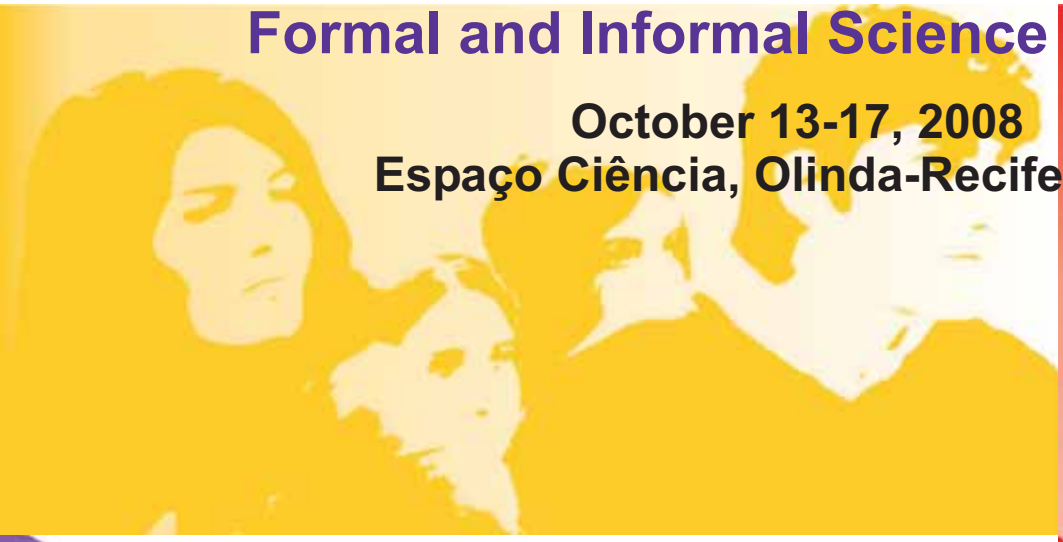
HSCI2008

Proceedings of the
5th International Conference on

Hands-on Science

Formal and Informal Science Education

October 13-17, 2008
Espaço Ciência, Olinda-Recife, Brazil



The Hands-on Science Network

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5th International Conference on Hands-on Science
Formal and Informal Science Education
13rd - 17th October, 2008
Espaço Ciência, Olinda-Recife, Brazil
ISBN 978-989-95095-3-5
Online available on http://www.hsci.info

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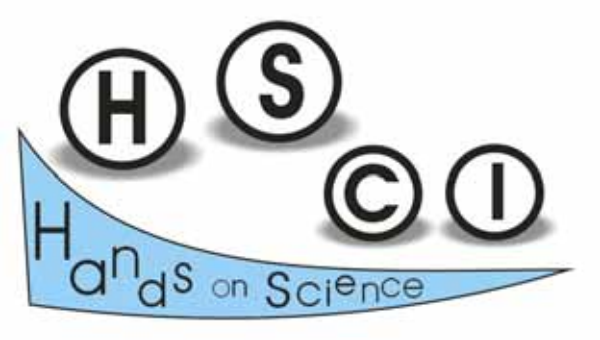

ISBN 978-989-95095-3-5

Printed by: Copissaurio Repro – Centro Imp. Unip. Lda. Campus de Gualtar, Reprografia Complexo II, 4710-057 Braga, Portugal
Number of copies: 200
First printing: September 2008
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 5th 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 5th International Conference on Hands-on Science. Costa MF, Dorrío BV, Pavao AF and Muramatsu M (Eds.); 2008, 13-17 October; Espaço Ciência, Olinda-Recife, Brazil. 2008. Page numbers.

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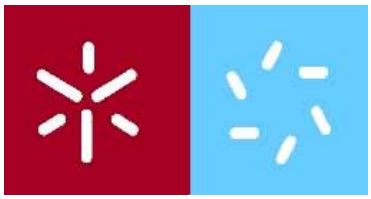
The Organizers of the 5th International Conference on Hands-on Science acknowledge the sponsorship cooperation and support of:



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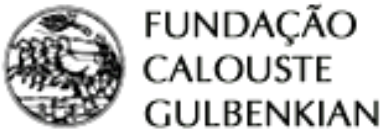

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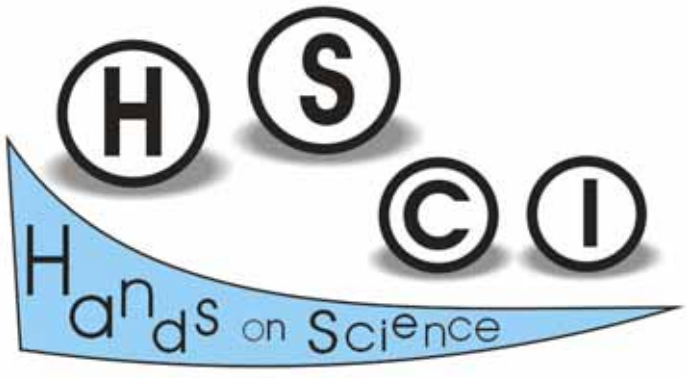

 ISBN 978-989-95095-3-5

FOREWORD

With a broad open understanding of the meaning and importance of Science to the development of our societies, each individual and of the humankind, the main goal of the Hands-on Science Network is the development and improvement of science education and scientific literacy by an extended use of investigative hands-on experiments based learning of Science and its applications.

Our activity extends to all subjects age levels, from pre-school basic secondary vocational and special education schools to higher education and adult education. Approaching science education from different angles and perspectives using different methods and teaching strategies although always trying to promote active self committed, hands-on, learning in formal and non-formal/ informal contexts.

Often considered isolated and unrelated contexts, the formative educational potential of activities in non-formal and informal environments and approaches was clearly un-profited on itself and to in-school formal learning. The recent extraordinary boom of science museums and centres, all over the world, lead to a very positive development in approaching and exploring the pedagogic usefulness of informal and non-formal educational approaches. The benefits to formal in school education, that is will and should be the main educational ground in our societies, of non-formal and informal activities should be further explored and the relationship enhanced in both directions.

Our 5th International Conference on "Hands-on Science. Formal and informal science education", the first one to take place outside the European Union, will focus on discussing and exploring new approaches to these subjects.

The environment of Brazil' Pernambuco state main science centre "Espaço Ciência" in the UNESCO World Heritage town of Olinda, Recife, will be the ideal nurturing ground for a open friendly and productive exchange of experiences and ideas among the expected over 250 participants from all over Brazil and the world. The 140 communications received, published in the conference' proceedings book and later on, after peer-review, at our new International Journal on Hands-on Science (http://ijhsci.aect.pt), will become an invaluable tool to be freely used by teachers educators and all persons interested and involved in science education

…towards a better Science Education…

As Chair of the conference and President of the International Association Hands-on Science Network it is my pleasure to welcome you to HSCI2008 wishing you a wonderful stay in Olinda!

Braga, September 22, 2008.

Manuel Filipe Pereira da Cunha Martins Costa
Chair

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FOREWORD

CONTENTS

 ISBN 978-989-95095-3-5

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5th International Conference on Hands-on Science
Formal and Informal Science Education
© 2008 HSci. ISBN 978-989-95095-3-5

Hands-on Sustainability: How Can We Contribute to the Construction of a Sustainable Future?

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Abstract. The scant response of citizens to reiterated calls for attention to the serious problems affecting all humanity leads to a belief that there are serious obstacles that must be studied in order to understand how to overcome them.

In this work we will focus on one of the more important of these problems – the widespread yet incorrect perception that the action of the individual is of little importance – and we will attempt to show from an eminently practical viewpoint the relevance, for the construction of a sustainable future, of what each one of us does or does not do, in general - as a consumer, professional and citizen - and in particular – in the sphere of education.

Keywords. Planetary emergency, Environmental Education for a Sustainable Future, Hands-on Science.

1. Introduction

Until the second half of the 20th century, our planet seemed huge, practically limitless, and the effects of human activity remained locally compartmentalised. These compartments, however, have begun to fade over recent decades and many problems have taken on a global character that has made "the world situation" a direct cause for concern. News on climate change, environmental deterioration, excessive, unchecked consumption of energy and raw materials with the subsequent exhaustion of resources and, in short, the serious situation of planetary emergency in which we are immersed [1-3], have all jumped to the front pages and opinion sections of the media. Calls by the international scientific community, NGOs and the UN itself, are multiplying. At the same time, there are over twenty international agreements on environmental protection linked to the same number again of protocols putting them into practice [4-5]. And yet most citizens, including policy makers and educators, continue not to react in the face of serious threats of social collapse [6] and even the extinction of our species [7], which is in principle in contradiction to existing positive social interest, as seen in innumerable information resources regarding necessary respect for the environment [8-11].

It can be concluded, therefore, that there are serious obstacles which hinder necessary changes in attitude and behaviour and impede even a determined involvement of educators at all levels of formation for citizens who are aware of the situation of planetary emergency and its causes, and prepared to adopt the necessary measures to face up to the situation [12].

It is necessary, then, to keep up efforts to bring these obstacles to light and study how to overcome them. In this article we focus on one that most directly hinders finding a positive answer to the key question "How can each one of us contribute to building a sustainable future?" This is a reference to the widespread perception that individual actions are irrelevant. We will critically analyse this misconception and put forward some proposals for action to overcome it.

2. Are individual actions irrelevant?

Participants in courses and workshops on education for sustainability often express doubt about the effectiveness of individual actions, small changes in our habits or our lifestyles, that education can foster: The problems of exhausted energy resources and pollution – they usually state, for instance – are due, fundamentally, to big industry; what each one of us can do regarding this is, comparatively, insignificant.

Quite simple calculations that participants themselves can make with regard to everyday situations (Figure 1) show, however, that individual commitment has a global repercussion. For example, although small reductions in energy consumption mean a small per capita saving, when this is multiplied by millions of people it can mean huge amounts of energy, with the subsequent reduction in pollution.

These calculations and estimations can be reinforced with hands-on activities [13-14] such as, for example, determining how much water is lost from a badly turned off dripping tap.

It should be stressed, therefore, that not only is it not true that our small actions are insignificant and irrelevant, but also that we are dealing with necessary, indispensable measures if we want to contribute in progressing towards a sustainable future and increased involvement of citizens.

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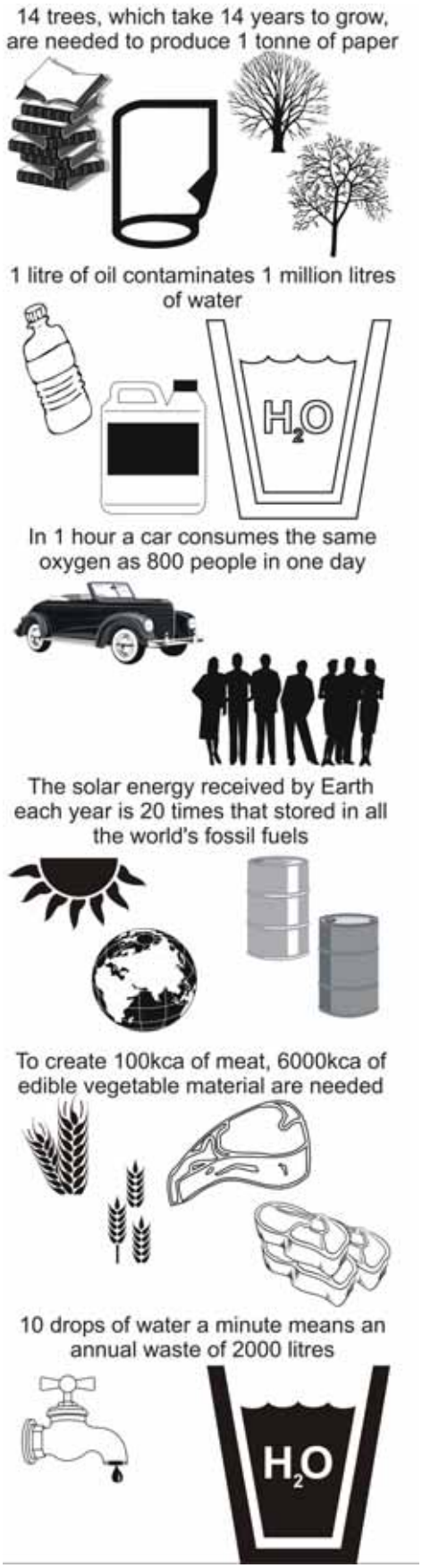

Figure 1. The importance of individual actions

For the future is going to depend to a great extent upon the model of living we follow and, although attempts are made to impose this on us, the capacity we all have to change it should not be underestimated [11]. Agenda 21, fruit of the first Earth Summit, already indicated that participation by civil society is a vital element in the advance towards sustainability.

A systematic effort is therefore necessary to incorporate education for sustainability as a key objective in the formation of future citizens, and make the need understood for actions that contribute to a sustainable future in several spheres: responsible consumption, professional activity and action by citizens.

A careful follow up of these actions is also needed. Continued educational activities are therefore required that transform our conceptions, our habits, our perspectives… and that guide us in the actions to be taken.

But it is not enough to understand the importance of our actions and have a general view of the fields of action: we need to move into action. In the same way that scientific education calls for hands-on experiments, education for sustainability demands involvement in specific actions that need to be defined and transformed into a commitment to act.

3. Specific proposals

In different workshops imparted to secondary and university students and trainee and working teachers, we have been able to ascertain that collective work in small groups, followed by group sharing, gives rise to numerous proposals for concrete action that can become the basis for real commitment that can be (self) evaluated for the building of a sustainable future.

Together with the classic "3Rs" (*reduce, reuse* and *recycle*), that correspond to us as consumers and that can give rise to numerous specific proposals of interest, another three guideline principles arise that also respond to our roles as professionals and citizens:

- *Use technologies that respect* the environment and people
- *Contribute to the education of citizens* (we are all educators as we interact with each other)
- *Participate in socio-political actions* for sustainability

And it is equally understood that there is a need for continual evaluation of the effects of our actions that introduces, if needs be, *corrective offsets*.

They are proposals that occur again and again in the workshops, as the fruit of collective work, and they turn out to coincide essentially

 ISBN 978-989-95095-3-5

with what is collected in wide-ranging literature [18-22]. Below (Boxes C1 to C7) we outline the most frequently formulated specific proposals:

C1. Reduce (Do no waste resources) [26-30]

***Reduce water consumption,* for hygiene, watering, swimming pools…**
Short showers
Turn off taps (whilst cleaning teeth, putting on soap, etc.)
Drip feed watering

Reduce energy use for lighting
Use energy saving light bulbs
Switch off unnecessary lights (beat inertia)
Make the most of natural light
Reduce energy consumption in heating and cooling
Insulate housing adequately
Do not programme very high temperatures (wear warmer clothing) or very low temperatures (ventilate better, use canopies…)
Switch off unnecessary radiators or air conditioners

Reduce energy consumption in transport
Use public transport
Use a bicycle and/or go on foot
Organise shared transport
Reduce speed, drive efficiently
Avoid plane travel whenever possible
Avoid lifts whenever possible

Reduce energy consumption in other household appliances
Load washing machines, dishwashers, etc. appropriately
Turn off the TV, PC, etc completely when not in use
Defrost the freezer, check boilers and heaters, etc.

Reduce energy consumption in food, improving it at the same time
Eat more vegetables, pulses and fruit, and less meat
Respect closed seasons and do not eat small, young fish
Avoid exotic products that demand high cost transport
Eat products in season and produced organically

Reduce paper use
Avoid printing documents that can be read on screen
Write, photocopy and print on both sides of the paper
Do not leave excessive margins

Combat Consumerism
Analyse advertising critically
Mute commercials
Do not be pulled in by commercial campaigns around St Valentines, Festive season, etc.
Programme purchases with a needs list

C2. Reuse [23-24]

Print on the other side of already used paper

Collect sink and shower water for the WC

Also collect rain water for watering or WC

Do not use disposable objects
In particular, avoid plastic bags and wrappers, aluminium foil, paper cups, etc.
Substitute them with reusable ones, repair these when necessary for as long as possible

***Use recycled and recyclable products* (paper, toner, etc)**

Encourage the reuse of computers, toys, clothes, etc.
Donate to charities that manage this

Rehabilitate housing
To make it more sustainable (better insulation, etc.) and avoid new construction

C3. Recycle [9,26,31]

Separate waste for selective collection

Take what cannot be left in the usual bin to "civil amenity sites":
Batteries, mobile phones, computers, oil, toxic chemicals, etc.

