels. ‘Hands-on Microscale Experiments in Environmental Chemistry’ is a set of microscale experiments designed to study atmospheric pollution by gases like CO_2, oxides of nitrogen (NOx) and oxides of sulfur (SOx) mainly formed during the burning of fossil fuels by vehicles and industries and can be easily understood and enjoyed by all levels of students from preschool children to University and even general public. Our experience is that students at low levels who may not understand the Chemistry involved, get excited while performing these experiments and thus take lot of interest in Science and Chemistry which is the need of the hour.

These experiments make use of a unique microscale technique which is incorporated in a low-cost, compact, light-weight and portable Microscale kit (http://www.cen-online.org/articles/90/i8/Makeshift-Chemistry.html). This specially designed innovative kit 20(l) ×12(b) × 6(h) cm. containing in all 24 items including eleven chemicals and a booklet will be used to perform these experiments. Most of the items are made of plastic and paper. All the participants can actively participate i.e. perform these experiments themselves while the Instructor is explaining them on a board in a regular classroom and no laboratory is required. Depending upon the number of participants, one kit can be conveniently shared by 2 to 4 participants. The quantities of chemicals included in the kit (1.5 to 2.0 mL in each vial) are sufficient to perform these experiments several times and the same kit can be used ‘n’ number of times with fresh chemicals. Guidelines to prepare these chemicals are also included in the booklet.

Purpose

1) To motivate students as well as teachers at all levels to develop interest in the subject of Chemistry in general and Environmental Chemistry in particular.
2) To develop awareness amongst all regarding Pollution in general, global warming and pollution of air.
3) To introduce to students and teachers the concept of performing Chemistry Experiments using ‘Microscale’ (downscaled or very small quantities) of chemicals and Microscale Techniques and thereby decrease pollution.

We strongly feel that our unique approach of combining Microscale Chemistry with low-cost equipment, the ‘Microscale kit’ will go a long way to promote hands-on science activities with limited resources especially in developing countries.

© 2012 HSci. ISBN 978-989-98032-0-6

PRE-SERVICE SCIENCE TEACHERS' VIEWS ON NATURE OF SCIENCE IN INQUIRY-BASED LABORATORY INSTRUCTION

S. Ozgelen[1], O. Yılmaz-Tuzun[2]
[1]*Mersin University, Faculty of Education, Elementary Science Education, Mersin, Turkey*
[2]*Middle East [2]Technical University, Elementary Science Education, Ankara, Turkey*
sozgelen@gmail.com, ozgul@metu.edu.tr

The study aimed to explore the effect of explicit-reflective and inquiry-based laboratory teaching on preservice elementary science teachers' understandings of the nature of science (NOS). Totally, 52 preservice science teachers (PSTs) enrolled in the Laboratory Application in Science II course. Specific inquiry-based science activities were applied during the semester. The design of the study was qualitative and exploratory in nature. Data was collected from pre and post participants' responses for the VNOS-B. This study utilized inquiry-based laboratory activities and the participants had chances to reflect on their understandings about NOS. The results showed that at the beginning of the semester, many of the PSTs held NOS views, which are described as 'inconsistent' with science reforms similar to past studies, such as a hierarchal relationship between theory and law; a conception of laws as universal and absolute; the notion of scientists as objective. However, at the end of the study, post data results showed that many of the PSTs furthered their understanding for many aspects of NOS. Moreover, as a group, the PSTs' number of statements that were aligned with contemporary views of NOS increased for all aspects at the end of the course. It can be concluded that, explicit-reflective instruction is effective to improve preservice elementary science teachers' NOS understanding when implemented in the context of inquiry-based laboratory courses. The constructivist approach was based in the present study, according to this approach, learners' experiences affect their cognitive structures, and scientific knowledge is constructed when individuals engage socially in discussions about shared problems or tasks. It can be stated that, after engagement in the explicit-reflective and inquiry-based laboratory activities PSTs constructed their understanding of NOS aspects. According to results, PSTs pointed out the importance of discussions held in small groups and between whole groups during the laboratory activities.

Keywords: Inquiry-Based Laboratory, Pre-service Science Teachers, Nature of Science.

BALLISTIC VEST

A. Gören[1], F. Soares[1], F. Macedo[2]
[1]*Escola Secundária Padre Benjamim Salgado, Rua dos Estudantes, Joane, Portugal.*
[2]*Universidade do Minho, Braga, Portugal*
attila.goren@gmail.com, j.quico@gmail.com

The aim of this work is to demonstrate the launching of a projectile, against a ballistic vest, for educational purpose. In order to perform this work, the combination of two different studies was necessary: one about the combustion of ethanol in a bottle, to create the launch device - that corresponds to the attack system - and another one about non-Newtonian fluids that corresponds to the necessary defence system. The combustion study aims at generating the highest amount of energy in order to launch a projectile (rubber stopper) with the highest possible speed while the non-Newtonian fluids experiment tries to absorb and dissipate the kinetic energy carried by the projectile.
A projectile launcher was developed. The main concern was to guarantee a safe launch and to hit the target in a precise position. Ethanol was introduced in the base hole with a spray bottle and its combustion was triggered with a multipurpose lighter. The fast combustion of ethanol, similar to an explosion, creates the ideal conditions to launch the projectile.
The simplicity and low cost had to be a priority, so a simple non-Newtonian fluid was synthesized using a common starch (2 in 3 parts) mixed with water (1 in 3 parts).
Once constructed the attack and defence system, the cannon of the launch system was pointed against the bag filled with the non-Newtonian fluid (the "ballistic vest") and the projectile was shot against it several times.
The experimental data obtained for the attack system using ethanol as fuel, revealed a velocity for the projectile of approximately 100 km/h.

 ISBN 978-989-98032-0-6

The results of the experiment with the ballistic vest were also clear: a functional substance changes from the liquid state into the solid state during the collision of the projectile into the vest, making it impossible for the projectile to pass through. The prepared liquid shows excellent properties for being considered as a bullet-proof protection and could also be used to teach non-Newtonian fluids in education.

USING HANDS-ON EXPERIMENT TO DEMONSTRATE HOW ATMOSPHERIC PRESSURE AND SYRINGES CAN LIFT AN ADULT

M.S. Yang, J.W. Tang, Z.Z. Lin, Y.Z. Su, C.H. Chou
National Kaohsiung Normal University, Taiwan
maysun5433@gmail.com

The purpose of this paper is to explore the possibility to develop students' concept and understanding of atmospheric pressure with a hands-on physics experiment. The material used to conduct the hands-on physics experiment are low cost objects that are easily acquirable. Two 300ml industrial syringe barrels each with a 5 cm diameter were used. Check valves, 3-way stopcocks, hoses were also used to turn the 50 ml syringe with a diameter of 3 cm into a pump. The hands-on physics experiment demonstrated how atmospheric pressure and syringes acting as vacuum tubes could lift up the object which weighs 20Kg. Thus, by utilizing the atmospheric pressure, it can uphold a person who weighs 50Kg. Students were deeply impressed by this demonstration. Through the hands-on physics experiment students can understand the concept of atmospheric pressure and also learn how to measure it.