Do not pour waste down WCs or drains

C4. Avoid products that do not respect the environment and people [9,26,32]

Personally apply the precaution principal
Do not buy products without finding out how harmful they are: check the ingredients of foodstuffs, cleaning materials, clothes, etc., and avoid those that do not offer guarantees
Avoid sprays and aerosols (use hand sprays)
Apply safety norms at work, at home, etc.

Opt for renewable energies at home, in the car, etc.

Use efficient, low energy, low contamination (A++) household appliances

Reduce battery consumption and use rechargeable ones

C5. Contribute to civil education and action [33-38]

Get well informed and discuss the situation with others (family members, friends, co-workers, students, etc.) ***and, above all, what we can do***

Carry out dissemination and encouragement tasks:
Use the press, Internet, video, ecology fairs, schools materials, etc.

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Help raise awareness of sustainability problems and those closely linked to consumerism, population growth, environmental decline, imbalance, etc.
Inform about actions we can take and encourage them to be put into practice, promoting campaigns such as the use of energy saving light bulbs, reforestation, responsible parenthood, forming associations, political work, etc.

Aid in conceiving measures for sustainability as an opportunity that guarantees the future of everyone and not as a limitation
Encourage social recognition of positive measures

Study and apply what one can do for sustainability as a professional
Research, innovate, teach…

Contribute to promoting the environment at work, in the neighbourhood and city where we live, etc.

C6. Participate in socio-political actions for sustainability [1, 19, 39]

Respect and help others respect legislation that protects the environment and biodiversity
Avoid adding to noise, light or visual pollution
Do not smoke where this might damage others, and never throw cigarette butts to the ground
Do not leave rubbish in the woods, on the beach, etc.
Avoid moving to housing that contributes to the destruction of ecosystems
Take care not to damage wildlife
Comply with traffic norms for the protection of people and the environment

Denounce continued growth policies that are incompatible with sustainability

Report ecological crimes:
Illegal tree felling, forest fires, waste dumping, predatory development planning, etc.

Respect and help respect Human Rights
Report any discrimination based on ethnic, social gender or other reasons

Collaborate actively and/or economically with associations that defend sustainability:
Aid programmes for the Third World, environmental defence, aid to people in difficulty, human rights promotion, etc.

Call for the application of the 0.7 aid for the Third World and contribute personally to this

Promote Fair Trade:
Reject products produced through predatory practices (such as tropical timber, animal pelts, over fishing, predatory tourism, etc.) or that are obtained using a workforce without labour rights, child labour
Support fair trade enterprises

Demand clear informative policies on all the problems

Defend the right for research without ideological censure

Demand the application of the precaution principle

Oppose unilateralism, wars and political predators:
Demand respect for international law
Promote democracy in world institutions (IMF, WTO, World Bank, etc.)
Respect and defend cultural diversity
Respect and defend language diversity
Respect and defend lore, customs and traditions (that do not contravene human rights)

Vote for parties with more favourable policies on sustainability

Work so that governments and political parties take on the defence of sustainability

Demand local, state and universal legislation for environmental protection

"Cyberactivism": Support solidarity and sustainability campaigns from the computer

C7. Evaluate and offset [40-41]

Carry out personal behaviour audits
At home, with transport, civil and professional action, etc.

Offset the negative repercussions of our acts (CO_2 emissions, use of contaminating products, etc.) ***through positive actions***
Contribute to reforestation, help NGOs,etc.

4. The educational role of action

It is essential, without doubt, *to understand* the relevance our actions have – what we do or do not do – and construct a global view of the measures in which we can become involved. But educative action cannot be limited to achieving this understanding, taking for granted that this will lead to effective shifts in behaviour: a fundamental obstacle in obtaining the involvement of citizens in building a sustainable future is the reduction of educative action to conceptual study

It is necessary, therefore, *to establish action commitments* in education centres, workplaces, neighbourhoods and in households themselves, in order to *put into practice* some of the measures [42] and carry out follow up of the results obtained. These actions, *properly evaluated*, become the best procedure for profound understanding of the challenges, and the impulse for new commitments.

With this aim it is helpful to transform the specific proposals given above into a follow up or (self) evaluation network, starting with the acquisition of concrete commitments that can be evaluated periodically, such as can be seen in Figure 2.

But before implementing this task in our courses and workshops, *it is necessary to create our own network of commitments that can be evaluated*, both in the realm of consumers and citizens (which allows us to aim better at those

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we work with, thanks to knowledge gained through our own experience), and with regards to our professional realm: In what way are we contributing, *as educators and researchers*, to the Decade of Education for Sustainable Development? What is our response to the call from the United Nations aimed at educators from all areas and levels for us to contribute to the formation of citizens prepared to contribute to the building of a sustainable future?

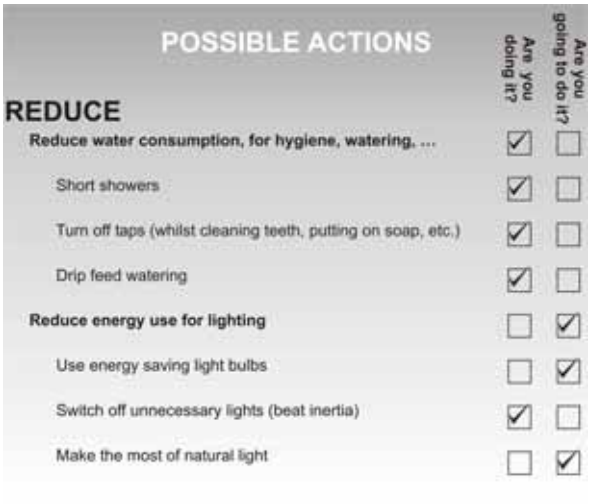

Figure 2. Network of concrete and (self) evaluation commitments

5. Conclusions

We end by remembering that we are at the start of a Decade that will be decisive for the future of humanity in one sense or another: sadly decisive if we cling to our inertia and do not become aware of the need to reverse a process of decay that constantly sends us unmistakable signs in the form of global warming, anti-natural catastrophes, loss of biological and cultural diversity, millions dying through starvation and war – the suicidal fruit of short term interests and fundamentalisms, of dramatic migrations, etc. Fortunately decisive if we are able to create a universal movement in favour of a sustainable future *that has to start today*. That is the objective that we can and must set ourselves, aware of the difficulties, but determined to contribute, as educators, as scientists and as citizens, to forging the conditions for a sustainable future.

6. Credits

This communication has been conceived as a contribution to the Decade of Education for Sustainable Development [43] instigated by the United Nations for the period 2005-2014.

7. References

[1] A. Vilches, and D. Gil-Pérez, Construyamos un futuro sostenible. Diálogos de supervivencia, Madrid: Cambridge University Presss, 2003.
[2] M. Delibes and M. Delibes de Castro, La Tierra herida. ¿Qué mundo heredarán nuestros hijos? Barcelona: Destino, 2005.
[3] C. Duarte, Cambio Global. Impacto de la actividad humana sobre el sistema Tierra. Madrid: CSIC, 2006.
[4] http://www.biodiv.org/
[5] http://www.unece.org/
[6] J. Diamond, Colapso. Barcelona: Debate, 2006.
[7] F.J. Broswimmer, Ecocidio. Breve historia de la extinción en masa de las especies. Pamplona: Laetoli, 2005.
[8] http://ec.europa.eu/environment/
[9] http://www.wri.org/
[10] http://www.globalreporting.org/
[11] http://www.eyep.info/
[12] D. Gil-Pérez and A. Vilches, La atención al futuro en la educación ciudadana. Posibles obstáculos a superar para su inclusión en la enseñanza de las ciencias. En, Martins, I., Paixao, F. y Marques, R. (Eds.) Perspectivas Ciencia-Tecnología-Sociedade na Inovação da Educação em Ciência, Aveiro: Universidade de Aveiro, 2004.
[13] UNESCO, 700 Science experiments for everyone, Doubleday: New York, 1962.
[14] M.F.M. Costa, B.V. Dorrío, P. Michaelides and S. Divjak, Selected Papers on Hands-on Science, Universidade do Minho: Braga, 2008.
[15] P. Comin and B. Font, Consumo sostenible. Preguntas con respuesta, Barcelona: Icaria, 1999.
[16] L.R. Brown, Salvar el planeta. Plan B: ecología para un mundo en peligro, Barcelona: Paidós, 2004.
[17] A. Calvo Roy and I. Fernández Bayo, Misión Verde: ¡Salva tu planeta!, Madrid: Ediciones SM, 2002.
[18] A. Gore, Una verdad incómoda. La crisis planetaria del calentamiento global y cómo afrontarla, Barcelona: Gedisa, 2007.
[19] E. Laszlo, Tú puedes cambiar el mundo. Manual del ciudadano global para lograr un planeta sostenible y sin violencia, Madrid: Nowtilus, 2004.
[20] A. Pessoa and A. Cassasin, Salvar la Tierra. Barcelona: Egedsa, 2007.
[21] M. Riba, Mañana. Guía de desarrollo sostenible, Barcelona: Intermón Oxfam, 2003.

 ISBN 978-989-95095-3-5

[22] The Earth Works Group, 50 cosas sencillas que tú puedes hacer para salvar la Tierra, Barcelona: Naturart, 2006.
[23] http://www.unesco.org/water/wwap/
[24] http://www.agua-dulce.org/
[25] http://www.energy.eu/
[26] http://www.idae.es/consejos/
[27] http://www.eufic.org/
[28] http://europa.eu/pol/food/
[29] http://www.vivelaagriculturaecologica.com/
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[31] http://www.recyclenow.org/
[32] http://www.eco-label.com/
[33] http://www.enviroliteracy.org/
[34] http://www.setem.org
[35] http://www.actionfornature.org/
[36] http://www.cites.org/
[37] http://www.sellocomerciojusto.org
[38] http://www.ilo.org/
[39] F. Mayor Zaragoza, Un mundo nuevo, Barcelona, UNESCO, Circulo de Lectores, 2000.
[40] http://www.greenpeace.org
[41] http://ecologistasenaccion.org
[42] J.S.M. Moreno and A. Pedrosa, Ecologic Sustainability and Individual and Collective Everyday Practices, In Azeiteiro, U. M. et al. (Eds.) Science and Environmental Education. Frankfurt: Peter Lang, 2006.
[43] http://www.oei.es/decada/

The Debate Forums in the Learning Regime

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Abstract. This communication approaches the construction of the interactive process in the forming of cooperative communities from the analysis of debate forums in the online environment. The selection of this thematic is motivated by the experience as teachers in the E-Learning regime at Universidade Aberta and by the recognition of the relevance of forums in the construction of learning environments.

The utilization of several forms of interaction and networked communication institutes a new branch of education that is denominated as long-distance teaching. The exponential growth that has occurred in the last decades within this teaching methodology is due to technological advances, especially in the virtual spaces of the internet that result in new pedagogical approaches and numerous possibilities of quick and easy access to information.

The debate forums, as pedagogical tools, contribute positively to promote a change in attitudes and methodologies in the teaching/learning relationship, in the sense of proximity and overture of the university to the world, for its organizational and temporal characteristics.

Keywords. Debate forum, Teaching, Learning, Long-Distance Teaching, Cooperative Learning.

1. Contextualization

The change in social structures allowed not only the appearance of new learning contexts, but also the appearance of new ways to create knowledge.

The new reality of the socio-cultural environment transformed, in a significant way, the structure of the economic fabric, and teaching, as a standpoint of sustainability of modern societies, as to adapt to the new constant demands, where change, and subsequent adaptation, is an unavoidable reality (Martins, 2006).

The interaction between teacher and student allied to the new network structures made possible the existence of communities with

 ISBN 978-989-95095-3-5

specific characteristics and with the capacity to construct knowledge.

Presently we live in exponential growth of the potentials of communication and information technologies, which has caused great changes in daily social, cultural and economic routine.

The revolution we've been living in for the past decades has also brought up new thoughts in the educational context and the permanent development of communication and information technologies has given potential to educational strategies, mainly in long-distance teaching.

In the beginning of long-distance teaching, the most utilized learning theory was the behavioural theory that considers that the student's answers are always possibly reinforced by some award system. This was the time of the hegemony of "Programmed Instruction" – a self-study system with emphasis on content, considered the apogee of the behavioural education application.

Later, with the appearance of cognitive and constructive theories, process was more valued than content, as well as the student's internal capacities (his perception, memory or reasoning). According to the principles of these theories, the cooperative learning networks were strengthened and the students became motivated to better express their thoughts, to defend them, to accompany the discussion among colleagues which also contributes to the construction of their own knowledge.

Practically, during online classes, students must gain incentive to develop activities in which they are active subjects of the process, interacting with the remainder of the group, through technological resources like forums, group activities, chats, e-mail exchange, constructing knowledge in a different fashion than with regular teaching.

Virtual learning environments have as an objective to create learning situations for students that are away from teaching centres, so as to offer adequate solutions to the learning/teaching process, resorting to Learning Management Systems.

The virtual classroom promotes interaction between students and teachers, through chat, giving the teacher the possibility to lecture based on a video window, resorting to a webcam and projecting the contents in an area of didactic exposition, the students having access to it through a password.

The internet is becoming increasingly more a familiar means of support to the building of new educational proposals, long-distance teaching representing a revolution in actual educational paradigms, in so that is presents several opportunities to universities to integrate and enrich their didactic material, offering new interaction and communication tools between teacher and student.

The main theories of long-distance education brought to the pedagogical environment a new perception of the dimension of space and time of learning.

In conventional teaching, the synchronization required as essential condition to the realization of processes is revaluated when it is developed in non-physically present environments, mainly after the introduction of the interned as a pedagogical tool.

In long-distance teaching the concept of space, in the sense of physical dimension where the learning-teaching process takes place, requires a new perspective. It is the improved classroom, assuming new shapes, making knowledge available to distant locations where it is of difficult access.

The new technologies of information and communication, especially the networked computer, brought with them a new way of understanding distance.

The new models of education are conceived from diverse forms of communicating and constructing existing knowledge. Rather than transmitting "accumulated knowledge", means are made available to build knowledge from virtual communities. In long-distance teaching we work with a different dimension of time, respecting the distinct apprenticeship times of those learning.

The management of time from the teacher's part is a crucial point in long-distance education. The amount of time needed to administer an online course is greater if compared with regular teaching, for the continuous presence of the teacher, his guidance and availability are fundamental for the success of the course, as well as the time spent to read and reply to the messages of students and read assignments being greater than in regular teaching.

The modality of education in which learning/teaching activities takes place, regardless of physical presence, at the same time and in the same space, characterizes long-distance education.

Thus, we can define long-distance education as a modality of education, where teaching is constituted to the physical and temporal distance, mediated by some form of technology both facilitating and being an incentive of communication and interaction between students and teacher.

After all knowledge is decisively the frontier for success in this new millennium (Martins, 2000), and long-distance teaching is itself a fundamental partner for its dissemination.

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2. The debate forums in the construction of learning environments

The process of teaching and learning through new spaces has expanded in the last two decades. The expression "learning space" indicates in its traditional application, "classroom, and library". However, the new learning spaces present a different connotation, being imaginary spaces.

Thus, the meaning of the term "virtual learning space" goes beyond the limits of the concepts of time and space, mainly with the emergence of the "networked society", new virtual learning spaces have been establishing themselves from the creative access and use of new technologies of information and communication.

In the virtual learning space there are no spatial limits and disposition, the internet allows all distance to be overcome originating a world of limitless knowledge and information.

Cooperative learning is made through group assignments and mutual help among students, for the purposes of cooperative learning are amply utilized because the collective tools made available by the internet both helps and offers this form of teaching.

Virtual support platforms to both teaching and learning, also called Learning Management Systems of virtual learning environments, are considered to be spaces contained with the internet's cyberspace, composed by various components that are responsible for the communication, interaction and availability of contents in the format of text, images and sound, allowing the construction of a community and making available tools that facilitated the contact of students among themselves and with the teacher.

Forums are applications destined for network use, made available on an intranet or the internet, from a web server that supports dynamic contents supported by database. In this fashion, forums allow students and teachers to communicate from a distance in an asynchronous way.

Although there are many forms of asynchronous communication such as e-mail, forums have many advantages, among them, the establishment of a notion of community, of group spirit, addressing messages to several students simultaneously.

The utilization of forums facilitates a group dynamic favourable to integration by the students and promotes the open work habits so common in the scientific community.