Keywords: atmospheric pressure, demonstration, hands-on, industrial syringe barrel, medical syringe.

SCIENCE COMMUNICATION BY CARTOONS AND COMICS: PROPOSAL OF AN EXHIBITION

C.A. Teixeira, M.I. Nogueira, P.K. Srivastava
Faculty of Public Health, Sao Paulo University
São Paulo-SP, Brazil

This is the proposal of a parallel exhibition of Cartoons and Comics to be presented during the 9th International Conference on Hands-on Science (HSCI'2012). Little is known about the use of cartoons and comics for communication of science and technology. There are not sufficient studies that allow a consistent systematic review of the literature published about this theme. The Faculty of Communication of Sao Paulo University (ECA-USP), Brazil, has an academic researcher center that studies comics, the Comics Observatory, where are developed master and doctoral researches on this theme. Yet, even in this research center there aren´t, until this moment, studies related to the public communication of science and technology using cartoons and comics. From August 23 to 26, 2011, ECA-USP hosted the "First International Symposium of Comics". At the symposium from all papers presented a single one was on the theme of science communication - it was presented the results of a systematic bibliographical research on PubMed database and the analysis of the cartoons and comics that were published on the newspaper "Jornal da Paulista", from Federal University of Sao Paulo/Paulista School of Medicine (Unifesp). By October, 17 to 20, Sao Paulo University hosted the "International Symposium: Building Knowledge Networks Through Universidade de São Paulo" and the "International Workshop: Public Communication of Science, Technology and Culture (SCo-T-C&S) Concepts, Actions and Local-Global Implications". Scientists and researchers from Brazil and India spent a time to discuss, construct and consolidate an academic network in the fields of science, technology and culture for the general comprehension of the society. The Symposium considered the main themes that present a mutual challenge in creating political and economic policies and strategies in education, science and technology. The Coordinator of the Brazil-India Symposium and Workshop, Maria Ines Nogueira is member of the program committee of HSCI 2012. By the

 ISBN 978-989-98032-0-6

occasion of the Brazil-India Symposium and Workshop it was organized a parallel exhibition of cartoons and comics: “Communicating Science Through Cartoons and Comics”. It was featured the works of an artist who works in the Unifesp and was the author of cartoons and comics, about health themes, published on the newspaper “Jornal da Paulista”. It was also exposed the work of a press officer of IPT (Brazilian Institute for Technological Research), who is also a cartoonist of science. The exhibition also featured the work of the Indian scientist Pradeep Kumar Srivastava, who will be one of the speakers of the 9th International Conference on Hands-on Science. The exhibition of cartoons and comics at the Symposium and Workshop Brazil-India was composed of 17 works, being the measure of each panel 80 cm wide by 90 cm of compliance. The Organizing Committee of HSCI 2012 decides how many panels may be exposed and what should be the measure of each one.

HANDS ON SCIENCE IN INFORMAL CONTEXTS

R. Patnaik
Azim Premji University, University Resource Centre, Educational Technology & Design, PES SE Campus, Electronic City, Bangalore 560100, India
rajkishore.patnaik@azimpremjifoundation.org

Using *The Story of Physics*, an illustrated comic book in storytelling sessions led the learners (aged 7 to 16) to go hands on. The story starts from fire to goes up to the fundamental particles in a child-friendly way. The teacher acted as a mere narrator/moderator. The challenge for the learners is each one of them would relive the life of a scientist who appears in the story for one month. Pythagoras, Archimedes, Hero from the olden times to Kepler, Galileo, Newton onwards the learners have enough characters to play, play with and play around. They will conduct/simulate the experiments under the same constraints in which the original work was done and share their joys (and frustrations!) of the discoveries/inventions. This line of pedagogy made them appreciate the socio-politico-religious forces that enabled/disabled scientific growth. That was a bigger takeaway than just the mere facts. From the toys made from trash under this theme they could see the evolution in skills, application and understanding of science. Interdisciplinary explorations happened around the story in an organic way.

Keywords: Storytelling.

SCIENCE TEACHING IN PRIMARY EDUCATION, WITH A IBSE PERSPECTIVE - WATER AND ENVIRONMENT

M.F.M. Costa, V.M. de Carvalho Belo
Universidade do Minho, Braga, Portugal
mfcosta@fisica.uminho.pt,
vania.belo@hotmail.com

Water and environment are subjects of great importance today. They are present in basic education curriculum and have major implications in our every day life. Therefore students, the school and society are more and more aware of that importance. However the teaching of these concepts is done, most of the times, in theoretical and demonstrative ways, giving rise to a science education focused on the teacher, who is the sole bearer of expert knowledge, and in which the students play the role of a passive agents, without the possibility to enroll in the learning process and to show their creativity.

The main objective of our research is to discuss and establish strategies for planning and development of practical/ experiments classes to execute hands-on experiments in sciences, based on a IBSE (Inquiry-Based Science Education) perspective, building practical guides to help teachers in the implementation of this activities and identificating strategies that allow the teacher to accept this educational perspective in their classroom. These activities are targeted for students from kindergarten to the third cycle of basic education, exploring the water and environment themes, with emphasis on experimental practice.

The study sample consists of four classes: a class of pre-school with 15 students and respective kindergarten teacher/ educator; a class of 3rd year, basic school, with 21 students and respective teacher; a 5th year class with 20 students and their Natural Sciences' teacher; and a 9th grade class (3rd cycle of basic education) with 14 students and respective professor.

During the implementation of the practical activities were applied pre and post-tests to the students and teachers involved in the activity. The tests applied to students are aimed to collect data on student's knowledge on the science subjects mentioned above. In the post-test, apart from this kind of questions, are also included a few questions aimed to collect students' opinions and feelings those activities induced on them. The tests applied to the teachers sought informations in various dimensions such as: personnel data and opinions, training and professional experience, and background of its practices in this school year.

The results obtained allow us to conclude that, in general, the students involved showed a lot of appreciation for the type of activities implemented, in particular the activities that involved manipulating materials. Also teachers appreciated this type of activities. They considered it very productive, stressing the importance of having at their disposal practical activities guides that can be adapted and implemented in their classes.

The work herein reported was developed in the frames of the FP7 European project (grant agreement no. 266647) "Networking Primary Science Educators as a means to provide training and professional development in Inquiry Based Teaching, Pri-Sci-Net" (www.prisci.net).

SCIENCE IN PRIMARY EDUCATION IN AN IBSE PERSPECTIVE. THE ENERGY TOPIC

M.F.M. Costa, C.S. Duarte Vieira
Universidade do Minho, Braga, Portugal
mfcosta@fisica.uminho.pt,
clarissedvieira@hotmail.com

Science and its study must be introduced to children early in their training not only for its intrinsic importance but above all by the competencies that allows to develop. However the teaching of science in Portugal has been characterized by the mere passive transmission of knowledge where the teacher monopolizes the intervention in the classroom and the student is simply a passive agent.

In order to improve the teaching of science it is important to change the current teaching paradigm, teacher centered and to involve the student actively in the learning process.