Communication through forums creates a spirit of loyalty among students because the questions and doubts are "public", allowing a global following of interactions, making possible for the teacher to have a global perspective of the interest and commitment by his students, and, to them, allows to benefit from the questions of their colleagues to clarify their own doubts, allowing for a less compromised participation.

Forums promote a space that facilitates the emergence of different perspectives and questions, so as to obtain diversified contributions to the resolution of problems and the elaboration of projects, allowing the exchange of experiences, the debate of ideas and the construction of new knowledge, space by excellence of asynchronous communication.

The forum is also characterized as a cooperative learning community, for presently, the creation of communities emerges from the web, motivated by the openness and ease of electronic communication.

In the teaching/learning environment the forum is a learning tool used to foment debate among users, requiring a significant amount of time for complete integration in the group.

An aspect that must be emphasized is the perception of the specific of each forum, where the clarity about its utilization and respect for the proposed topic must be preserved. From this observation, which is usual, we incur the existence of forums denominated as "thematic", whose objective is to focus on the emergent reflections of group debates, as differentiated spaces, where users can deal with questions, sharing difficulties and dialogue over diverse subjects. Forums are, equally, a powerful tool for dialogues and exchange of experiences subsequent to the reading of bibliographical material recommended by the teacher.

After all, one of the main strategies in this type of teaching is the cooperative work and the interchange of ideas, the students being encouraged by the teacher to interact among themselves, participating in the forums in the logic of continuous learning. The conversation between students represents an indication of cooperative learning in the measure that the exchange of experiences originates, generally, a growth in personal knowledge, thus, the students aren't restricted to receive information strictly from the teacher or to interact strictly with him.

The cooperative community is also characterized by the sharing of resources, its sense, the diversified authors of learning, pleasure in divulging their breakthroughs, such as texts, references, authors, events, etc.

The process of constructing cooperative communities brings out quite often movements that transcend the virtual space itself, bearing witness to the fact that, in the specific case of

 ISBN 978-989-95095-3-5

Universidade Aberta, they are numerous, students that feel the need for a greater approach, namely, through meeting personally.

3. Final considerations

Debate forums are easy to use, being accessible to all and constituting an asset in the learning/teaching process and enhancing the university's community.

However, the predisposition to using the forums assumes the existence of specific tools.

Throughout this article, we reflected on the importance of debate forums as spaces of cooperative learning, where we mainly encounter the value of different experiences, the reflexion of studied material, the construction of knowledge, articulating between what is known and the new information being assimilated.

A primary facet is its structure as an essential tool for the existence of dialogue, in a virtual learning environment, being a space for the construction of knowledge where users resort, by participating in a forum, to an exponential increase of knowledge, since they must initiate their participation with the reading of already existing messages by colleagues to, only later, add their contribution and present new ideas, new reflexions and new contributions.

We must never forget that the fundamental difference between regular educational processes and those pertaining to long-distance education concern asynchronous communication and absence of face-to-face contact, situation that the teacher must both minimize and habitually, work around, for the sake of educational success.

The development of a society is also measured by the degree of maturation of its community of educational learning, for only species capable of continuous evolution are capable of survival, as theorized by Darwin. The capacity to evolve, progressively, in technological tools is important, but the motivation for learning, the creation of true learning communities, only results from the combined effort of the human being, the centre of all things.

4. References

[1] L.G. Aretio, La educación a distancia: de la teoría a la práctica, Ed. Ariel, Barcelona, 2006.

[2] J. Bottentuit, C. Coutinho and D. Alexandre, M-learning e webquests. As novas tecnologias como recurso pedagógico, Proceedings of 8th International Symposium on Computers in Education (SIIE2006), Vol. 2, (pp. 346-353), Servicio de Imprenta de la Universidad de León, León, 2006.

[3] S.E. Brennan, C.B. Lockridge, Computer-mediated communication: A cognitive science approach, in K. Brown (Ed.), ELL2, Encyclopedia of Language and Linguistics, 2nd Ed., Elsevier Ltd., Oxford, UK, 2006.

[4] L.S. Cheung, A constructivist approach to designing computer supported concept mapping environment, International Journal of Instructional Media, Vol. 33, pp.150-155, 2006.

[5] C. Coutinho and J. Bottentuit, Tecnologia Educativa em Portugal: Um Contributo Para a Caracterização do Seu Quadro Teórico e Conceptual, Revista Psicologia, Educação e Cultura, Vol. XI (1), Maio, 2007.

[6] M. Dougiamas and P. Taylor, Moodle: Using Learning Communities to Crate an Open Source Course Management System, Proceedings of the EDMEDIA 2003 Conference, Honolulu, Hawai, 2003.

[7] C. Grenhow, What Teacher Education Needs to Know about Web 2.0: Preparing New Teachers in the 21st Century, In R. Craslen et al (Eds.), Proceedings of the 18th International Conference of the Society for Information Technology & Teacher Education, SITE 2007, pp. 2027-2034, Chesapeake, VA: AACE, 2007.

[8] A.E. Martins, Capital Intelectual – Ensaio Exploratório de Modelo Explicativo, Tese de Mestrado em Ciências Empresarias, ISCTE, Portugal, 2000.

[9] A.E. Martins, O investimento directo estrangeiro em Portugal – o caso da Polónia, Tese de Mestrado em Economia e Estudos Europeus, ISEG, Universidade Técnica de Lisboa, Portugal, 2006.

[10] M. Meirinhos and A. Osório, B-Learning para a formação contínua de professores, Actas do VIII Congresso Galaico-Português de Psicopedagogia, Vol. 2, pp. 949-964, Universidade do Minho, Braga, 2007.

[11] J.M. Moran, Propostas de mudança nos cursos presenciais em educação on-line. http://www.abed.org.br/congresso2004/por/htm/153-TC-D2.htm, 2004.

[12] K.P. Pallof, Collaboration Online: Learning Together in Community, Wiley, John & sons, Incorporated, 2004.

[13] M. Paulsen, E-Learning: o papel dos sistemas de gestão da aprendizagem na Europa, Colecção formação a distância & e-Learning, Inofor, p. 21, 2002.

[14] F.L. Reis and A.E. Martins, Os Desafios do Professor no Contexto do Ensino Online, Actas da Conferência V Simpósio sobre a

 ISBN 978-989-95095-3-5

Organização e Gestão Escolar, Universidade de Aveiro, 2-3 de Maio, 2008.
[15] F.L. Reis and A.E. Martins, Benefícios do E-Learning no ensino Universitário, Actas da 3ª Conferência Ibérica de Sistemas Y Tecnologías de Información, Universidade de Vigo, Espanha, 19-21 de Junho, 2008.
[16] F.L. Reis and A.E. Martins, Perspectives of the distance education in Portugal, Actas da Conferência International Council on Education for Teaching, Universidade do Minho, 14-17 de Julho, 2008.
[17] G. Salmon, E-moderating – the key to teaching and learning online, Kogan Page, London, 2000.
[18] A.T. Santos, As TIC e o Desenvolvimento de Competências para Aprender a Aprender: um estudo de caso de avaliação do impacte das TIC na adopção de métodos de trabalho efectivos no 1º Ciclo EB. Dissertação de Mestrado, Universidade de Aveiro, Aveiro, 2007.
[19] R. Tavares, Aprendizagem significativa em um ambiente multimedia, V Encuentro Internacional sobre Aprendizaje Significativo, Madrid, 2006.
[20] B. White, Is Web 2.0 the Future of the Web? Comunicação oral apresentada no ED-Media 2007, Vancouver, CA, AACE, 2007.

Magical Numbers May Govern the Optimum Size of Curriculum Classes

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Abstract. Frequently, the public education institutions are yearly financed, based upon the total number of students, enrolled by those institutions, at the beginning of the academic year. The social demand to increase the number of graduates prompts enlarging the size of classes, within the upper limits imposed by the infrastructure, by pedagogic, ergonomic or administrative regulations, size, usually, less connected with the results of an entire cycle. But, how to choose the size of a class, to ensure both the maximum financial support and the minimum number of graduates expected by the society? The authors suggest that a criterion for finding the optimum size of classes be connected with the their academic results through the curriculum cycle, f. e. with the ratio graduated seniors / enrolled freshmen**,** result to comply with accreditation conditions for passing between years. Thus, there may be numerically determined the optimum size of a class of freshmen, governed by "magical numbers", specific to the legal accreditation rules in force.

Keywords: Accreditation Rules, Econophysics, Education Funding. Magical Numbers, Optimum Size of Curriculum Classes.

1. Introduction

The management of education, at different levels, rises, frequently, questions about how to decrease the cost of education, per student. This aspect is particularly important when the expenses of an education institution (E.I.), university, school, are integrally supported by the public budget, national or local and when the society needs more graduates.

In many countries, including Romania, the public education institutions are yearly financed based upon the total number of students (respectively, pupils) enrolled with those institutions, at the beginning of the academic (school) year.

The yearly expenditures of an E.I. consist of fixed and of variable ones.

The variable costs for the E.I. are those proportional with the number of students.

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The fixed costs which, by name, would be independent of the number of students, are, finally, for a rather large education unit, also roughly proportional, with the total number of students enrolled in that institution, subject to a small relative error (of the same order of magnitude with the relative error on the variable costs). F. e., for an institution having ~ 50 classes, the relative error of appearing or disappearing a class is ~ 2%, value acceptable for the relative error on variable expenses.

Each year, the E. I. tries to enrol the maximum, possible for it, cohort of students and tries to divide all enrolled students in classes which, usually, to have the standard allowed maximum size The fixed expenditures of an E.I. are connected with the number and the size of classes. Larger the class, smaller their number less fixed costs per student, but there are limits of the upper size of a class, imposed by the E.I. infrastructure, by pedagogic, ergonomic or administrative regulations.

Usually, there are provisions in the rules of Ministry of Education or of other regulatory bodies, about the size of a class, depending of the type of activity: f. e. 80-120 attendants for a lecture, 20-30 students for a tutorial, 10-15 students for a laboratory work, 5- 10 students in a plastic arts class.

How to choose the size of a class, to ensure, both, the highest financial support and at least the minimum number of graduates expected by the society from a given curriculum?

There is needed a criterion for optimum.

2. A criterion for the optimum size of classes

The authors suggest that this criterion for the optimum size of classes of a curriculum be connected with the result of education (training) through that curriculum, for example with the ratio graduated seniors / enrolled freshmen, for a complete cycle of studies of a given program (curriculum), result to comply with accreditation criteria.

Usually, ministries of education or, eventually, parliaments, set conditions [1] that a curriculum be periodically (T= ~ 5y) accredited and/or financed (yearly) including: conditions for ratio of students passing in the next year, p_a, and a condition for passing the final (graduation) examination, p_b. Not fulfilling these conditions means non accreditation and non financing of that curriculum in the future[1].

Therefore, there exists a supplementary restriction to be dealt with by managers of an education institution, restriction depending of final results and not only of initial conditions.

The authors show that, by applying this criterion of observing accreditation conditions (the conditions for passing academic years and final examination) one can numerically determine the optimum size of a class when enrolling freshmen, to, both, ensure the highest amount of funding and its best use and the fulfilment of the society minimum requirements.

3. Magical numbers

Because the requirements for accreditation are expressed in the provisions of the existing rules as minimum acceptable percentage [1] and because the number of students implied must always be an integer (the upper rounded up integer, resulting from any computations, because the conditions are minimum ones), these conditions, especially for small cohorts, impose thorough choice optimum size appearing as being limited by “magical numbers” determined by concrete provisions of the accreditation rules. The determination of the size of the class subjected to accreditation requirements becomes a problem in Statistical Physics or in Econophysics.

4. Hypothetical case study

Here following, there is described an example [2] of such sizing of a program of study (curriculum)[2].

4. 1. The Statement of the proposed problem

"At the Admission competition into a First Cycle (“License”) of an Engineering Curriculum (4 years of study + license examination), at a newly created Faculty (let say “AS”), there are, initially, offered, by the University, for the first cohort of the curriculum, 100 places, funded by the State, from the quota given to the whole

[1] If observed by state authorities, but this may, sometimes, not happen.

[2] The authors proposed this problem, to the participants at the ceremony of inauguration of the headquarters (“DECANAT”) of the new Faculty of Applied Sciences of the University “POLITEHNICA” in Bucharest, on 8th of March 2007. This Faculty has been created, in the summer of 2005, as an independent faculty, on the opportunity of implementing Bologna Reform of Higher Education in Romania. The number of candidates enrolled as freshmen in the academic year 2005-6, with the curriculum offered by the new faculty of Applied Sciences was 105 = D_0. The students passing in the second year was 68, coresponding to a p_1 = 65%.

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University. Because of the existing demand and of the results at the admission examination (3 hour tests in Mathematics and in Physics), the Faculty AS asks, from the University, 5 more State funded places, (to reach D_0 = 105 freshmen) taking the 5 public budgeted place from another faculty, that other faculty not having covered with demands its initial quota.

The University approved that increase.

Soon, the candidate ranking the 106th on AS list, which has an average mark a little smaller than the mark of the 105th candidate, but larger than the minimum average mark for admission in the University, asked to be admitted in the Faculty AS, too. But he was not accepted by the Faculty. This candidate demanded, directly, to the University, to offer Faculty AS one more supplementary place for a newly enrolled student

The University, because the request was not implying for it supplementary public financing, accepted the demand of the 106th candidate, subject to the Faculty AS' decision. But the Faculty AS did not accept the generous offer of the University (to have M_0 = 106 freshmen). The Faculty AS, refused the place additionally funded (place increasing with 1/105 the initial financing of the curriculum, for its freshmen)**,** mentioning the future accreditation conditions.

Explain the two managerial positions, of the Faculty and of the University, considering the funding per year, per enrolled student, **E**, as being constant, during the whole cycle of License studies and observing the conditions for accreditation.

Legal information [1]: Compulsory Conditions for Accreditation of a Curriculum of Studies by ARACIS (the Romanian State Accreditation Agency for Higher Education), Annex. I. 3. 3., the Provisions:

-- CNO IV 5: "between two successive years of study, the minimum percentage of passed students to be achieved must be p_a = 40%" (1)

-- CNO IV 10: "the minimum percentage of the students successful in taken the graduation examination must be p_g = 51%". (2)

4.2. Solution of the problem

The strategy of solving the problem is to determine, when observing (1) and (2), the minimum necessary numbers of **graduates** of the curriculum, with License's degree, D_f (for the D_0 desired by the Faculty AS) and respectively, M_f (corresponding to the M_O freshmen, figure not accepted by the Faculty AS) and to compare them.

The accepted results for D_f and M_f are to be the upper next integers of the exactly found values. (3)

There are then to be compared the costs involved versus the changes in the number of enrolled freshmen.

If the number of students would not be integers, the minimum percentage of graduated students, out from the freshmen, compulsorily resulting from accreditation conditions, P_f, would be:

$P_f = p_1 * p_2 * p_3 * p_4 * p_g = 0.40^4 * 0.51 =$
$=0.013056,(4)$ roughly, 1 graduate in about 76-77 freshmen.

The number of graduates, G_D and G_M, starting from the two initial situations, D_0 and respectively, M_0, rounded only at the end of computations, would be:

$G_D = P_f * D_0 = 0.013056 * 105 = 1.37088 \rightarrow 2.$ (5)

$G_M = P_f * M_0 = 0.013056 * 106 = 1.383936 \rightarrow 2$ (6)

That means that, the conditioned final result, expressed in rounded up integers, would be the same for both number D_0 and M_0 of enrolled freshmen: 1 graduate (lower value) or 2 graduates (upper value), depending of the convention of final rounding up (here - 2 graduates for the normal, upper, rounding up).

Based on this model, the Faculty might had accepted the offer of the University, offer increasing its funding for freshmen with 1/105 of initial value, without supplementary obligations at the end of the 4 y + graduation examination cycle.

But, if there is a rounding up to the upper integer, for **each** year of study, the things change significantly!

4. 2. 1. Summary of the data known from the Statement when rounding up to the upper integer

Known data (input) :

$D_0 = 105$; $M_0=106$; $p_i = p_a=0.40$; $p_g=0.51$, (7)

$D_i, M_i, D_f, M_f \in N$, (3)

where D_i, M_i are the numbers of students finishing the i^{th} year of study,

$i \{1, 2, 3, 4\}$, (8)

Data to be found (output):

D_f =?; M_f = ? (9)

$T_D = \Sigma D_i$ = ? ; $T_M = \Sigma M_i$ = ? (10)

where, T is the total number of funded year*student, for the whole cycle.