One should propose activities to students, other than those that were offered up here, so as to make them significant learning experiences, active, diverse, integrating and socializing, and able to develop in the students' knowledge but also skills and attitudes essential for their integration into society.

Across the various levels of education children are confronted with issues related to Sciences in different approaches and with different purposes. With this work we explored the theme of energy and more specifically the concept of heat and its transfer, taught according to a perspective of *Inquiry Based Science Education (IBSE)* giving emphasis on hands-on experimental activities.

Our main goal is to make students an active agent in the teaching/learning process able to define analise project programand perform tasks aimed to test their ideas discussing their findings and establishing their conclusions.

Different guides were designed for both students and teachers in order to help the development of the work. A pre-test and post-tests were used In order to help us to understand the strengths and weaknesses of this teaching method and improve it. The tests are aimed to collect data on student's knowledge on the science topics studied. In the post-test a few questions were added aimed to collect students' opinions on the activity and the feelings that those activities promoted on the students. Teachers were also asked to provide basic information's on various dimensions such as: personnel, training and professional experience and background.

This study was developed at various study levels: kindergarten; 1st; 2nd and 3rd cycles of basic school. The activities are adapted according to the specific characteristics of each school level.

From the analysis of the results of this project it is possible to conclude that the students involved reveal much and increasing interest and empaty with this kind of activities. In addition, it also allows us to realize that educators and teachers consider this type of activities useful and productive although sometimes feel uncomfortable with these science subjects and this type of pedagogical approach.

The work herein reported was developed in the frames of the FP7 European project (grant agreement no. 266647) "Networking Primary

Science Educators as a means to provide training and professional development in Inquiry Based Teaching, Pri-Sci-Net" (www.prisci.net).

FROM BOARDING DISTRICT SCHOOL STUDENTS EYES: HANDS ON SCIENCE, SCIENCE AND TECHNOLOGY LESSON

Ş. Yılma[1], B.Timur[2]
[1]Abant İzzet Baysal University Faculty of Education, Turkey
[2]Çanakkale Onsekiz Mart University Faculty of Education, Turkey
sirinyilmaz87@hotmail.com, betultmr@gmail.com

By the new science and technology teaching program, constructivist approach; which is student centered, makes students active in learning, based on hands on activities, makes them construct new information by themselves rather than taking it, directs students to questioning and search, internalizes the process evaluation approach and depends on new teaching methods, was approved. In Turkish education system, there are Boarding District Schools (BDS) which are giving importance not only educational activities but also real life activities. In schools in rural areas, there are some problems like material deficiency, student-teacher communication deficiency, and insufficient financial support. The aim of this study is to reveal the opinions of the elementary students in BDS about the science and technology activities. In the study, quality descriptive methods were used. Sample of the study is composed of 19 students which are 6th, 7th or 8th grade students in a BDS in Elazığ during the 2011-2012 academic year. In the study, interview questions developed by the researchers to detect the views of the students about science and technology course were used. According to the findings, it was found that the best loved course is science and technology and the reason is that the science and technology course includes experiments and funny processes. In students' dreams, in a science and technology course, they dream themselves active and teaching is activity based and teacher has the role of guide. The students have positive views about the teachers' role of guide, teachers' feedbacks and guidance. In addition, it was concluded that the students watch the TV programs including scientific activities and these programs help them to review the knowledge and transfer it into real life. Under the light of these results the teachers in Boarding District Schools should give much importance to activities and experiments, and the financial support should be increased to overcome the material deficiency problem.

Keywords: Science and Technology Course, Science and Technology Activities, Boarding District Schools.

TYPES OF SCİENCE COMMUNİCATİON EVENTS İN SCHOOLS, SCİENCE CENTERS, CULTURAL CENTERS AND CİTY FESTİVALS: A SOCİAL ENTERPRİSE MODEL İN MOBİLE HANDS-ON SCİENCE ACTİVİTİES

O.B. Arslanoğlu
EĞLEN BİLİM Eğlenceli Bilim Etkinlikleri, Turkey
ENJOY SCIENCE Scientific Entertainment Activities, Turkey
onurberk@eglenbilim.com

Science communication generally refers to public media aiming to talk about science with non-scientists. This often involves professional scientists (called 'outreach' or 'popularization') but has evolved into a professional field in its own right. It includes science exhibitions, science journalism, science policy and science media production, among other things. Science Communicators can use all the same methods of entertainment and persuasion as in other professions, including humor, story telling, and metaphor. These people are sometimes even trained in some of the techniques used by actors.
Eğlen Bilim is a social enterprice which aimed to actualize engaging children with the passion of science by popularizing the complex phenomenons and inspiring them with different types of hands-on activities. These portable activities are: workshops, theatrical shows, stand activities, festival organization, educator

 ISBN 978-989-98032-0-6

trainings, TV programmes and conducting the science clubs in schools.

As a social enterprise company that working in science communication market, Eglen Bilim has created many activities, reached over 5000 pupils in Turkey and also experienced some disadvantages of mobile hands-on science activities. These all pros and cons are investigated and result of this argument is shared. By the help of this data, science centers can easily consider about the science communication activities and may programme some outreach programmes in their own region.

DRAMA AS AN EDUCATIONAL WAY ON FORMING WATER CONSCIOUSNESS IN SCIENCE AND TECHNOLOGY EDUCATION: TO EXAMINE THE EFFECT AND AVAILABILITY OF DRAMA VIA PROSPECTIVE SCIENCE AND TECHNOLOGY TEACHERS' VIEWS

H. Bertiz
Abant İzzet Baysal University, Elementary Education Department, Science Education Program, Gölköy-Bolu, Turkey
E-Mail: hbertiz@gmail.com

The purpose of this study is to determine the effect and availability of drama on forming water consciousness. The study was carried out with prospective science and technology education teachers (14 female, 3 male) educated in spring semester in Gazi University, Gazi Education Faculty of Science Education Program. The implementations of the study covered 12 weeks. In the study, a form which is called Writing Interview Form (WIF) was used to prospective science and technology education teachers to determine their views towards availability of drama on forming water consciousness. For the qualitative data analyze, descriptive and content analyze techniques were used. As a result of the study, it was determined that the drama is an effective method on forming water consciousness. Also, the prospective science and technology education teachers' views showed that the drama has high availability on forming water consciousness. At the end of the study, in the lights of findings, the results were discussed and some suggestions were offered.

Keywords: Drama, Forming Water Consciousness, Drama in Science and Technology Education.