4. 2. 2. The symbolic solution

$D_{i+1} \geq p_a * D_i$; $M_{i+1} \geq p_a * M_i$ (11)

$D_f \geq p_g * D_4$; $M_f \geq p_g * M_4$ (12)

$D_i, M_i, D_f, M_f \in N$, (3)

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4. 2. 3. The numerical Solution

The minimum number of students to pass in the next year (**rounded up to the upper integer**), for 4 years of study are, successively:
D_i : D_1 = 105*0.40= **42**; D_2 =16.8 → **17**; D_3 =6.8 → **7**; D_4 = 2.8 → **3 (**13)
M_i: M_1 = 106*0.40= 42.4 → **43**;
M_2 = 17.2 → **18**; M_3 = 7.2 → **8**;
M_4= 3.2 → **4 (**14)

The minimum number of students to pass the graduate examination and receive diplomas (rounded up to the upper integer):

$D_f \geq p_d * D_4 = 0.51* 3 = 1.53 \rightarrow \mathbf{D_f = 2}$ graduates (15)

$M_f \geq p_d * M_4 = 0.51* 4 = 2.02 \rightarrow \mathbf{M_f = 3}$ graduates (16)

4. 3. The interpretation of the results

The relative growth of the number of graduates due to curriculum AS, expected by the investor (the University), $\mathbf{r_f}$ is:
$\mathbf{r_f} = (M_f / D_f) - 1 = 3/2 - 1 = \mathbf{50\ \%}$ **, (**17)
for a relative increased investment in the freshmen, $\mathbf{r_0}$ of:
$\mathbf{r_0} = (M_0 / D_0) - 1 = 106 / 105 - 1 = \mathbf{0,95\ \%}$ (18)
For the University (the investor) the resulting leverage, $\mathbf{L_0}$**,** would be:
$\mathbf{L_0 = r_f / r_o = 50\% / 0.95\ \% = 52.63 \sim 53}$ **times ! (**19)

The cumulated (consolidated) expenditures, during the whole cycle, due to the enrolment of one supplementary freshman, would increase from
$T_D = \Sigma D_i$= 174 year*student*E (20) to
$T_M = \Sigma M_i$=179 y*s* E, (21)
relatively, $\mathbf{r_t}$, with **2.73%** (22)

The Leverage on the total expenditures for getting one more graduate, L_f, would be:
$\mathbf{L_f = r_f / r_t}$ = 0,5: (5/174)= **17.4 times.** (23)

Therefore, the University is highly interested to have enrolled, by the faculty AS, the 106th student.

The Faculty may had looked at the offer of the University as an obligation to got three graduates instead of two (50% more efforts) for that cohort, for an increase in funding of only 0.95% for freshmen and of 2.73%, for the entire cycle. Therefore the Faculty is not wishing to enrol the 106th student, with a view to the coming accreditation inspection, at the end of the cycle.

It was not worth for the Faculty to accept the additional offer of the University.

Because the examinations are internal procedures, the faculty could, eventually, reduce the level of standards for assessments, applied if accepting the 106th freshmen, but the Faculty AS did not want to do that, the Faculty considering the international standards of assessment as being more important. [3]

5. Magical numbers

By further exploring the model along a wider spectrum of enrolled freshmen in a curriculum, for the same accreditation conditions [1], the authors have found that there are some intervals between which the number of necessary graduates for accreditation is the same; specifically to the mentioned accreditation conditions [1], for the intervals:
$D_0 \in 1 - 12 \rightarrow D_f = 1$ graduate (24)
$D_0 \in 13 - 105 \rightarrow D_f = 2$ graduates
$D_0 \in 106 - 187 \rightarrow D_f = 3$ graduates
$D_0 \in 188 - 262 \rightarrow D_f = 4$ graduates
$D_0 \in 263 - 342 \rightarrow D_f = 5$ graduates
$D_0 \in 343 - 417 \rightarrow D_f = 6$ graduates
$D_0 \in 418 - 500 \rightarrow D_f = 7$ graduates

Therefore, one may define discrete, stiff transitions in the number of graduates over the magical numbers of freshmen:
12; 105; 187; 262; 342; 417; 500 . . . (25)

From this finding, an advice for managers of curricula: observe the upper limits of classes for the freshmen: do not exceed Magical numbers!

We have to note that the difference between successive intervals slightly oscillates, but the trend is towards the value $1/ P_f = p_1 * p_2 * p_3 * p_4 * p_g$ = 0.0256*0.51 = 1/0.013056= ~ 76 students.

For other accreditation conditions, there are too easily be found other sets of magical numbers.

6. References

[1] Ministry of Education, Research and Youth, www.edu.ro/index/php/articles/6746

[3] Sometimes, some education institutions diminish the level necessary for passing, especially high schools. Consequently, the Government felt obliged to introduce, a couple of years ago, the final highschool examination ("Bacccalaureat") as an external examination, based upon national unique tests and external commissions. The first result was that some highschools in Romania, especially from rural area, obtained a null rate of graduation. The second result was large attempts of cheating.

Unfortunately, in Romania, some public highscools with null graduates have not been closed, in spite of the (theoretically) compulsory accreditation provisions.

On such a rural area, the leader of the largest opposition party in Romania has declare to run for a senator' mandate, at next, automn 2008, parliament elections.

[1.1.] "METODOLOGIA de evaluare externa, standardele, standardele de referinta si lista indicatorilor de performanta ale Agentiei Române de Asigurare a Calitatii în Invatamântul Superior Bucuresti", Art. IV. 4.2.4.e: p_a = 0.40 (1) and Art. IV. 4.2.4.j: p_g = 0.51 (2).
[1.2.2] "Cerintele Normative Obligatorii in vederea Acreditarii, ale ARACIS – Fisa Vizitei, Anexa Nr. I. 3. 3. a " :
C. N. O. IV 5 : p_a = 0.40 (1) ;
C. N. O. IV 10 : p_g = 0.51 (2).
[2] R. Chisleag, A Problem of Accreditation, Workshop EDEN I – "Econophysics, a new Exploratory Domain"; University of Pitesti, Romania, March 20, 2008.

E-Learning : A Way in Teaching / Learning

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Abstract. In this communication we take a look to the most important aspects in E-Learning as a way in teaching/learning at long distance. With time new technologies in the informatics field changed, for some reasons, in the present methods teaching/learning. In relation to the organization methods and social forms, they were broken by the advance of science and technologies. Teachers and students, with the boom in new interactive technologies, start to use tools as Internet, e-mail, videoconference that specifies the long distance tutoring. This increase the learning spaces, the learning opportunities and a better offer of the population.

Keywords. E-learning, Distance Education, Online.

1. Introduction

We are living in a constant learning society and is important a permanent formation in a work market, more and more complex, that because an accelerated technologic change we have to make an effort to continue learning.

It is learning a big amount of different things in a short time, having access to a big volume of information that we can see and learn with a changing speed that carries the student to a constant learning method.

The changes in the social structures allow the appearance of new learning methods and new forms in the built of knowledge.

The changes in community's concept with the new technological tools permit the appearance of new groups that didn't exist.

The built platforms beginning in this new network concept move towards the construction of a learning community. In the present, the communities appear, not in a certain place, but in many due to values differences, illuminations, and other reasons.

We have a natural need to communicate, and it take us to create this communities. New technologies allow us to create communities each time there is a need to communicate.

The e-learning is already use in many parts of the world.

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This model of education is characterized by the separation between the teacher and the student being their transmission of educational aspects done through the use of technical means of communication.

This way it allows the student to access in learning without timetables, without problems with moving towards an institution and be able to create his own study programme.

However, the e-learning does not separate the student from the teacher, but yes search the reduction that life itself has created, and does not put aside the direct contact between the student and between the teacher and the student.

The traditional means in spreading knowledge, in the present teaching, as well as the books and the class rooms has been changed with the interactive technologies appearance, e-learning, e-mail and audio conference based in video conference.

The teachers and students passed using Internet tools that changed electronic teaching systems like e-learning, e-mail and audio conference based in digital video conference.

In Portugal, many of the present teaching institutions are still accepting with pessimism the adoption of e-learning because it takes a big investment in resources and success is not fully guaranteed.

However have been made studies, such as in us high teaching schools, due to the collaboration between students stimulated by the lack of chance to question directly the teachers, and with either present or virtual classes, the virtual is the more successful.

The e-learning is the most demanding to the student and for the teacher, than the present teaching for a several number of issues, in opposition to the sincrone communication of the present teaching, that demands to the intervenient to be able to communicate in constructive way and precise with a sensibilized behaviour, alert and careful towards the student.

This in a way to overcome the apcent of the human component of communication measured by computer

The student has a better level of motivation and a better learning autonomy, as well as in managing its own time, being only to develop independence and work skills.

The teacher has the need to elaborate the e-aspects in a way of make it easy, with didactical, the learning process to be more autonom based in self study, demanding more time in the preparation and conception of the class.

2. E-learning as a long distance way to teaching

We live in a present where the information is all in the web, and we have been looking to a development in this communication and information technologies.

So, is very important to go with this evolution trough an innovating teaching and a quality that stands for an autonom reaching several means and methods of communication.

This way, the long distance learning appears based on the web and trough Morten Paulsen (2002) is characterized with the separation of the teacher and the student.

E-learning is a way to education on-line that together is a process and application, like computer based learning and virtual classrooms. It dispobilizes program methods trough Internet, cd-rom, interactive tv.

Nowadays with the continuous changes, the individual formation became an addition to the enterprise requiring a permanent learning process.

E-learning as the most recent way in long distance learning corresponding to the demands in the system and methods, as well as personnel teaching where the management of time is a problem of the student.

The e-learning systems should include tested applications, when possible also a evaluation trough forums, choice possibilities trough the interactive Works, information in the student interest and sound system and pictures up to communicate, synchronal and asynchrony.

For some years we live in times of rapid development of informatics technologies, with access to global networks, data base, virtual libraries, e-mail, cd Rom and a great Bio variety of Software offers.

This new technologies help us to overcame the actual forms in learning and teaching.

With the massification of the new information and communication technologies it is imperative the adoption of these in learning and teaching. This is called e-learning.

This way teaching is with collaboration, giving the chance to the student to benefit the support and the feedback from the other students with the learning procedure.

The number of teachers that give lessons this way is growing in Portugal and in the rest f the world. This is because the reason is centred in the student, allowing to build his way through self formation, interacting with the available information and their need in learning, in flexible way, without time tables or place, by himself and the theory to several activities.

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This methodological kind way in long distance tutoring, has a lot of benefits, such as the circulation of information in real time, with access to everyone interested, in any time or place, when connected with a informatic study.

This has a role in the different types of learning that are impossible in the normal school structure.

When the interactive is about change, from a teaching whit limits, the students role in the search from information is where he tries to adapt to the patent information is whatever he looks for.

The several pat to interaction when learning upon e-learning, is the student computer interaction, student-work interaction student-teacher interaction.

The teacher must have a important role in the permanent contact whit the student with a certain motivation, involving, understanding, trust and high participation, and if necessary, good acting and cannot let the other students run away from the courses for feeling isolament or, that the work of the group on the demands, that can be personal or professional.

At last, the teacher must be alert to the differences in the cultures, differences in the several societies and the several experience levels of the students.

The change to use accrue understanding communication (allows a bigger reflexion, fixation of the knowledge, opinions ect…) and sin crone communications (with the chats that can promote the thought of belong and feeling of be in a class room).

The several aspects of this communication are available in on-line environments, sin crone and assurance, they demand that the teacher is on to have a talk in a constructive and certain way and have a right behaviour: as well as be expert, alert and sensitive for students that don't have a regular and continuous presence in forums and on the debate causes, give time to the student to answers to the messages develop questionnaire tactics and of debate(on-line teaching tools).

In the on stands. like in e-learning the several ways to take the students into a discussion like for example the group, (summary of the group work results)and to show it to the group in general.

The sincrone communication instead of the accrue is time table dependent, or example to chat use when is necessarily fast information.

In this type of learning methodology, the teacher is now conceiving and designing teaching activities such as: pedagogical resources or pedagogical e-tools and e-contents, due to the necessity of making the contents available in the shape of didactic materials that facilitate a more autonomous learning process based on self-study, so as to utilize available technological resources in the online environment.

And also the possibility of synchronous interactive classes – videoconference, audio, chat (virtual written and oral conversation rooms) and asynchronous – forums, email, debate groups.

The preparation of materials must include those activities which are the main elements of activating knowledge, the themes to be developed from the student's participation and interaction. More so, the definition of the available types of online collaboration for each activity, the demands and expectations from the online teacher, the work methodology, the activity grading techniques and their value faced with final grading.

In e-learning teaching procedures grading has an aggravated importance, with the nature of the learning-teaching context having to be quite explicit.

The teacher, when preparing online and offline materials for each activity (programs, reading assignments, group and individual assignments, debate issues), must take into consideration the time demanded for the realization of the activity, the deadline for its conclusion, the "mutual help forums" as an interaction tool between students to mutually help each other in doing said activity.

E-learning demands of the student a greater level of motivation and greater learning autonomy than regular schooling. However, it promotes innovation in formative processes, stimulates the creation of multimedia contents, allows the creation of learning communities and broadens the geographical coverage of schooling. But e-learning is only advantageous if it also allows for good pedagogical results for the student.

E-learning and b-learning (Blended Learning), more recent developments of long-distance teaching methods, present themselves as innovative formative and educative strategies that are considered crucial for the present days. Besides, they give students the possibility to become critical pro-active thinkers, building their own cognitive structure for analysis and interpretation of information, so as to more effectively intervene in reality.

The most recent form of teaching dresses itself in an increasingly greater success in a determined target-audience and in determined corporate sectors, given the convergence of needs between the company and new technological assets. It gives students

 ISBN 978-989-95095-3-5

knowledge by giving them the possibility of training directed to the quality and demands of systems and contents, where the management of time is at the student's criteria.

The growing development of an economy based on knowledge cannot help but place new expectations regarding the necessary adaptation of Higher Teaching Institutions, since significant challenges and great opportunities are faced.

The emergence of knowledge appreciation in society is interconnected to the development of information and communication technologies, in so that they drive its creation and dissemination processes.

Information and communication tools, essentially e-learning tools, offer teachers several possibilities to develop the traditional learning model in accordance with the new learning references, such as Mode 2 systemized by Hill & Tedford, 2002. The designated e-learning platforms (PeL), by offering an enlarged set integrated with functionalities, allow the establishment the creation of distributed environments that can support new approaches in higher teaching.

Information and communication technologies and e-learning platforms in particular, are seen as a potential response to a great diversity of problems and needs, specifically, pedagogical, administrative, of professional ethics in area research and organizational learning.

Moodle (Modular Object-Oriented Dynamic Learning Environment) is a web platform that creates internet-based resources. Technically, it's open-source software (free software) that works in any operative system that supports PHP language.

Based on a constructive philosophy, the development of Moodle is sustained in the premise that people build knowledge more actively when interacting with the environment. The student goes from a passive attitude of receptor of knowledge to an active attitude in the joined construction of knowledge.

Long-distance teaching as advantages over regular teaching, like breaking geographical barriers, getting knowledge through to everyone regardless of fixed times or place; the student can build his self-learning oath at his own learning pace by interacting with available contents according to his learning needs; it allows the creation of teaching communities; the possibility of synchronous interactive classes – chat, videoconference, audio and asynchronous– forums, debate groups, email.

E-learning support tools are varied, among which: interactivity, synchronous and asynchronous communication, resources, forums, feedback, and course guide.

As for interactivity it's about changing a teaching system where the student's role in seeking out information is limited and where he tries to adapt to existent information, to a teaching where the information adapts to the student. The various types of online interactive teaching are: student-computer interaction, student-content interaction, student-teacher interaction, student-student interaction.

The teacher must have a dominant role through permanent contact with the student and make so that his motivation, involvement, commitment, confidence and participation remains elevated. And if necessary, act timely so as to avoid the students dropping out due to feelings of isolation or learning pace or diversified demands of personal/professional character. Lastly, the teacher must take into consideration the cultural differences, of different social and cultural environments and different levels of experience among students.

The different modalities of communication available in the online environment, synchronous and asynchronous, demand of the teacher that he must be able to communicate in a precise and constructive fashion and have a certain behaviour: how to be attentive and careful, being aware of the students who have no regular and continuous presence in the forums and debate groups, give time to the student to answer messages, develop questioning and debate techniques (online teaching tools). On online learning there are diverse forms of motivating students to get involved in debates, such as group reports (debrief of the results of group assignments) and to present the same to the class for general debate.