THE EFFECTS OF DRAMA ON PROGRESS AND AWARENESS OF SCIENCE AND TECHNOLOGY EDUCATION PUPILS TOWARDS INTERACTION BETWEEN TECHNOLOGY AND ENVIRONMENT

H. Bertiz
Abant İzzet Baysal University, Elementary Education Department, Science Education Program, Gölköy-Bolu, Turkey
E-Mail: hbertiz@gmail.com

In this study, i) it was aimed to determine the prospective science and technology education pupils' awareness towards interaction between technology and environment, ii) to investigate the effect of drama method on progress towards this interaction between technology and environment. One-group pre-test post-test experimental design was used in this study. Word association test (WAT) was applied to pupils (22 Female and 10 Male) who were studying in the first class of Science Education Department of a University in Ankara. WAT was applied as a pre-test and post-test to the study group. This study lasted 4 weeks consisted two session per week in fall semester. A concept map was drawn on the basis of the frequency table that was prepared by using the pupils' responses to the selected key concepts. Results of the data analyses showed that the pupils produced more responses in the post-test than the pre-test. It was seen that the drama affected the progress and awareness of pupils towards interaction between technology and environment. Some important suggestions were proposed related to results of this study as well as future studies that can be made in the light of results of this study.

Keywords: Drama, Technology, Environment, Science and Technology Education.

 ISBN 978-989-98032-0-6

DO INQUIRY-BASED TEACHING PRACTICES MAKE A DIFFERENCE ON TURKISH STUDENTS' SCIENCE ACHIEVEMENT IN PISA 2006?

M. Ozel[1], S. Caglak[2], M. Erdogan[3]
[1]*Nigde University, Niğde, Turkey*
[2]*Florida State University, Tallahassee, FL, United States*
[3]*Akdeniz University, Antalya, Turkey*
muratozel@nigde.edu.tr, mozeltr@gmail.com, serdarcaglak@gmail.com , mmerdogan@gmail.com

The purpose of this study was to investigate the relationship between inquiry-based teaching practices; e.g. (1) models or applications, (2) hands-on activities, (3) interaction, (4) independent investigations, and science achievement for 15 years old students in Turkey based on PISA 2006 data set. Hierarchical Linear Modeling (HLM) was utilized to test the proposed model representing the relationship among inquiry-based teaching practices and Turkish students' science achievement scores in PISA 2006. Our results revealed that students reporting more frequent use of models or applications and interaction have lower achievement in science. However, students reporting higher frequency with regard to hands-on activities and independent investigations tend to have higher achievement in science. Our findings emphasize the importance of lessons that have hands-on activities and independent investigations.

Keywords: inquiry, science education, PISA, Turkey.

PRESERVICE TEACHERS` PRACTICE WITH HANDS-ON LEARNING STATIONS: DOES IT BRING CONCEPTUAL CHANGE ON 8TH GRADE STUDENTS' UNDERSTANDING OF EARTH AND SPACE SCIENCE CONCEPTS?

N. Bulunuz, M. Bulunuz, E. Öztürk
Uludag University, Education Faculty, Nilüfer, Bursa-Turkey
nermin.bulunuz@gmail.com, *mbulunuz@gmail.com*

The general purpose of this research was to determine the effect of hands-on learning stations, implemented by six preservice science teachers on their students' conceptual understanding of seasons, wind, plate tectonics, volcanoes, earthquakes, and mountain building. The preservice teachers, students in an elective course, *Theories and methods of conceptual change in science education* taught by the first author, acted as *guide teachers* during their school placements. This study had two purposes: (a) to determine what initial understandings Turkish eighth grade students had about earth and space science concepts to be taught at their grade level, (b) to evaluate the effectiveness of science learning stations versus lecture/explanation as conceptual change strategies for clarifying these concepts. Two intact classes were randomly assigned either to the experimental group (N= 32) or to the comparison group (N= 31). Data sources were pre and post instructional interview results, and the students' personal written answers and notes about the science learning stations while rotating through the stations. Five open-ended questions were asked during the interviews. Findings indicated that the experimental group's percentage of misconceptions decreased from 60% to 31% after engaging in hands-on learning stations while the percentage of misconceptions in the comparison group decreased only from 64% to 50%. Four students in the experimental group gave scientifically correct answers after participating in the learning stations, while none of the students gave correct answers after listening to lectures on the topics. According to preservice teacher reflections, this experience increased their confidence in designing/implementing learning stations on

earth/space science concepts in classroom settings. The results suggest that lecturing and explaining about the topics do not improve students' conceptual understanding of difficult science concepts. Therefore, teachers need to include different hands-on science activities in their lessons to make these concepts more meaningful and concrete for their students.

Keywords: Science learning stations, earth and space science concepts, conceptual understanding, misconceptions.

RESEARCHERS PROMOTE SCIENCE IN SCHOOL

B.V. Dorrío[1], M.F.M. Costa[2]
[1]*Universidade de Vigo, Vigo, Spain*
[2]*Universidade do Minho, Braga, Portugal*
bvazquez@uvigo.es, mfcosta@fisica.uminho.pt

Sometimes science teaching is conducted with little care about actual scientific facts and it is often not more than a large collection of information and concepts offered in a non articulated mode. As a result its influence is reduced to get basics skills that are not enough to meet today needs for long life learning. In this context it is usual that students go to science museums, research centers and interpretative exhibitions located outside the school in order to obtain a complementary knowledge about the fundamentals and develop a more positive connection to Science and Technology. However different programs [1,2] can now be employed to allow researchers to participate in a normal class where certain concepts are explained with a research perspective based on the active learning of the participating students. With the intention that the methods developed for colleges, universities and museums [3,4,5] can be applied for schools, during the last academic year 2011-2012 we organize several one-day visits to schools in a particular specific scientific contents with the aim of promoting science education. These visits were designed to engage and motivate students in their learning of science and support the teaching of science curriculum making use of common and pedagogical material in realistic hands-on demonstrations. An activity designed in general to provide an interactive learning experience through entertainment and enjoyment and, in particular, to facilitate discussion for example about energy, magnetism, electricity or optics and that attempted to merge informal and formal learning. Visits begun with a presentation that provides the context for learning about these concepts, in primary and secondary school. Later a set of activities with cheap equipment is organized as useful resources that help students to visualize, comprehend and connect to the textbook´s contents (Figure 1). Part of the material was known and readily available but other was provided by our research laboratory (Figure 2), trying to provide fun but also meaningful experiences. During the presentation proper in-context relations with the curricula are established, health and safety instructions are given and ideas to help explain some aspects of the scientific work are presented. Since the hands-on demonstrations spark student's interest, facilitate learning, are short and easy to make, these visits have also the objective of instigate the teachers to progress their daily work, since instructors must innovate, must develop new educational material, and must introduce new methods of interaction between the subject and the students.

Figure 1. *Hands-on demonstrations during a school visit*

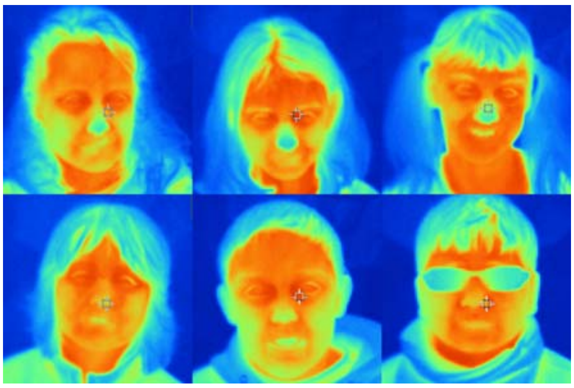


Figure 2. *Thermograms of some participants*

This work was drawn in the frames of the activities of the PRI-SCI-NET project supported by the European Union Seventh Framework Programme (FP7/2007-2013, grant agreement no. 266647).

References

[1] http://www.scienceinschools.edu.au
[2] http://extra.shu.ac.uk/cse
[3] Freier, G.D., Anderson F.J., A demonstration handbook for Physics, AAPT, 2002
[4] Mamola, K.C., Apparatus for teaching Physics, AAPT, 1998
[5] Cunningham, J., Herr, N., Hands-on Physcis activities with real.life applications, John Wiley and Sons, 1994.
[6] http://www.exploratorium.edu/snacks/

EDUCATIONAL ROBOTICS & IBSE: A CRITICAL POINT OF VIEW TO IMPLEMENT PRI-SCI-NET OBJECTIVES

I. Gaudiello, E. Zibetti
Laboratoire CHART-LUTIN EA 4004, Université Paris 8, EPHE Paris, Cité des Sciences et de l'Industrie, Paris, France
i.gaudiello@gmail.com
ezibetti@univ-paris8.fr

As pedagogical approaches, Educational robotics (ER) and Inquiry Based Science Education (IBSE) show compatibility to a great extent: both include problem solving procedures and specific scaffolding dynamics. More in detail, ER and IBSE share a sequence of phases (i.e., engagement, observation, manipulation, questions, hypothesis, testing, explanation and conclusion) through which pupils are confronted with open interrogatives or challenges, whose answers and solutions should imply the acquisition of empirical and transferable learning (Bell, 2010). The scaffolding provided by teachers range from strong instructionist to minimal constructivist guidance (Mayer, 2004). Due to such a high compatibility between ER and IBSE, recent works in the domain of Science Education (Anagnostakis & Michaelides, 2012), Engineering Education (Demo, Moro, Pina, & Arlegui, 2012; Bers & Eguchi, 2011) and Cognitive Psychology (Gaudiello & Zibetti, forthcoming *a*) seek to combine the two approaches in an integrated learning environment. However, beyond the similarities, these works also let emerge some interesting discrepancies. Concerning problem solving, the IBSE question “how to solve a problem?” is converted in the ER question “how to make the robot solve a problem?” (Wing, 2008; Gaudiello & Zibetti, forthcoming *b*). Concerning scaffolding, the IBSE constructivism is converted in the ER guided constructivism according to which children can rely on different types of support (e.g. teacher’s explanation, workgroup, web documents, virtual communities etc.). Hence, we carried out two pilot studies in the frame of Pri-Sci-Net Project (http://www.prisci.net/) to assess how the implementation of IBSE in curricular settings and ER in extra-curricular settings affects children learning performances. These pilot studies rely on science activities protocols conceived according to the objectives of Pri-Sci-Net. Different critical issues emerged on children side: the persistence of children misconceptions despite the direct observation, the tendency to propose egocentric rather than sharable questions, the difficulty in formulating hypothesis and in remembering hypothesis after the testing, the perception of falsification as failure, the use of narrative instead of scientific explanation, etc.. Some critical issues have also emerged on teachers’ and educators’ side: the need for lesson plans, specific learning objectives, and assessment worksheets; logistical constraints in terms of materials availability, time scheduling, number of pupils who can actually benefit of material manipulation and self expression, etc. A critical point of view is thus proposed in order to draw attention to those features of ER (immediate feedback of the robot, workgroup to raise allocentric questions, programming as conditional statements training, progressive modules from narrative to scientific, etc.) that can contribute to overcome the observed limits and constraints, towards the building of a Robotic Based Science Education approach (RBSE).

Keywords: Educational Robotics (ER), Inquiry Based Science Education (IBSE), guided constructivism, Robotics Based Science Education (RBSE)

© 2012 HSci. ISBN 978-989-98032-0-6

ENVIRONMENTAL EDUCATION

© 2012 HSci. ISBN 978-989-98032-0-6

© 2012 HSci. ISBN 978-989-98032-0-6

LET'S KEEP THE BIRDS

C. Dinler, R. Doğan, M. Siğlan, C. Temizkan, K. Kar, Ö. Ata, D. Avkan, S. Sürmelioğlu, M. Taçyildiz, E.A. Köksal
Elementary Science Education Department, Niğde University, Turkey

1. Introduction

There are some animals that hardly supply their food and other needs in the outside. Thinking on what we can do for these animals, we came up with a project idea. We decided on making a bird-bath, water bowl, and feeder, because we did not want to break the balance of nature and did not want the birds to die. Our aim is to help the birds in their life and in finding food and water that they eat and drink easily, and to increase their likelihood to live. The literature survey over the Internet gave us information about a project about birds, and the bird species living in Niğde.

1. Project with Birds: The Nature and Wildlife Conservation Society, in their project, "Get a Second Nest", aimed to train the young people of Samsun Yaşar Doğu Orphanage on protecting the environment. With the project the youngsters learned to make nests, water bowls and feeders for birds and install them in appropriate places.

2. The Birds of Niğde: Niğde is very rich in bird population. Thanks to Akkaya Dam, which is also a watershed, there are 194 bird species live in our city. Instead of including all bird species, we decided on sparrows, because their habitats are close to human, these birds do not migrate. Sparrows have 11-12 cm long, and in brown, black and gray colour. They form big herds. They feed with fruits and insects. They eat also seeds and bread crumbs. They build nests on trees, tree holes or under the roof. Sometimes they stay on swallow nests. A female sparrow lays four-five eggs, which colours are white with brown spots. The incubation period is 11-12 days. The chicks leave the nest two weeks after they hatch. A couple lays eggs three-four times during the summer.

2. Methodology

We searched on the Internet of constructing a bird-bath, curb and feeder. We prepared a materials list. In order to supply these materials, we made some shopping from a supermarket and seller of dried nuts and fruits.

We looked out for placing the bird-bath, curb and feeder on the places where the birds are plentiful. We also though of preparing appropriate materials so that the birds can easily reach them. We put the bird-bath, curb and feeder on the tree branches in our schoolyard. The remaining curbs and feeders were placed similarly on the gardens of three female halls (General Directorate of Credit and Dormitories Agency's Dormitory for Girls, Sabancı Girls' Hall, and Hüdavent Hatun Sorority) after getting permission from the managers.

3. Results and Discussion

Table 1. *The weekly decrease in food and water inside the bird water cup and feeder*

Weeks	Amount of Food (gr)	Amount of Water (ml)
1st	100	250
2nd	69	130
3rd	30	20

© 2012 HSci. ISBN 978-989-98032-0-6

When we first placed a bird-bath and feeder on a tree without considering what the sparrows can eat, we saw that the birds did not consume any food and water. We then, by ascertaining the bird species living in Niğde, made another curb and feeder and put them on a tree. When we observed that the amount of food and water inside the curb and feeder decreased. This means that we chose the correct curb and feeder. The following table shows the food and water consumed in the cup and feeder.