Sometimes, virtual silence is understood as the student not contributing to the learning community. This must not be taken as a negative sign, but rather as another way to communicate, since most often they are the ones that are interested in learning through interaction with colleagues. However, it's necessary to differentiate between passive students from those who quit.

Synchronous communication, unlike asynchronous, is dependent on a fixed timetable, for example, the usage of chat when quick information is required.

Some of the challenges presented by e-learning teaching are the constant adoption by teachers of a constructive, cooperative, incentive so as to make students feel stimulated and develop the curiosity, critical spirit initiative skills, participation and self-motivation.

The teacher must also consider the rules of social gathering specific to the online communication environment, trying to maximise

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the "human" component of computer-mediated communication. Furthermore, he must always encourage a relationship of sharing and cooperation with students, ensuring frequent communication among all, as well as stimulating students to have a group spirit that is particularly important in this kind of learning context.

The teacher's action is fundamental for the creation of a sense of community, building and maintaining a collective learning environment, through which e-learning occurs.

Mobilize competences in different learning modalities: self-learning, cooperative learning and team-learning. Encourage all students to contribute to the discussion of available contents orienting them to a more adequate management to deal with the information.

The forums as pedagogical tools contribute quite positively to promote a change in methodologies in the teaching/learning relationship, in the sense of approximation and overture to the world, through its organizational and temporal characteristics. Forums are applications designed for net usage, made available through intranet or internet from a web server that supports dynamic contents supported on databases. Forums allow teachers and students to communicate from an asynchronous distance.

Communication through forums creates a spirit of loyalty among students because questions, doubts, participations are "public allowing a global observation of interactions, usable in different fashions. It gives the teachers a global perspective of interest, commitment and learning evolution of the students. To these, it allows them to benefit from questions of their colleagues to assuage their own doubts.

This support instrument to e-learning teaching constitutes a plus to the teaching/learning process and the dynamic of the student community. But the predisposition for the usage of forums assumes the existence of specific tools. Such platforms are not yet readily available, especially cost-free, easily manageable and adequate to the establishment of the teaching/learning community.

Feedback from the teacher as to the performance of students has a crucial importance for them, due to the characteristics of the online environment and communication. It's fundamental that students know their grading criteria for each activity so as to be aware of what will be graded and when, just like continuous grading based on participation in class debates or grading individual or group assignments and tests.

The course guide has as primordial objective for each teacher to make available on-line the contents referring to their curricular units. And it also allows students to input their own papers, questions, comments that may be visible to all creating a cooperative learning environment. It functions as a "course map" for the teacher and for the student and describes the learning process for curricular units. It's also a guide about contents, course structure, proposed activities, work methodologies and grading.

On the course guide must feature: The objectives and expectations of the curricular unit, the competences to be developed by the students, the content guide to the curricular unit, methodology adopted in the curricular unit, learning resources understood as the whole of the bibliographical learning support, the learning environment, the grading and sequence of learning activities, detailing, for each of the activities, the thematic, scheduling, objectives and competences to be acquired, the structure of the activity, the teacher's actions, learning resources and form of grading. Activities are moments of work, interaction, and learning.

3. Final Considerations

The most recent form of long-distance teaching, denominated e-learning, is having an increasingly large success, given the convergence of needs between the company and new technological assets. Learning while resorting to new technologies, through e-learning, generates the possibility of the student to manage his own time, be manager of his own knowledge, to have a continuous and constantly updated learning.

E-learning is increasingly the solution to the development of competences. It began to develop itself with the scholarly intent of university usage and is also at the present a solution for companies wanting to stay competitive. However, the motivation of students is taken as a critical factor in the occurrence of drop-outs, and a well-elaborated and explicit learning contract may be an important attribute to the reduction of the serious teaching problem, not only in e-learning, but in teaching in general.

E-learning teaching allows students to progress at their rhythm with access to vast and updated contents with experts from various areas and to learn anywhere and at any time. But it also requires computer knowledge, self-motivation and self-discipline in terms of the challenges placed by online teaching, they develop mainly around the emergence of the group, supported in communication mediated by computer. This factor introduces profound changes relatively to structuring aspects of conventional long-distance teaching.

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The group brings many benefits to learning, such as the diversification of possibilities in student-student interaction, student-content, student-teacher, the sharing of information and the individual and group-based construction of knowledge.

Professional development and learning throughout life are considered today as social needs that are present in all sectors of activity, gaining a more significant pertinence when we factor in the potentialities for technological development that lead to today's Society of Information and Knowledge. It is in this more widespread context that today we hardly speak of training and learning without reference to e-learning and the learning environments associated with it.

In recent years we have seen a great concern in training teachers in the context of e-learning teaching, since in this kind of teaching there are many specific competences like pedagogical, technical and aesthetical aspects essential to the creation of content.

E-learning demands of the student a greater level of motivation and autonomy than regular learning. However, it promotes the innovation in teaching processes, stimulates the creation of multimedia contents, allows the creation of learning communities and expands the geographical coverage of teaching. But e-learning is only advantageous if it also allows the student to obtain good pedagogical results.

E-learning and b-learning (Blended Learning), most recent developments of long-distance teaching methods, present themselves as teaching and educational strategies that are considered crucial in today's world. Furthermore they give students the possibility to become proactive thinkers by building cognitive structures aimed at analyzing and interpreting information so as to intervene more effectively in reality.

The most recent form of teaching can claim ever increasing success in a determined target audience and in certain corporate sectors, given the convergence of needs between the company and new technological assets.

Giving students' knowledge gifting to them the possibility of training aimed at the quality and demands of systems and contents, where management of time is at the student's criteria.

E-learning has a tendency to reproduce traditional learning methods based on the transfer of knowledge, underestimating the opportunities offered by an environment favourable to innovation, cooperative learning, etc. Presently we see an accentuated growth in the number of e-learning courses, and where a number of them don't go beyond recreating a traditional, albeit digitalized teaching system, which subverts the meaning of long-distance teaching environment.

Today we have the need for a European common virtual teaching and of a system of common European diplomas. Virtual education has placed itself essentially in the national stage, and presently we see some international cooperation. There are already many established consortiums between specialized grounds in the Netherlands, Finland and France. And there are also many virtual universities.

Questions like the assurance of quality, certification and international strategic alliances are broadly discussed.

In long-distance teaching, the roles of teachers and institutions are not put into question. What is changed is their function, no more teaching agents but partners in learning. In this way, personal contact is not diminished, but rather made more interesting.

4. References

[1] L.G. Aretio, La educación a distancia: de la teoría a la práctica, Ed. Ariel – Barcelona, 2006.

[2] J. Bottentuit, C. Coutinho, A. Dulclerci, M-learning e webquests. As novas tecnologias como recurso pedagógico, Proceedings of 8th International Symposiumon Computers in Education (SIIE2006), Vol. 2, pp. 346-353, Servicio de Imprenta de la Universidad de Léon, León, 2006.

[3] C.B. Brennan & Lockridge, Computer-mediated communication: A cognitive science approach, in K. Brown (Ed.), ELL2, *Encyclopedia of Language and Linguistics*, *2nd Edition*, UK: Elsevier Ltd, Oxford, 2006.

[4] L.S. Cheung, A constructivist approach to designing computer supported concept mapping environment, *International Journal of Instructional Media*, Vol 33, pp.150-155, 2006.

[5] C. Coutinho and J. Bottentuit, Tecnologia Educativa em Portugal: Um Contributo Para a Caracterização do Seu Quadro Teórico e Conceptual, Revista *Psicologia, Educação e Cultura*, Vol XI (1), Maio, 2007.

[6] T. Dougiamas, Moodle: Using Learning Communities to Crate na Open Source Course Management System, Proceedings of the EDMEDIA 2003 Conference, Honolulu, Hawai, 2003.

[7] C. Grenhow, What Teacher Education Needs to Know about Web 2.0: Preparing New Teachers in the 21st Century, In R. Craslen et al (Eds.), Proceedings of the 18th International Conference of the Society for Information Technology & Teacher

 ISBN 978-989-95095-3-5

Education, SITE 2007, 2027-2034, Chesapeake, VA: AACE, 2007.
[8] M. Meirinhos and A. Osório, B-Learning para a formação contínua de professores, Actas do VIII Congresso Galaico-Português de Psicopedagogia, Vol 2, 949-964, Univ. do Minho, Braga, 2007.
[9] J.M. Moran, Propostas de mudança nos cursos presenciais em a educação on-line, http://www.abed.org.br/congresso2004/por/htm/153-TC-D2.htm, 2006.
[10] K.P. Pallof, Cllaboration Online: Learning Together in Community, Wiley, John&sons, Incorporated, 2007.
[11] M. Paulsen, *E-Learning: o papel dos sistemas de gestão da aprendizagem na Europa,* Colecção formação a distância & e-Learning, Inofor, 21, 2006.
[12] F.L. Reis and A.E. Martins, Benefícios do E-Learning no ensino Universitário, *Actas da 3ª Conferência* Ibérica de Sistemas Y Tecnologías de Información, Universidade de Vigo, España, 19 a 21 de junho, 2006.
[13] F.L. Reis and A.E. Martins, Perspectives of the education the distance in Portugal, *Actas da Conferência International Council on Education for Teaching*, Universidade do Minho, 14-17 de Julho,2008.
[14] G. Salmon, *E-moderating – the key to teaching and learning online,* Kogan Page, London, 2000.
[15] A.T. Santos, *As TIC e o Desenvolvimento de Competências para Aprender a Aprender: um estudo de caso de avaliação do impacte das TIC na adopção de métodos de trabalho efectivos no 1º Ciclo EB*. Dissertação de Mestrado, Universidade de Aveiro, Aveiro, 2007.
[16] R. Tavares, Aprendizagem significativa em um ambiente multimedia, *V Encuentro Internacional sobre Aprendizaje Significativo*, Madrid, 2006.
[17] B. White, Is Web 2.0 the Future of the Web? Comunicação oral apresentada no ED-Media 2007, Vancouver, CA: AACE, 2007.

Solar-Recharged UPS as a Low Cost AC Power Supply for Electronics and Environmental Education

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Abstract. This article describes the transformation of an Uninterruptible Power Supply (UPS), commonly used as power backup for desktop computers, into a solar rechargeable portable mains supply. Almost any commercially available UPS can be used and the conversion can be made without having detailed knowledge about electronic circuits inside. A few external elements must be added: solar panel, charge regulator (commercial or self-made), a protection diode, cables and connectors. The system has many applications as a solar educational kit, as a small power source for car or camping, or for lighting and powering small isolated buildings.

Keywords. Solar Power Supply, Electronics, Environmental Education.

1. Introduction

Uninterruptible Power Supplies (UPS) are a simple and inexpensive protection against mains failures for computers and many other electronic systems. These devices contain almost all the elements required (battery, charger and inverter) to make a portable mains supply that can be recharged by many sources like solar photovoltaic energy, wind energy or hydro-electric power. If any of these sources is not available, it could be removed and recharged with a car battery or an ordinary ac socket.

Some external elements must be added, like a solar photovoltaic panel, a charge regulator and protection elements. The battery capacity can be increased adding a second element connected in parallel.

This article describes all the changes that must be made and elements that have to be added.

Figure 1 shows the system with external elements, cables and AC socket ready to use. This system was projected to light an old flour mill where we are planning to make an educational exhibition about traditional uses of renewable energies. Figure 2 shows the mill and surroundings with water channel or lead. In this application the system could be recharged by solar or hydraulic energy.

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Figure 1. Complete solar kit with panel and ac socket

Figure 2. Mill and water channel (lead)

2. UPS description

A common UPS (Figure 3) contains the following elements:

1) Power supply and battery charger that are connected to external ac mains and keep the 12V battery completely charged.

2) Battery (Figures 4 and 5) of lead-acid type, 7-12 Ah. This capacity is enough to light one or two low consumption lamps for several hours.

3) Power inverter that receives 12V DC from the battery and provides an output of 230V AC.

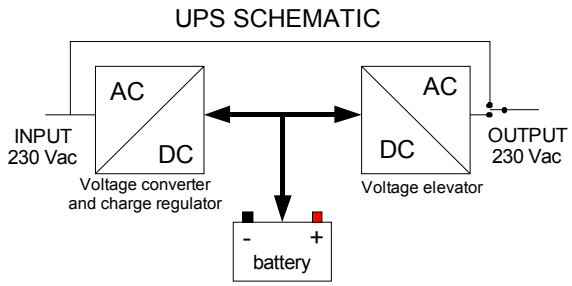

Figure 3. UPS internal schematic

These devices are typically connected to the mains all the time, and battery is always full. When there is a power failure UPS inverter starts generating power from the battery.

Figure 4. UPS and battery housing

Figure 5. Lead-acid battery

In our application UPS is simply disconnected from the mains, and will continue generating power until battery is empty. If we can recharge the battery without reconnecting it to the mains we will get an independent power source that can be used anywhere.

3. UPS modifications

The following changes have been applied to allow solar recharging, as can be seen in schematic (Figure 6):

- An external connector must be installed and

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connected to the battery to allow access and recharging (Figures 7 and 8).

- A solar panel and external regulator must be connected directly to the battery. The solar panel should provide at least 14V and 10-20W of peak power [1]. The regulator can be a commercial type or a self-made one (see next section).

- A protection diode must be inserted between the battery and external regulator. This diode allows simultaneous working of external and internal recharging and avoids discharge of the battery through the solar panel.

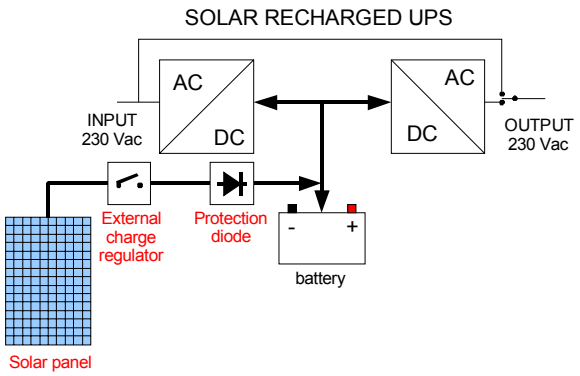

Figure 6. UPS modifications to allow solar recharging (external elements in red)

Figure 7. External recharge connector

4. External regulator

UPS's have an internal charge regulator to avoid damage to battery. This regulator could be incorporated into the solar recharging system, but unfortunately manufacturers [3] do not provide enough information about internal circuits, so this option must be discarded. That's the reason we decided to develop our own regulator based in an integrated circuit of common use in electronics, the voltage regulator LM317 [2]. The circuit is adjusted to obtain an output of 14,5V. Figure 9 shows the schematic of this circuit that can easily be assembled by electronics students in a typical school workshop. Figure 10 shows a prototype of regulator inside an outdoor box.

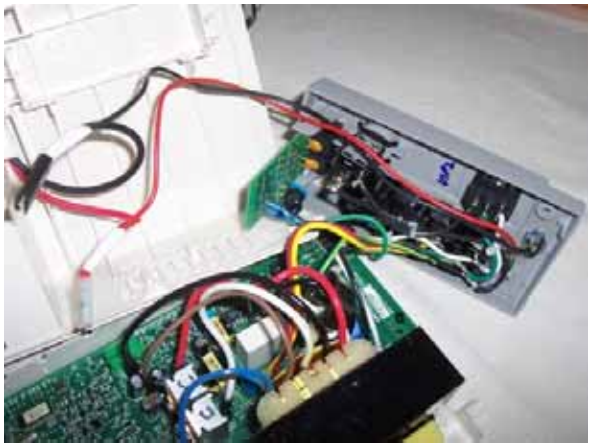

Figure 8. Detail of internal connections

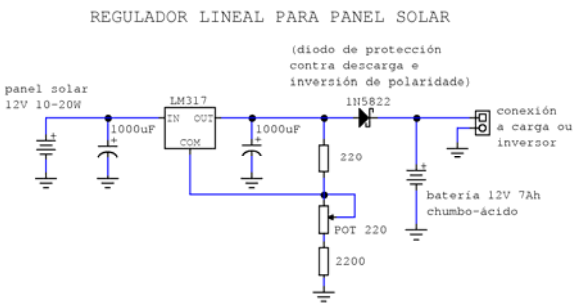

Figure 9. Charge regulator schematic

Figure 10. Charge regulator fully assembled

5. Final assembly

To make the final assembly of the system the following steps must be followed:

1) Solar panel must be connected to the charge regulator input. It can be checked with a multimeter (under direct sunlight).
2) Regulator output must be connected to external battery connector in the UPS (see Figure 9).
3) UPS output must be connected to an electric appliance (like a low consumption light). A mains socket (schuko or similar) can be mounted at the UPS output to allow different charges to be easily connected and disconnected.