With this project, without polluting the environment, we provided food and water to the sparrows. We helped these birds on their feeding. We understood that the animals living outside should be thought of. We recognized that we should do something for them all the time rather than when it is needed.

As long as we have the materials and time, we are able to prepare more curbs and feeders for the birds. We can hang them on wherever the trees are. We are also be able to urge people on not to forget the animals living outside.

This project was implemented only in one region, and if it is done in other cities we will reach our aim.

4. References

http://www.ua.gov.tr/index.cfm?action=detay&yayinid=395990855BD4783520F36EE9C445A090F5E15&CFID=1046634&CFTOKEN=40042987

http://blog.milliyet.com.tr/hadi-gelin-kuslara-yemlik-yapalim------kus-yemligi-yapimi-/Blog/?BlogNo=344077

http://www.downsendromuforum.com/index.php?topic=1868.0

http://www. vikipedia.com.tr

TÜBİTAK Bilim Dergisi. Prof

USING NATURAL RESOURCES ONLY ONCE WHILE USING WASTES FOREVER

E. Şener[1], H. Akan[2]
[1]*Necati Bey ilkogretim okulu, Samsun, Turkey*
[2]*Harran Üniversitesi, Biyoloji Bölümü, Şanlıurfa, Turkey*
e.mutlusener@mynet.com

"You teach the children the things we teach our children: Earth is our mother. What happened to the land, the per capita income of his sons. Because we know that the earth is not man, man belongs to the earth. Everything is linked together like the blood which connects one family. What happened to the land, the per capita income of their son. Human beings did not create the texture of life. That part of the tap. You tissue, whatever you do, you're doing to yourself. "The head of the Duwamish Indians in Seattle, in 1854, more understanding of the ecology of the period sent a letter to U.S. president to protect the natural environment against white people tried to avoid the pillage

A time interval of more than a century has passed. These days, humanity has a much more advanced information, on ecology, environment, etc., on the balance of nature. However, consistent with the information in the hands or in a direction worthy of them is not working. Researchers and scientists see things getting worse and doing constant warnings.

Action of the factors that destroy the environment are at the forefront of people's consumption. Small and a concrete example: People are issued by the nature of raw materials, such as aluminum, are handled is the box, put into soft drinks, soft drinks removed from the cycle and use as litter boxes. And a new aluminum for the box again to remove from nature, all the hazardous effects on the environment will continue to spin the wheel production to bring them into boxes again.

However, we consider an unmanned nature, we see that the concept of waste. In nature, waste, re-used, unless a different entry forms. Here's recycling practices carried out today, a source of inspiration, this is the law of nature.

We have our project, we can reach so many people's attention, to take the phenomenon of recycling through recycling, recycling live in the city to contribute to the expansion of applications

increased, this way, both the nature and aim to fulfill our responsibilities to future generations.
Because:

- Participate in recycling 1 ton of paper can avoid providing the 17 tree cutting
- Transformed for every tonne of glass, saving 100 liters of oil would be supplied.
- The attenuation of the destruction caused by mining nature
- By promoting the use of scrap paper instead of wood, 74% of air pollution, water pollution by 35%, water use by 58% by reducing the elderly contribute to our world, comfortable to breathe
- Applying the method for iron and steel recycling, air pollution, 85%, and 76% of water pollution, water use, I should take note that 40% of the decline.
- Recycling an aluminum box, to get the product from the raw material by 95% to 97% energy savings in plastic packaging. The energy necessary for the reprocessing of the paper is the introduction of what is needed for normal operations is 50%. Recycling of scrap iron and steel material with 35% glass 32% energy savings are possible. I should explain all these to people around us.
- Contribute to recycling glean, consumption of raw materials such as oil will become less dependent on outside money that we would stay at home
- As a result of the recycling of synthetic fibers, such as water pipes and vinyl products to be supplied from abroad by selling foreign exchange inflows to Turkey
- Run recycling system, significantly decrease mountains of garbage

Widespread recycling and re-use process and demand would diminish the need for raw materials. And we knew that, OUR CHILDREN should have the limited natural resources, and even their grandchildren and the future generations. *"The world is not the legacy of our ancestors, to our children custody"*. It had a responsibility to custody. Primary duty of all of us into the right habits from the age of these responsibilities.

And we were aware of the ongoing neglect of duty. Should have done something. First job, we have prepared a panel as a "once only usıng natural resources whıle usıng wastes forever!", what is the phenomenon of recycling, the benefits and how to do the application, and our panel exhibited there, constantly updated information. Thus, the students "recycling" created awareness of the phenomenon. Decorate cardboard boxes, colored paper and then received more markets "recycling bins" prepared. We presented them to all classes in our school. Establishing cooperation with the Municipality established a system of accumulated waste is collected and conveyed to the relevant places. Our inspections of waste not suitable for recycling classroom recycling boxes came lesions. Or vice versa, could turn back the waste bins filling. This situation is in the hands of many of the students did not know whether it is suitable for recycling of waste due to get it.

Have already identified the problem, now the time is for solution. We wanted to hit the road for a solution to their imagined worlds: fantastic costumes designed. These costumes consisted of waste can be recycled completely. Color bags, newspapers, papers, juice boxes, dresses, capes, pants planted. Disposable plastic gloves, wedding dress, pet bottles, title, buttermilk and obsolete plastic boxes, flowerpots bags, egg packages as skirt, worn nylon bag tablecloths prepared gardener. We did not forget to use CD and battery designs. And the costumes, presented in the form of fashion show April 18, 2012 our school garden. Since then recycled waste recycling boxes filled with really. Litter boxes can say is left empty. Because the vast majority of the school environment, the recycling of waste can be released for recycling.

Our study had attracted a lot of interest. Encouraged by that, the busiest street in our city's most crowded time of the fashion, in the form of street demonstrations to the public's attention back to the present and more people have decided to take the phenomenon of conversion and 17 May 2012 Mecidiye Street made a second presentation. The mayor was there, very impressed by our work, "Environment Day" activities, there is also scope to offer a feast for the fashion organization, wanted. Thus, had the opportunity to showcase the fashion third, June 8 2012 on Republican Street.

After Mecidiye and Republic Square activities, then people are not know to come to us. Until this day, is the only waste paper recycling boxes

 ISBN 978-989-98032-0-6

and shopping bag, then composite, metal and glass for recycling wastes accumulate to send her. We were very happy to see and hear it gained meaning efforts.
All of these efforts, the date of February 20, 2012 until June 15, 2012, non-instructional times, students and their mothers come together, democratic, participatory, and collaborative carried out in the atmosphere. We are proud! Because we did not educate students about recycling phenomenon. Creativity, self-confidence, we have demonstrated in the feeding process.

BIRDHOUSES AT SCHOOLYARD

O. Çevik, A.A. Arslan, İ. Akda, Ş. Özta, E.A. Köksal
Elementary Science Education Department, Niğde Üniversity, Turkey

1. Introduction

There are a lot of living things in our environment. Most of these creatures live in harmony with each other. While human beings sometimes have a negative impact on this balance, they sometimes affect it positively. We in the simplest way wanted to create a positive effect on nature by constructing a birdhouse to school.

1.1. Problem Statement

There are two effects of bringing birdhouses, which have an important place in ecological balance, in nature. One is the need of birds to a nest, and the second is the rehabilitation of pests with birds and birdhouses.
First let's specify why birdhouses are required for birds. The most important reason for birds to set up a house is the vulnerability of their eggs and the hatched nestlings. Especially when the mother goes out hunting for them, the chicks stay undefended. But those nests that are kept in tree tops, gooks, slopes, or among grasses perform the task of a shelter. Another characteristic of birdhouses is to protect nestlings from the cold. The chicks are born without any feather and at the same time cannot operate their muscles since they are quite active. For this reason, in order not to freeze, the chicks need nests insulated the cold. Especially "knitted nests" as from their structure can provide this warmth to the nestlings. The construction of these nests is very detailed and hard. The hen forms the nest by knitting in a long time and with a great care. At the same time, she fills out the hen with fibre and bristle, and increases the insulation of hen.
Second effect of a birdhouse is related to biological control. Biological control is the management done by means of utilizing an organism in order to reduce the pest population. In biological control, insectivorous birds that feed on pest insects occupy the most important place. Research showed that a bird especially in breeding period consumes insect up to several times of its own weight in a day. In order to facilitate the reproduction of birds, which are very effective on depleting harmful insects, artificial bird nests should be hanged.

1.2. Purpose

Our aim in this project by designing a simple birdhouse at school yard is to obtain increased interest to natural environment, to be informed of how bird nests contribute biological control, and to ensure people be more sensitive to environment.

2. Methodology

We first get information on why birdhouse is build ad how it can be made from the Laboratory Applications in Science Teaching II course instructor. Then by discussing in our midst we agreed on which way to follow.
In the first run, we took two plastic bottles, one was one and a half litre and one was two and a half litre. And we opened a hole as big as birds so that they can enter inside it. We wrapped the bottles with blue fancy papers and attached yellow construction papers around the bottles so that one of those papers worked as a shed on the hole. In the second run, we took an empty box and covered it with a plastic bag so that no rain can get inside it.
In order for birds to perceive the nests we made as very natural, we put some grass, soil, and so on inside the house. We decided on a tree that can be easily seen by birds. And we hanged our nest on the branch of the tree with a rope. Then, we observed whether birds come or not at the certain intervals of the day.

© 2012 HSci. ISBN 978-989-98032-0-6

3. Results, Discussion and Conclusion

We in our project come to a conclusion through our observations. The people who saw us when putting up the nests become curious and asked about what we were doing. We told them that we were making birdhouses. The people did not previously know that birdhouse can come true in an artificial setting. We stated that if the same thing is done in forest, harmful insects can be remediated and told of biological control.
We at the end of this research were informed of biological management. And we paid more attention to natural environment. Additionally, we become more conscious of organisms have in an environmental balance in nature and human beings should provide assistance to this equilibrium. And we started to make people around us conscious of this issue.
If we perform this study again, we would make a better planned birdhouse thanks to the experience we gained. We would survey people in our university on if they are informed of biological control. According to the findings of the survey, if needed, we would ask an expert to give a seminar at the university.

4. References

http://10marifet.org/etiket/kus-yuvasi-yapimi
http://web.ogm.gov.tr/birimler/bolgemudurlukleri/mersin/Sayfalar/OzmSbMd.aspx
Birds of the World. Avrupa'nın Kuşları (Peter HAYMAN).

DEVELOPING ARGUMENTATION BASED ACTIVITIES ON CIRCULATORY SYSTEMS

I. Üstünkaya, A. Savran Gencer
Department of Primary Science Education, Faculty of Education, Pamukkale University, Turkey

Depending on the progress of knowledge and technology, studies in recent years have been advocated approaches which drive students to deliberate on their own learning process. Argumentation is one of the inquiry oriented ways in the context of science learning. Arguments or claims with the scientific evidences are the basis of a good argumentation. In the learning environment in which argumentation strategies are used learners would have similar experiences like a scientist and construct the scientific knowledge in its real context. The scope of the current Science and Technology Curriculum in Turkey has been associated with the basic principles of argumentation. For example, one of the teachers' roles is defined as to provide students learning environment to discuss and evaluate on the emerging alternative idea (MEB, 2006). In this respect, argumentation has evolved as an important construct in contributing to the development of scientific culture of students in their own society.
The purpose of this study is to develop learning activities based on Toulmin's Argumentation Pattern on the subject of Circulatory System

© 2012 HSci. ISBN 978-989-98032-0-6

according to the sixth grade level primary science and technology curriculum's learning outcomes. Activities were prepared according to the seven steps instructional sequence. Each activity consists of learning outcomes, aims, learning goals, time, the role of student, the role of teacher, and application For each activity a worksheet was designed based on Toulmin's Argumentation Pattern which includes claims, evidences, warrants, rebuttals and backings. The worksheets usually use different strategies of argumentation such as "Competing theories", "Construct an argument", and "Evidence cards". The activities are called as: "Journey into the heart", "Heart as a pump", "Blood vessels", "and The structure of the blood", "Circulation and Blood types". These examples to be presented require students doing hands on activities that is favorable for the scope of the conference.

Keywords: Argumentation, Science Education, Circulatory System, Competing Theories, Evidence Cards, Construct an Argument.

SOCIO - SPECTROMETRY WORKSHOP: TRACING A SOCIO-SPECTRUM

I.R. Chisleag Losada[1], R. Chisleag[2]
[1]*National School of Political and Administrative Studies, Bucharest, Romania*
[2]*University"Politehnica", Bucharest, Romania*
chisleag@gmail.com

"Socio-spectrometry", defined as an inter-disciplinary science aiming to apply spectral analysis knowledge in measuring, modeling and understanding social phenomena, is a natural part of Socio-physics. This new interdisciplinary science, "Socio-spectrometry", is connected with "Socio-optics" both sciences relying on the duality wave-particle which seems convenient to model relationships within society and its members, by using Physics models, models which start to be known from school, models which might become powerful tools to be used by every socially committed educated person, including bright pupils, to model social and economic phenomena, among them, social inequalities.
A new class of models is to be introduced to the participants in this HSci EE Workshop: "the socio-spectra", defined as spectra of social inequalities. During the Workshop, there will be made appeal to the Optics background of pupils and to the analogy between optical spectra and the newly introduced by the authors "socio-spectra". Firstly, there will be displayed optical spectra, familiar to school pupils: the spectra of white light of the projector and of a laser pointer, by using a glass prism and will be introduced notions as: colors, wavelength and frequency. These optical spectra, represented also graphically (as continuous and respectively, line spectra, Y=f(X)), connect the spectral (relative) intensities of light components (differently colored) emitted by a source with the wave length (and / or frequency). There will be shortly discussed spectral intensity and the intimate connection of wavelength and frequency of the spectral components of the analyzed light.
The minimal optical knowledge necessary to understand socio-spectra being revised, the participating children will be invited to imagine and suggest to trace a socio-spectrum, connected with the HSci EE Antalya event.
Upon their proposals and following a short debate generated by concurrent proposals, the Workshop coordinator will finally suggest to the participating children in the Workshop to try, for example, to spectrally describe the affiliation of the participating (in the HSci EE) children teams. Together with the pupils, there will be chosen a parameter connected with affiliation, able to insure the largest variation in the spectrum. Will be suggested: the topics of the children contributions connected, in real time, with the 9th HSci I. C. topics; school, town or country affiliations. The pupils will have to find that the most accessible and convenient parameter would be, f. e. the "*country affiliation of each participating team*", as the $\mathbf{X_i}$ parameter (a discreet one). The children will be invited to identify themselves the possible values of X_i using the HSci EE Programmed and to choose traffic mineralogical plate abbreviations (TR, RO, D, F, . . .), as symbols to be put on the abscissa in a histogram, histogram to be prepared together with them, their findings being forwarded to the coordinator of the Workshop.
The Y parameter is to be suggested to be chosen as the *"number of participating children teams originating in a country*", as identified in the Programme and got on the spot by the participants in the workshop. To this end, the participants \in the Workshops, will be divided in