If everything is right the power supply will start generating electric power. If there is enough solar energy to partially recharge the battery every day the system will work indefinitely without any external contribution.

 ISBN 978-989-95095-3-5

6. Applications

The system can be used wherever there is need for ac power with low consumption, like lighting in small isolated houses, camping, powering of small electronic devices like tv or radio transmitters, etc.

An important field of application is electronics students training, since these students can both make the system elements (like the regulator or connectors), and use them as a solar energy practice.

Students of other fields can also take advantage of this system due to its low cost, like in subjects related to environmental themes.

It can be used in exhibitions or science fairs about renewable energies, especially if other power sources are used for recharging instead of solar power (like a small wind generator, hydraulic generator, etc). As an example of this applications, the kit was shown at "Encuentro Solar 2007" meeting in Granada, Spain.

Another interesting application is as a backup power source for laptops when used outdoors. A fully charged battery can provide 2-4 hours of use of computer.

7. References

[1] Kyocera Solar Panels technical information and datasheets, http://www.kyocerasolar.eu
[2] National Semiconductor technical information and datasheets (LM317 circuit), http://www.national.com/mpf/LM/LM317.html
[3] APC UPS technical information, http://www.apc.com, http://www.apcmedia.com/salestools/ASTE-6Z7VBG_R0_ES.pdf
[4] Atersa 10W solar panel, http://www.atersa.com/461.0.html

A Reflexion on the Importance of Web in Long-Distance Teaching

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Abstract. The present communication is centred on a reflexion on the importance of Web 2.0 in long-distance teaching.

The Internet is a powerful tool and an alternative to the traditional teaching methods; it didn't come to replace traditional teaching, but rather to add a whole new dimension to it.

This reflexion focuses on the long-range teaching and learning modality, considering the actual context of Web 2.0 as one of the most important forms of information transmission and knowledge acquisition.

Presently, in all sectors of activity, the professional development and learning through life experience exist as social needs, acquiring a more significant pertinence when equated with the potentialities of the technological development that led to the current Information and Knowledge Society. It is in this more encompassing context that today we hardly speak of training and learning without mentioning e-learning and the learning environments associated with it.

Keywords. Teaching, Learning, Long-distance Teaching, Web.

1. Contextualization

We live in a learning society where it is crucial to have permanent education in a job market ever more complex because we can verify an accelerated rhythm of technological change, that demands of us continuous learning. Thus, the human being must learn a great deal of different things in a short amount of time due to a great volume of information that we must process and the speed of change that takes us to constant improvement.

The alteration of social structures allowed the appearance of new learning contexts and the appearance of new ways to build knowledge.

The modification of the concept of community allied with the new technological tools allowed the appearance of new groups previously non-existent and the platforms built from the concept of a network are a vehicle to the construction of a learning community.

 ISBN 978-989-95095-3-5

Presently communities spring up, not aggregated to a place, but due to the convergence of values, ideas, etc, motivated by the natural necessity to communicate, facilitated with the advent of new technology that allows the creation of communities each time there was a need to communicate.

Long-range teaching is already used in great part of the world, being characterized by physical separation between teacher and student, where the transmission of educative content is made through the usage of technological means of communication. In this way, it allows the student access to a teaching without fixed schedules, without concern about going to the learning institution and being able to create his own studying program.

However, long-distance teaching doesn't create the separation between student and teacher, but it seeks to reduce the distances that life created, and doesn't exclude direct contact among students or between them and the teacher.

Led intensively by economic globalization and by the development of technologic and information technologies, society faces a series of doubts in its paradigms, as an epoch denominated as Age of Knowledge and Information.

We are faced with a new culture (denominated by some as cyber-culture), being characterized by the existence of a network of computers, with technologies that bring as devices new possibilities to live the world. In this way, technology that involves cyber-culture revolutionizes the machines and interactions that subjects make among themselves and in society, transforming their capacity to relate to each other.

Networked society diminishes distances and brings people closer with common interests, giving birth to a space of open communication through the interconnection of computers where digital information flows. The computer, the PDA (*personal digital assistants)*, the fax machine, among others which have as its purpose the transmission of information may even be interconnected.

The concept of community is characterized by the existing relation between people and the fact that its existence is associated with a certain location. Today, communities appear not aggregated to a location but to the convergence of common interests.

World economy lives a process of intensification of competitiveness and growing capacity to breed technological innovation, where the learning process is permanent, becoming ever more essential, the option on long-distance teaching becoming an important alternative to the acquisition of knowledge.

The technologies of information and communication (TIC), due to the extraordinary evolution of scientific knowledge, have been infrastructures to new forms of relations with knowledge and learning, bolstering e-learning which is a process that applies the full potential of learning and communication technologies to the development of teaching and training. Indeed, it's a personalized process that allows flexibility in terms of time and space, for the student and the teacher are not physically in the same location, but connect through the network, and it is through the internet that the educational content is transmitted.

E-learning is but one of the various new forms of long-distance education, for it is a learning process that implicates the temporal and/or physical separation between teacher and student, and when this formative action is carried out via Internet or intranet we're in the presence of e-learning.

Presently, through the internet we can conduct several activities that favour learning and apprenticeship, among which, the creation of collaborative and cooperative situations than take place in e-learning.

The internet is always evolving, offering its users several tools increasingly interactive and easier to access and use, the pedagogical use of TIC in learning having been, for a few years now, an institutional priority worldwide.

2. The applications of web semantics

Learning resorting to the web allows an increased flexibility in the student's access, for with asynchronous communication, the student can manage his own studying time.

The notion of learning community on the web has subjacent to it a flexible conception, where hypermedia technologies constitute the form of development of effective collaborative environments.

The construction of a learning community is fundamental for the success of an on-line classroom, for it constitutes the means through which learning occurs, valuing the social context as mediator and potential enabler, the teacher's action online being as the factor that minimizes physical absence from the virtual space.

With the web's contribution, the frontiers of long-distance teaching are now open, having the possibility of joining in a single mode of communication, the singular advantages to each of the different ways of transmitting information, ever more interactive, amplifying the possibilities

 ISBN 978-989-95095-3-5

for self-learning through the recourse to numerous options for seeking out information.

The emergence of publication technologies and networked communication systems gave origin to the appearance of a fourth generation of long-distance teaching models, where interaction and communication are valued assets. After all, with technologies that support e-learning practices, geographical distances have been overcome, cultural exchange now taking place through "virtual space", that, by not implicating the simultaneous presence of both teacher and student, allows for greater flexibility in managing time for all intervening sides.

Teachers must be good managers of time, adopting strategies that optimize the system due to the nature of online long-distance teaching being flexible in relation to time, since it can be performed at any time in any place, requiring the preparation of the class and the daily management of the interactions that are implicit to the learning community in this type of teaching.

We live in the age of web-based information, where we've been witness to an exponential growth in information and communication technologies. So it's fundamental to accompany this evolution through an innovative and quality teaching that offers autonomous apprenticeship by resorting to different means and forms of communication.

In this way, comes long-distance education based on the web and which according to Paulsen (2002) is characterized by the separation between teacher and student, by the use of a computerized network to present program contents, and by bidirectional communication so that students can communicate amongst themselves and with their teacher.

In the current setting of continuous change, the individual's formation has become an asset to the company that requires a permanent learning process.

E-learning being the most recent form of long-distance teaching, makes possible a training directed towards quality and the demands of systems and contents, as well as a personalized teaching where the management of time is at the student's criteria.

E-learning systems must include diverse aspects, namely, tested content, an evaluation made through forums as much as possible, the possibility of choice through interactive content, and other information of the student's interest.

For a few years now we have been living in an epoch of rapid development of computer technologies, with access to global computer networks, databases, virtual libraries, e-mail, CD-ROM and a great variety of software on offer that helps to amplify and modify the current forms of teaching and learning.

With the widespread divulgence of new technologies of information and communication it's become imperative to adopt them in learning and teaching processes.

The number of teachers lecturing in this modality of teaching is increasingly larger in both Portugal and the rest of the world. With the appearance of sophisticated interactive technologies the teachers and students both started using such tools as the Internet (namely the use of the World Wide Web that is getting ever more a complete multimedia system, allowing multiple interactions, being a medium of choice for teaching/learning), e-mails, and audio-conference based on video-conference.

Collaborative teaching projects are more motivating towards students especially if a system of forums, mails, video-conference or chat is applied.

The key to success in teaching e-learning is centred in the performance and availability of the teacher and for this reason the training courses in e-learning are of primordial importance.

In the last few years we've witnessed a great concern in graduating teachers in the context of teaching e-learning for in this type of teaching there are many specific competences there being the need to learn pedagogic aspects, as well as technical and aesthetic ones to the creation of contents for e-learning training.

Indeed, there are numerous researches that point out the inevitable nature of adequate transmission of knowledge to new realities, co-substantiating itself in a new form of seeing organizations and fundamental pillar of creating value. The model of knowledge management is based on Intellectual Capital, there existent a vector of valuing teamwork, through new collaborative forms, of human capital, of process capital and of client capital (Martins, 2000).

E-learning allows learning at a self-establish rhythm by associating the theory to diverse practical activities and makes possible to train those who lack the possibility to leave their workplace or have no availability for fixed schedules.

However, e-learning demands of the student a greater level of motivation and greater learning autonomy than regular education as well as some experience in using the Internet. On the other hand, it promotes innovation in formative processes, it stimulates the creation of multimedia content, allows the creation of learning communities and broadens the geographical coverage of teaching, but it is only

 ISBN 978-989-95095-3-5

advantageous if it also allows the student to obtain good pedagogical results.

The internet came to revolutionize electronic systems of teaching, like e-learning, making innovation possible in the traditional means of divulging knowledge, such as books and classrooms, that have evolved with e-learning.

This situation leads us to reflect on the primordial importance in training courses for teachers in this teaching modality that amplifies learning spaces and studying opportunities to a great part of the international population that is not inserted in traditional teaching, for several reasons, namely, lack of available time or difficult access to teaching locations.

Since in online teaching communication is asynchronous, it is demandable of the teacher that he is capable of communicating in a precise and constructive fashion, of being present, as well as a certain behaviour: he must be attentive and careful, to be sensitive to the students who don't have a regular and continuous presence in the forums and debate groups, to give time for students to reply to a message, to develop questioning and debate techniques (online teaching tools).

In online teaching there are diverse ways to motivate students to being involved in online debates, such as group reports (summary of the results of group assignments) and presentation to the class for debate. Generally, virtual silence is taken as a non-contribution by the student towards the learning community, but it must not be understood as negative, for it may very well be another way of communicating, for example, of those who are interested in learning through the interactions of others. However, it's necessary to learn to differentiate those who are passive from those who have simply given up.

Synchronous communication, unlike asynchronous, is dependent on fixed schedule.

E-learning allows learning at a self-establish rhythm by associating theory to several practical activities and makes possible to educate those that have no availability to excuse themselves from their workplaces or have no availability for fixed schedules. However, e-learning demands of the student a greater level of motivation and greater learning autonomy than traditional learning and some familiarity in using the Internet, thus promoting innovation in formative processes, stimulating the creation of multimedia contents, allowing the creation of learning communities and broadening the geographical coverage of education, but it is only advantageous if it allows for good pedagogical results for the student.

E-learning and b-learning (Blended Learning), most recent developments of long-distance teaching methodologies, present themselves as innovative training and educational strategies that are considered crucial in the future development of society.

3. Final considerations

The most recent form of teaching dresses itself in an increasingly larger success within a determined target-audience and in determined corporate sectors, given the convergence of needs between the company and new technological methods, allowing workers and students to be kitted out with specific knowledge, giving them the possibility of training directed towards the quality and demands of systems and contents, where the management of time is at their own criteria.

Web based teaching still constitutes a challenge for both students and teachers. The web is no longer a passive tool to which we resorted to only to seek information. We point out the study if Anderson (2007) where he concludes that "the internet is slowly dropping its origins as a tool for reading and writing and entering a new more social and participative phase".

In fact, e-learning has benefited from the capacities of the new generation of Internet developing a collaborative learning, and offering a more profound retention of knowledge due to the superior involvement of the student in the learning process.

On the other hand, it's quite motivating for the student to perform tasks from within the web, which motivated teachers to rethink their educational condition in the Information Society of which we are all part. It is very important to be able to take advantage of the web's resources in an educational context and it's up to the teachers to make the best of those resources available in the World Wide Web.

E-learning has been operated with the use of teaching platforms and many of them are not free or *open source* (open code) this presenting a limitation in institutions with little financial resources. One of the ideas of the new paradigm of the Internet / Web 2.0 is to use the web as a platform, that is, the applications and services may be used together, aggregating assets for courses and users to choose the application that best satisfies their needs, with no additional cost.

Many conducted studies have already demonstrated that the use of Web 2.0 tools have a strong contribution for the continuation of the development of e-learning.

Long-distance teaching makes possible for millions of people all over the world to access a more elaborate knowledge and quality education.

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The Internet offers the possibility of amplifying the continuous education of teachers, for a competence in new technologies recognizes the rapid assimilation of changes and adaptation to new situations demanding a reconstruction of knowing how to teach. The new wave of teaching enables a continuous process of building knowledge in integrated fashion, leading the student to interact and research, in a logic designed as a didactical/educational tool facilitating the process teaching-learning.

The student assumes himself as a fundamental actor in the educational action and the teacher constitutes himself a facilitating agent in the assimilation of knowledge. The acquired experience and intangible factors, more than ever are the differentiating factor of quality teaching, where knowledge stimulates learning by the pleasure of incrementing itself.

4. References

[1] L.G. Aretio, La educación a distancia: de la teoría a la práctica, Editorial Ariel, Barcelona, 2006.

[2] J. Bottentuit, C. Coutinho and D. Alexandre, M-learning e webquests. As novas tecnologias como recurso pedagógico, Proceedings of 8th International Symposium on Computers in Education (SIIE2006), Vol. 2, (pp. 346-353), Servicio de Imprenta de la Universidad de León, León, 2006.

[3] S.E. Brennan and C.B. Lockridge, Computer-mediated communication: A cognitive science approach, in K. Brown (Ed.), *ELL2,* Encyclopedia of Language and Linguistics, 2nd Ed., Elsevier Ltd., Oxford, UK, 2006.

[4] L.S. Cheung, A constructivist approach to designing computer supported concept mapping environment, International Journal of Instructional Media, Vol. 33, pp.150-155, 2006.

[5] C. Coutinho and, L. Bottentuit, Tecnologia Educativa em Portugal: Um Contributo Para a Caracterização do Seu Quadro Teórico e Conceptual, Revista Psicologia, Educação e Cultura, Vol. XI (1), Maio, 2006.

[6] M. Dougiamas and P. Taylor, Moodle: Using Learning Communities to Crate an Open Source Course Management System, Proceedings of the EDMEDIA 2003 Conference, Honolulu, Hawai, 2003.

[7] C. Grenhow, What Teacher Education Needs to Know about Web 2.0: Preparing New Teachers in the 21st Century, In R. Craslen et al (Eds.), Proceedings of the 18th International Conference of the Society for Information Technology & Teacher Education, SITE 2007, 2027-2034. Chesapeake, VA: AACE, 2007.

[8] A.E. Martins, Capital Intelectual – Ensaio Exploratório de Modelo Explicativo, Tese de Mestrado em Ciências Empresarias. ISCTE, Portugal, 2000.

[9] A.E. Martins, O investimento directo estrangeiro em Portugal – o caso da Polónia, Tese de Mestrado em Economia e Estudos Europeus. ISEG. Universidade Técnica de Lisboa, Portugal, 2006.

[10] M. Meirinhos and A. Osório, B-Learning para a formação contínua de professores, Actas do VIII Congresso Galaico-Português de Psicopedagogia, Vol. 2, 949-964, Universidade do Minho, Braga, 2007.

[11] J.M. Moran, Propostas de mudança nos cursos presenciais em educação on-line, 2006, Disponível em: http://www.abed.org.br/congresso2004/por/htm/153-TC-D2.htm.

[12] K.P. Pallof, Collaboration Online: Learning Together in Community, Wiley, John & sons, Incorporated, 2004.

[13] M. Paulsen, E-Learning: o papel dos sistemas de gestão da aprendizagem na Europa, Colecção formação a distância & e-Learning, Inofor, 21, 2002.

[14] F.L. Reis and A.E. Martins, Os Desafios do Professor no Contexto do Ensino Online, Actas da Conferência V Simpósio sobre a Organização e Gestão Escolar, Universidade de Aveiro, 2-3 de Maio, 2008.

[15] F.L. Reis and A.E. Martins, Benefícios do E-Learning no ensino Universitário, Actas da 3ª Conferência Ibérica de Sistemas Y Tecnologías de Información, Universidade de Vigo, Espanha, 19-21 de Junho, 2008.

[16] F.L. Reis and A.E. Martins, The Role of Online Professor, Actas da First International Conference on Business Sustainability, Universidade do Minho, 25-27 de Junho, 2008.

[17] G. Salmon, E-moderating – the key to teaching and learning online. Kogan Page, London, 2000.

[18] A.T. Santos, As TIC e o Desenvolvimento de Competências para Aprender a Aprender: um estudo de caso de avaliação do impacte das TIC na adopção de métodos de trabalho efectivos no 1º Ciclo EB. Dissertação de Mestrado, Universidade de Aveiro, Aveiro, 2007.

[19] R. Tavares, Aprendizagem significativa em um ambiente multimedia, V Encuentro Internacional sobre Aprendizaje Significativo, Madrid, 2006.

[20] B. White, Is Web 2.0 the Future of the Web? Comunicação oral apresentada no ED-Media 2007, Vancouver, CA. AACE, 2007.

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Mobile Phones in the Classroom

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Abstract. The paper presents some examples of usage of mobile phones as tools in educational processes. In particular the usage of such devices in the classroom is discussed. The basic idea is that today practically all, including children are equipped with mobile phones which are in fact small computers and the possibility of their programming offers new functionality. In particular the collaborative activities enabled through Bluetooth technology are discussed. In such a way the mobile phones can be used as responders giving the immediate feedback to the teacher. They can also be used as multiple remote controls that could be used to control interactive computer simulations, possibly in group activities. Besides these positive opportunities the dark side of usage of these popular devices in the classroom is also discussed.

Keywords. Mobile Devices, Classroom Collaboration.

1. Introduction

Figure 1. Mobile devices in the classroom

The period from 2000 to 2010 is known as a "digital decade" which will be followed by the period of pervasive computing. One of the characteristics of these times is increasing usage of mobile devices, mostly phones which have more and more functionalities. They are in fact small computers with limited capabilities. It is known that we can create and install small programs written in a restricted version of Java. Such programs are called MIDlets. They are usually developed on regular PC computers and copied to the mobile devices by wired or wireless connection.

Considering the paradigm of mobile computing the question is raised how this technology can be used in the regular educational processes. In particular how the teaching and learning in the classroom can be affected.

2. Sample educational applications for mobile phones

It is more known that mobile phones have extended functions like games and Internet browsing. There exist also some other applications which could be used also in education. For example we can have implemented vocabularies translating from one language to another. Of course the calculator can be useful in the classroom and assignment works.

More focused and problem specific educational applications are for the moment not so popular. In the domain of chemistry we can find some MIDlets presenting the periodic table of elements. Figure 2 shows a screenshot of such application.

Figure 2. Periodic table on mobile phone

Mobile devices could be used for the visualization of learning objects dedicated to natural sciences. Such example is the

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presentation of human digestive system on a phone display as shown in figure 3.

Figure 3. Visualisation of human digestive system on mobile phone

Looking a variety of educational applets which are available on Internet it would be interesting to have also simple simulators which could represent various physical phenomena. However at least for the moment we should take into account limited computational and graphical capabilities of mobile phones. But this will certainly change in the future.

3. Collaborative applications

For collaborative applications some kind of wireless interconnection between mobile devices in the classroom should be exploited. We should discard the usual communication capabilities with SMS or even dial up connections since the students (and also the teachers) are not willing to spend their private money for such activities.

More and more phones are supporting Bluetooth technology which permits cost free intercommunication between devices and their applications.

An example of such application could be a system providing immediate feedback between the teacher and his students in the classroom. Such systems are known as “responders”.

Supposing that all learners own mobile phones with Bluetooth they can establish connection with teacher`s computer which can act as a server. The teacher can open an electronic questionnaire which can be controlled by student`s phones. Teacher`s computer display is shown to the audience on a large screen. The students can answer to the presented question by means of their mobile phones connected to the computer via Bluetooth. Such system is presented of figure 4.

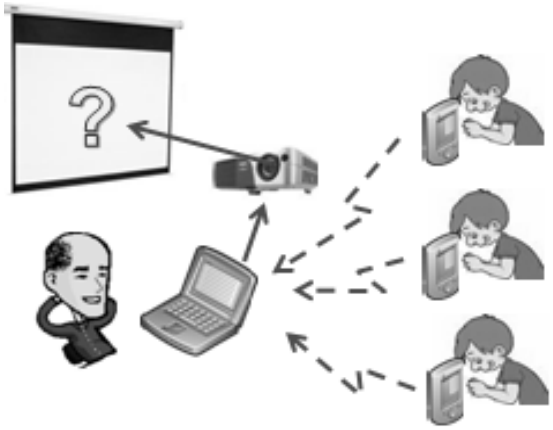

Figure 4. Electronic answering system

Figure 5 presents the software modules on both sides.

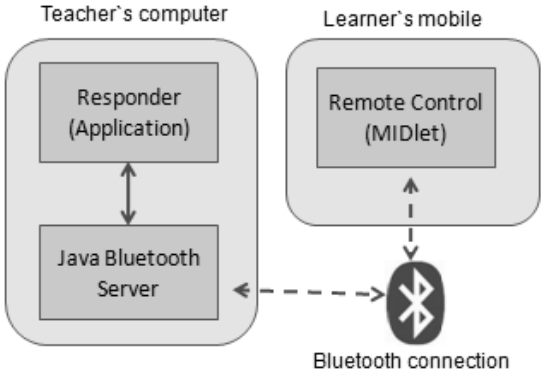

Figure 5. Software modules of electronic answering system

In such a way the teacher could get immediate (on-line) answer if his lecture is appropriate or too difficult. Or he could put more specific questions and see if the students really understand the subject.

The typical characteristic of such answering system is that it is anonymous and therefore the individual students are not afraid sending their feedback.

Of course such electronic answering systems are already known for many years but usually

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they require (expensive) equipment and software support. In the case of mobile phones the required “infrastructure” is already present, the Bluetooth communication represents no cost and it is sufficient to have the needed open source software supporting this.

4. Digital simulations and interactive collaboration

The wireless interaction between a teacher`s computer and student` mobile devices (phones or computers) can be also exploited in the case of simulation programs which should be adapted accordingly. This is possible in the case of open source programs where interaction with the simulation should be enriched with commands received by the accompanying server program. Such possibility was tested with some java applications and applets. One example of such adapted program is JTics which permits simulation of electric circuits. The figure 6 presents a screenshot of this program.

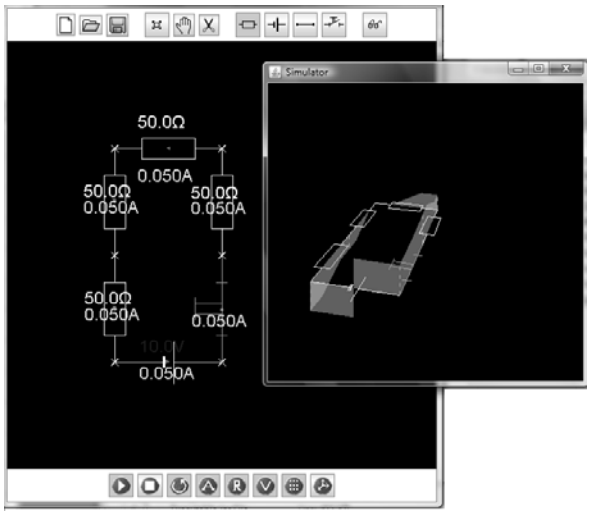

Figure 6. Simulator of electronic circuits

5. Dark side of mobile devices in the classroom

The usage of mobile devices in the classroom opens also some problems. One already known from computer equipped classrooms if of course that the children could be distracted by games and internet browsing. Another which is more related to the mobile devices is that they can establish their “private” ad hoc networks which could be easily exploited during written examinations. Since the mobile devices are getting smaller and smaller it is really difficult to suppress such undesirable communications. On long term the only possible solution is to influence on the moral character of involved participants.

5. Conclusions

The usage of mobile devices in the classroom offers new opportunities in the classroom. As Personal equipment they could Enable students to independently **e**xperiment and explore concepts as they are taught. As typically communication devices they permit the establishment of ad hoc communities that could be useful during lectures and group activities. On the other side this will certainly represent a problem, in particular during written examinations.

6. References

[1] S. Divjak, Mobile and Pervasive Computing in Education: http://colos.fri.uni-lj.si/SUMMER%5FSCHOOL%5F2008/

[2] M. Meisenberger; M Learning,- mobiles computergestuetzten multimediales Lernen: http://drei.fh-joanneum.at/mle/docs/diplomarbeit_mLearn_2004_05_28.pdf.

[3] M. Yerushalmy and O. Ben-Zaken, Mobile phones in Education, the Case of mathematics: http://construct.haifa.ac.il/~michalyr/celular%20report.pdf.

[4] Midlet.org: Software categories: Education; http://midlet.org/category.jsp?parentLevel=2

5th International Conference on Hands-on Science
Formal and Informal Science Education
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Some Simple Experiments in Optics Using a Photo-Resistor

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Abstract. A few simple and well-known experiments can be conducted in order to enhance further the student's grasp on the theoretical concepts. The main idea supporting these experiments is that the process of learning should be able to teach more than only reproducing and observing the physical phenomena. In this article we present simple experiments measuring light intensity and show how these simple experiments can be conducted in order to train and teach other concepts and capabilities far exceeding ones most obviously involved. The first problem presented to the students is that concerning the light detector. Our experiment uses an inexpensive, find to easy and trustable one. After initial calibration this detector is used to analyze the intensity behaviour of a point source with distance, Malus' law and the intensity profile across a diffraction fringe. Data treatment explores linear and exponential graphics comparing their features. We present procedures and results obtained with this simple experiment sand discuss them and their validity.

Keywords. Laboratory Teaching, Optics Laboratory, Optics Teaching, Simple Experiments.

1. Introduction

Nowadays, most countries are facing an increasing need for physicists and engineers since new technologies and their applications present an exponential growth. But, in general, most of those countries have not had a strong increase in the number of students looking for the so-called "hard sciences". In our university, the figures of the evasion from the four years undergraduate course of Physics are about seventy five percent. So, our teaching efficiency is quite low. Furthermore, there are still problems with those who succeeded on finishing their undergraduate courses: many of them do not have a good comprehension of practical or experimental problems. The knowledge transference from theory to day-to-day life problems is very scarce if there is any at all. We can attribute these difficulties also to a deficient laboratory teaching. One of the possible solutions would be a development of small and cheap laboratory experiments and their application to training and demonstration with students [1,2]. So the scope of this work is contributing with a cheap and easy way to do teaching experiments, in order to interest more students to persist and progress in Experimental Physics and, particularly, Optics. In Optics Laboratory teaching a recurrent problem is the measurement of light intensity. Several experiments depend on a fair evaluation of irradiances. We can cite a few among the most important: Point Source Irradiance Inverse Square Law; Malus' Law; Irradiance from a Cylindrical Lens. We named just these because they are among those most basic experiments in Optics Laboratory and the irradiances to be measured are quite high. Therefore we are just limiting the scope of this work to the experiments in which we can verify laws and behaviours with relatively high intensities. The scope of this work is to provide teaching laboratories with a cheap and powerful tool in order to proceed to experiments otherwise impossible to be made. Furthermore, mounting, calibrating and using this simple component, a photo-resistor, forces the students to learn important laboratory techniques and to develop the necessary patience and determination in order to obtain results with good level of accuracy. Two experiments are proposed in this work: Verification of the Point Source Irradiance Inverse Square and Malus' Laws. These experiments are basic in Optics teaching laboratory [3] and are fundamental for the scientific learning of the students. The scientific learning and the formation of a scientific spirit [4] is more important than only reproducing some experiments passing by them almost like scenery seen from a train window.

2. Methodology and Discussion

The experimental schemes for all of these experiments are well known, therefore due to this article space limitation we do not present them limiting ourselves to the results, which must be graphically presented.

2.1. Choice of an irradiance detector and its calibration procedures

The choice of a common photo-resistor was supported by a number of reasons: price, easiness to find them; it is practically foolproof; simple circuitry and a fairly good linearity (although over small regions). On the other hand they present some inconvenient aspects like: nonlinear dynamic range; slow response to intensities; nonlinear spectral response, which is

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much similar to that of human's eye. This scenario makes for a good place to start, setting the stage for building and understanding more complex experiments and procedures. The first question is how to conveniently mount the photo-resistor in order to detect intensity changes. The easiest way is simply measure changes in the photo-resistor internal resistance. One needs only an analogical or digital ohmmeter and measures the internal resistance variations of the photo-resistor. It is necessary to assume the ohmmeter scale is fair calibrated or execute its calibration. We think this step can be circumvented provide that students are warned about that. The electrical scheme of mounting can be seen in any good basic Physics book. The next step towards the Optics experiments is to calibrate the photo-detector response to incident intensity. The photo-resistor response also is opposed to the common sense of the students, that is, instrument readings are smaller for larger incident intensities. Therefore, the problem is to be sure the incident intensities vary linearly or with some well-known function, which can be fitted from experimental data. One can use some set of photographic neutral filters, or a graduated variable intensity filter, which, of course, are not easily available. A homemade solution is using a set of microscope slides. Each slide reflects about four percent of the incident light in the first surface and more four percent of remaining light. Therefore, one can plot the function of light intensity against number of microscope slides and use it to calibrate the photo-resistor against intensity. By the other hand, if one has a calibrated photo-detector like a silicon photodiode, he could use a much simpler mounting. Two polarizer filters can be used to grade incident intensities, which can be simultaneous (or not) monitored by the photo-detector. This is true for normal incidence and a 1.5 refraction index glass [3, 5] and we assume the light absorption is quite small compared to the reflection in the dielectric boundaries. However, as we are interested only in the functional behaviour of our light "filter" and not in absolute values of intensities we can consider these values quite good for our experiment. An extension of this experiment would be to measure the refraction index of microscope slides and calculate the reflectance with measured value. Afterwards the students should calculate the mismatch between first figures and those from measured values. Surely, they will conclude that the errors the first procedure could introduce in the experiment are negligible. The conduction of the experiment will depend on the scope, time and available equipment. It can be conducted without leaving anything to chance or following to the verification of hereinabove named laws without the same strict regard to precision. In a laboratory with more resources a set of neutral filters with stepped intensities could be used or still a variable neutral density filter. A low cost car stoplight incandescent lamp was used for this calibration. The incandescent lamp has a spectral emission curve much like of a blackbody at the same temperature, therefore it couples quite well with the spectral sensibility curve of the CdS photo-resistor. Nevertheless, the great infrared emission of incandescent lamps will pose some problems in the verification of Malus' Law. An experimental curve of the spectral sensibility of CdS photo-resistor should be made, but a few more sophisticated equipment must be used in order to have a trustful result.

2.2. Verification of the inverse square law for the irradiance of a point source

Despite that this experiment is quite simple some attention must be paid to a few details in order to have experimental results consistent with theory. Correct alignment of all components is very important because detector will be displaced during the experiment. To a more precise experiment the light from a 300-watt lamp taken from an overhead projector is focused onto a variable diaphragm aperture and later strikes the photo-resistor. This is order to have enough light striking the detector still when the aperture of the diaphragm is very small and more similar to a real point source in the laboratory physical limits. Distances between diaphragm and photo-resistor are measured with a scale. A few attempts must be made in order to verify the amount of error introduced by increasing source diameter. One must consider whether the illumination system presents a focusing apparatus or not. If yes, this will distort the result as long as the wave front can have a negative vergence, a positive one or still no vergence at all. But, with a less demanding experiment an incandescent lamp of a car stoplight can be used with the advantage of low cost and low heat generation.

2.3. Verification of Malus' Law

This verification is a little simpler than the preceding ones. The polarisers are the usual ones used in photography and are mounted in a support with a goniometer. The polarizer are aligned in order to deliver the maximum irradiance, afterwards the direction of one is changed in five degrees steps from zero degrees to one hundred and eighty degrees. One can

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tabulate the results, calculate the cosine of those arcs, square them and make a graphic of intensity against square cosines. It is convenient to normalize the measured intensity values and trace a theoretical curve to compare with the experimental one. Another kind of graphics can be made to facilitate the comparisons, for instance, intensities versus square cosine and so on. In the measurement, special attention must be paid to the background infrared radiation since the normal polarisers do not act on infrared radiation. Once again, depending on the laboratory resources, a heat filter can be used or one can be improvised with water [6].