 ISBN 978-989-98032-0-6

enough teams with 2 members, at their choice. Other few small teams of participants will have the task to independently find the total number of countries and the total number of participating teams, using the available Programme.

When discussing their findings, there will be done a few comments on errors appearing almost every time and every where and will be introduced the average number of participating teams by participating country. There will be explained that for all values Y_i, the (physical) dimensions equations must be identic, the quantities on the same axis be of the same nature and that their relative errors be spread over a short range, only.

Finally there will be traced (represented) as a histogram, the socio-spectrum $Y_i = f (X_i)$, i. e. the number of participating teams vs. participating countries in HSci EE first yearly children summit.

The children will be invited to interpret themselves the obtained by them socio-spectrum and to draw some conclusions as f. e. how to represent better the inequality of representation (by eventually chosen an other Y parameter for their distributions f.e. teams per million of citizens).

The children will be invited to imagine actions how to improve equality in the next HSci EE meeting. They will be induced to understand that when the components of a social group (sub-groups or individuals) have unequal: background, education, wealth, social positions, rights, duties, chances and/or unequal evolution paths, this situation may be approached in general, as being an inequality in the group and be described by conveniently chosen specific socio-spectra.

The children will be stimulated to draw some conclusions about the social inequalities in the representation in the Workshop itself, of their possible origins and to make suggestions how to fight and prevent the generation of such inequalities in the future children meetings.

Learning to trace socio-spectra, interpret them and clearly explain them to the target audience may be useful for Environmental, Physics and Social Education of children and their teachers with, possibly, very extended other uses.

The results of the suggested workshop might be a new tool mastered by the participants children and their teachers and also a contribution to the self-evaluation of the HSci EE itself. *Socio-spectrometry* may offer strong tools in dealing with the tracing and the processing of the *spectra of social inequalities*, by offering a deeper understanding of the studied society and its components.

There will be mentioned the authors' expertise in stimulating socio-spectrometric approach by systematically asking their students taken courses in Spectroscopy to find applications of the newly got by them spectroscopic knowledge, to model social and even everyday life phenomena, to find spectra of social inequalities, eventually engaging in such activities other possibly interested colleagues.

Keywords: Socio-spectrometry; Socio-spectra; Spectra of inequalities of representation; Socio-optics; Socio-physics.

FREE FERTILIZERS

D. Gülsari, M. Öna, Z. Sayar, H. Kuzu, H. Can, E.A. Köksal
Elementary Science Education Department, Niğde Üniversity, Turkey

The living things, which are called microorganisms and cannot be seen by bare eye, degrade the organic matters inside the litter by using the oxygen of the environment. In this project, we aimed to increase the capacity of the soil.

For this aim, we first put some soil into a can. And we placed many organic materials, such as fruits, leaves, and grass. Then we put some soil and organic materials onto it again. Finally, we added some water into the can, and closed the lid. As the time passes, we included some water to the can.

During our observation of the can, we found that the lid became tight and made a balloon. The can began to smell. The organic materials inside the can started to pale and got mouldy. The gas making the lid to swollen was the carbon dioxide formed during the composting. The smell, colour change and mould result from the decay of the organic materials inside the can. The colour of the soil turned black.

With these results we also determine the requirements for making compost. We learned that certain temperature, water, and oxygen are required for compost, because the survival of the microorganisms especially the fungi are belong to oxygen and appropriate temperature. Beside these, the water amount should also be adequate (40-60 %).

Keywords: Environmental education, project, compost.

WASTE, RECYCLING AND GARBAGE REDUCTION

U. Cengiz, N. Dermen, B. Olcay, S. Ercan, E.A. Köksal

Elementary Science Education Department, Niğde University, Turkey

The aim of this study is to raise the awareness of students on household solid waste and related problems. The information about recycling, recyclable materials and the importance of recycling will be also presented. This presentation will be completed with the reporting of an activity in which different kinds of waste were buried onto the ground. The results of this activity are expected to show the student the importance of garbage reduction, and positively change their attitudes toward consuming goods and littering.

Although waste is an unnecessary element arising from the activities of any industry, it is a misplaced resource, existing at a wrong place at a wrong time.

Recycling is the inclusion of waste with the possibility of reuse into the production process after a variety of physical and chemical processes through being transformed into the secondary raw material. Iron, steel, copper, aluminium, lead, batteries, paper, plastic, rubber, glass, engine oil, waste oils, accumulators, car tires, concrete, X-rays films, electronic waste and organic waste are recyclable.

Waste minimisation is systematically reducing waste at source by prevention and/or reduction of waste generated, efficient use of raw materials and packaging, efficient use of fuel, electricity and water, improving the quality of waste generated to facilitate recycling and/or reduce hazard, and encouraging re-use, recycling and recovery. Waste minimisation is also known as waste reduction, pollution prevention, source reduction and cleaner technology.

Activity

The students will be given some chewing gums, candies, and nuts. And they will be allowed to eat them. Then the students will be asked to list which materials they litter, what happens to those materials after they throw them into the garbage can.

The students will be distributed a transparent plastic cup of soil and be asked to bury their trash into the soil. The students will be asked check the condition of the materials inside the soil weekly.

The students will be given information about what happened to the materials buried in the ground in our school yard.

We collected plastic bottles, glasses, metal cans, and wood sticks. We dug five holes with 20 cm deep to our school yard. We buried these materials to the pits together and separately. We put some stones onto the re-covered holes. Then we checked the materials inside the soil few months later. We found that only metal can was oxidised. Glass and plastic decomposes in four thousand year, in other words, they have a long recycle period, and they had no change.

Keywords: Environmental education, project, recycling, garbage reduction, decomposition.

© 2012 HSci. ISBN 978-989-98032-0-6

Author Index

© 2012 HSci. ISBN 978-989-98032-0-6

© 2012 HSci. ISBN

The Organizers of the 9th International Conference on Hands-on Science acknowledge the sponsorship cooperation and support of these sponsorships and collaborations:

Universidade do Minho
Escola de Ciências