3. Results and discussion

3.1. Photo resistor calibration

Figure 1 presents theoretical, experimental and an adjusted function curves for the light transmission against intensity. Experimental data were normalized for easiness. The theoretical curve was calculated using an estimated 4 percent transmission to each air/glass or glass/air boundary for normal incidence. The experimental curve was obtained using a calibrated photo-detector and one can see from the graphics that experimental data show good agreement with the theoretical ones. Therefore, microscope slides filter can be used safely to calibrate other detectors like a photo-resistor.

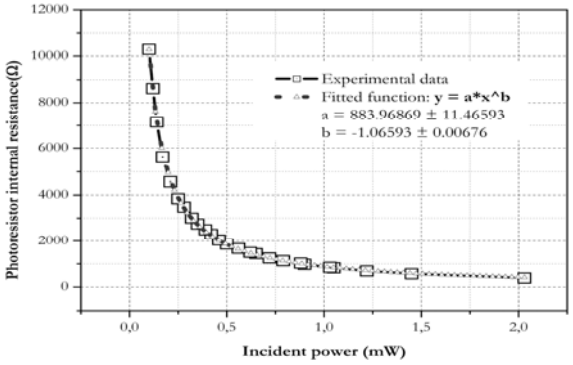

Figure 1. Transmittance x Number of added reflecting interfaces

The adjusting function $y = e^{-0.03835*x}$ will provide a good help acting like a mathematical filter for the data obtained with the unknown photo-detector. Therefore, it is of the utmost importance to have a filter with a well-known transmission function. It will liberate one from the uncertainty about detector function response to intensity. But, it is important to remember that all this procedure will permit only qualitative measurements, not the quantitative ones, that is, it does not permit to obtain absolute values of incident power.

Figure 2 shows the results using a more complex scheme with a power detector, polarizer filter set, power monitoring by a fixed (50/50) beam splitter and a silicon photo-diode.

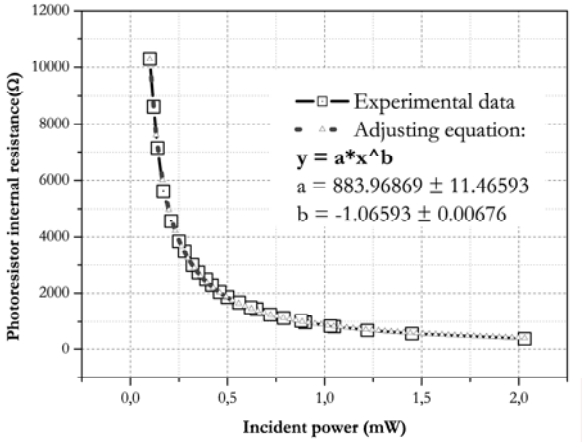

Figure 2. Photo-resistor internal resistance x Incident power (Reduced range)

The graphics has been elaborated using the $OriginPro^{TM}$ 7.0 Server. As the photo-resistors present strong nonlinearities at both high and small incident power since they have a constant minimum internal resistance and that evolutes almost exponentially with very low incident power we limited the operational range of our photo-resistor to 0.1 to 2.0 mW of incident power. In spite of that, it is clear that the photo-resistor have a good linear response only in the range of about one to two mW of incident power.

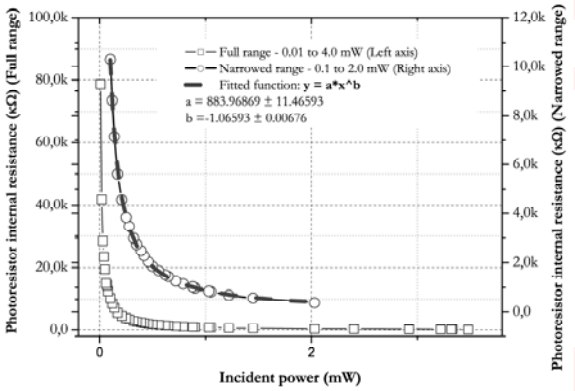

Figure 3. Photo-resistor internal resistance x Incident power (Full and reduced ranges)

Nevertheless, one can divide in small sectors and in each of them the photo-resistor will present a quite linear behaviour. Besides that, the adjusting function $y = 884 * x^{-1,07}$ can be used to correct the measurements made with

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this photo-resistor in the presented range. With this curve the student can transform his/her measured values in power figures. So, absolute measurements can be performed using the graphics presented in Figure 2. In order to get a better comprehension of the problem, Figure 3 presents the photo-resistor full range measurements comparing it with the smaller portion we have assumed for better accuracy. One can observe the quasi divergence of the photo-resistor internal resistance at low (< 0.1 mW, typically) and a flat behaviour at large powers (> 2.0 mW)

3.2. Verification of the Inverse Square Law for the irradiance of a point source

Figure 4 shows the result of photo-resistor application in the determination of the behaviour of a near punctual light source with the distance. The point source used was a common car stoplight lamp. We have preferred to use this one because of its friendliness: it is cheap, easy to find, easy to mount and turn on. We did not worry to focus the lamp light in an iris diaphragm in order to obtain a much more punctual source and the reason for that is the small power of the this lamp. In spite of these unforgivable imprecisions in the experiment assembly, the result is quite consistent with the theory.

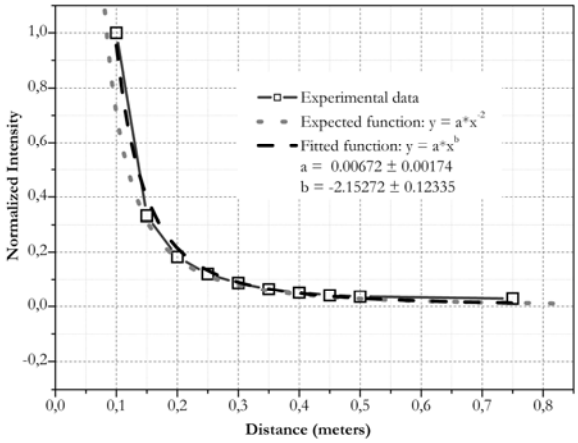

Figure 4. Inverse Square Law verification

That can be seen from the fitting function for the experimental data, $y = 0.0067x^{-2.15}$, which has a good agreement with the real dependence $y \propto x^{-2}$. A larger number of experimental points would be better for a more precise reproduction of intensity behaviour at small distances to the source, that is, in the interval between 0.1 and 0.3 meters. This discrepancy at smaller distances can also be attributed to the real dimensions of the source, which is minimized at larger distances.

3.3. Verification of Malus' Law

Figure 5 presents the results obtained for the Malus' Law. In this experiment, two photo-resistors were used and also a selenium photocell, which delivers a few mA current when illuminated.

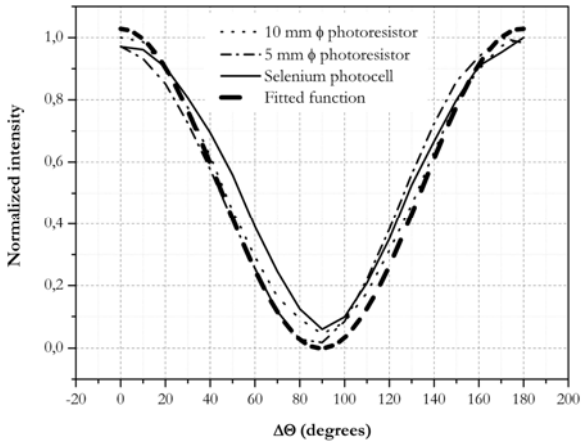

Figure 5. Malus' Law verification

This last one was used only as an additional reference. One can see from the graphics that the best result is obtained with the 5 mm diameter photo-resistor. As expected, the best agreement between theoretical and experimental curves occurs in the regions in which the incident power is larger, that is, there is a discrepancy in those curves when the incident power values tend to zero. Surprisingly enough, both photo-resistors present more accurate results than those of the selenium photocell. We believe with a little more effort these results can be still enhanced but the clear dependence of experimental data with the theoretical curve is noticeable and the fitting function below confirms that.

$$y = A\{\sin[\pi(x - x_c)/w]\}^2; \text{ with}$$

$$x_c = 89.55408 \pm 0.68404;$$

$$w = 180 \pm 0 \text{ and } A = 1.02834 \pm 0.01323$$

4. Conclusions

We have shown how a few interesting and involved experiments with light can be performed using cheap, easy to find components. Furthermore, these experiments can be tailored to the audience, in accordance to the students' general level of knowledge. There is still room for other experiments looking for improving the results and figures presented in this article, but

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not only that. Experiments to determine the photo-resistor internal resistance dependence with incident light spectrum are very promising and can lead to other interesting experiments and so on. Effectively, there is no dead end for the experimentalist. For the college students work to enhance the results and pursue a better data treatment using some convenient software can be very rewarding. Nowadays we have also to develop the student skills in dealing with informatics but not only that! Our vision is that the best way is to ally laboratory work with data treatment and simulation.

5. Acknowledgements

To FAPERJ for the grants, which have supported this work.

6. References

[1] A. Dias Tavares Jr., R.J.M. da Fonseca, L.P. Sosman and L.A.C.P. da Mota, Proceedings of SPIE, series 3, vol. 5622, pp. 1522-1526, 2004.

[2] A. Dias Tavares Jr., L.A.C.P. da Mota and G.J. Vieira, Proceedings of the 4th International Conference on Hands-on Science Development, Diversity and Inclusion in Science Education, vol.1, pp. 203-210, 2007.

[3] E. Hecht and A. Zajac, Optics, Addison-Wesley Publishing Co, Menlo Park/California, USA, pp. 46 and 225-226, 1979.

[4] G. Bachelard, La formation de l'sprit scientifique: contribution à une psychanalyse de la connaissance, Librairie Philosophique J. Vrin, Paris, 1938.

[5] F.A. Jenkins, H.E. White, Fundamentals of Optics, McGraw-Hill Kogakusha, International Student Edition, 4th edition, Tokyo/Japan, pp. 503-504, 1976.

[6] J.D. Strong, Modern Physical Laboratory Practice, Prentice-Hall, Inc., New York, pp. 369-371, 1938.

Educational Exhibition about Flow of Renewable Energies in Traditional Maize Culture in Galicia

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Abstract. One of the main fields of interest of the authors of this article is the study of relationship between cultural heritage, sustainable development and renewable energies. As part of this work we are planning to adapt an ancient hydraulic flour mill to host an educational exhibition about traditional uses of renewable energies in the cycle of maize in Galicia (Spain), the first place in Europe where this cereal was introduced from America. The mill is in good condition and continues working, and will be itself an important part of the exhibition. The project consists of five parts, dealing with the different stages of cultivation, conservation, milling and baking of maize. The first part is about maize cultivation related to solar energy. The second part is about harvest, drying, storing and different energies involved in these processes. The third part is about flour mill, milling and hydraulic energy. The fourth part is about traditional wood oven, baking process and biomass energy employed. And the last part deals with energy performance of the whole process and conclusions. The exhibition is addressed to high school students, but could also be useful for other educational levels.

Keywords. Educational Exhibition, Renewable Energy, Hydraulic Mill, Maize Culture.

1. Introduction

Renewable energies have been for many centuries the main source of power for all agricultural and industrial processes. Solar energy is still now the only source for plant growing and human feeding. And the need for agricultural production has been one of the major sources of cultural, scientific and architectural development. Many different types of buildings all over the world have been used for different agricultural works and adapted to take advantage of different energy sources.

In the case of Galicia, there has been a strong relationship between agriculture and certain renewable energies like hydraulic, wind and bio-mass, that has been the base of an environmentally friendly culture broken in the last decades by industrial development and

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contaminant energy sources like carbon oil.

This article focuses in the particular case of maize cycle in Galicia, the agricultural processes, constructions and renewable energies employed.

The photographs, descriptions and technical data have been obtained in Beade (Vigo, Spain) from neighbours and relatives of the authors. Figure 1 shows the traditional mill described in this article.

Figure 1. Mill and water channel

2. Cultivation of maize

2.1. Maize plant and field

Maize sowing in Galicia is made often in small fields (eiras), with a typical density of 2-3 plants per square meter. Sowing time is april-may and harvest is about september-october.

Figure 2. Maize field and plant

Many tools are used for cultivation with help of animals like oxes, Figure 3 shows some examples of traditional tools.

Figure 3. Tools for maize cultivation (arado and grade)

2.2. Solar Energy Conversion

Growing of maize plants uses a high amount of energy that is obtained from direct and diffuse sunlight. We will try to estimate the average solar energy needed to produce a kilogram of dry grain of maize using real data from different sources:

- Average production of maize in Pontevedra in kg/hectare: 10525. Source: Spanish Ministry of Agriculture 2007 report [6].
- Daily average solar radiation in Nigrán, Pontevedra: 3,9 kwh/m2. Source: IES Escolas Proval Weather Station (Nigrán, Pontevedra) [7].
- Maize sowing and harvest time: april-september (5 months) [1], these months concentrate about 60% of annual solar energy.
- Energy of dry maize grain: 3000kcal/kg.

Using the above data we can calculate the percentage of solar energy that is stored into maize grain:

a) Solar energy received april-september: 925.71kwh/m2, that is
925.71*860.4kcal=796480kcal/m2, or
796480/1,0525kcal/kg=**756750.6kcal/kg**
b) Energy stored in maize grains per kilogram = **3000kcal/kg**
c) Performance: 3000/756750.6=**0,4%**

Another data should have been taken into account into these calculations to get a more accurate result. For example, human and animal work should be considered in terms of food consumption. If one person is needed to take care of one hectare of maize for 5 months and its food consumption is 2000kcal/day, the food consumption per maize kilogram yields:

2000*153/10000/1,0525=**29kcal/kg**

The same calculation should be performed for animal food consumption and machines fuel.

3. Harvest and storage

Harvest, storage and drying are the next operations that must be carried out when maize is fully developed. Ox chart is used to transport maize and it is stored in a typical building specially developed to keep grain dry and safe.

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3.1. The Galician ox cart (carro de bois)

Ox cart was used as the universal mean of transportation in Galicia until oil-powered vehicles began displacing them. It is completely made of wood and iron and pulled by a couple of oxes called parella. Figure 4 show two images of ox charts.

Figure 4. Galician ox chart

3.2. The Galician grain storage (hórreo)

Figure 5. Grain storage (hórreo)

This type of building has been used for centuries to store grain [1]. Its special construction with many slots to let air flow through the walls can keep grain dry for a long time even in wet places like Galicia, and it can be considered one of the best examples of solar and wind energy use in agriculture. And its elevation over the terrain helps keep animals away from stored products. Figure 5 shows an example of hórreo made of traditional materials like stone, wood and tile.

4. Milling

4.1. The Hydraulic Flour Mill

In Galicia there are many different types of flour mills according to the source of energy employed (wind, rivers, tide) and type of construction. The most common type is the water mill placed beside a small water stream with a small reservoir and a horizontal water channel (levada) that create a difference of level with the main water stream and can be converted into mechanical energy. Figure 6 shows one example of this type of mill. Figure 8 shows the lower part of the mill, with a wheel that converts water energy into circular movement. This energy is transmitted to the millstone (Figure 7) by mechanical coupling.

Figure 6. Mill and water channel (levada)

4.2. The Milling process

Many hydraulic mills belong to a certain number of families that share the property and operation costs. Every family is assigned a number of hours of use per week.

The first step of milling is transportation of grain to the mill that can be made by hand, ox cart or mule, especially in places of difficult access. Figure 9 shows arrival at the mill with a sack of grain. Milling can only be made when water flow and pressure provide energy enough to move the wheel and stone. Figure 10 shows the water input at the upper part of the mill (cubo) that works as a buffer storage and creates the difference of level (potential energy). The image on the right shows the water output that is placed at the lower part of the mill. Figure 11 shows the flow control of the mill (left) that opens or closes a valve to let water reach the wheel. The speed control (right) raises or lowers the upper stone of the mill, in such way that when the two stones are in close contact the mill stops completely.

Milling process requires a precise control of the amount of grain that is allowed to get into the small space between stones. Too little grain could make upper stone increase speed and burn grain, and too much would stop the mill. Control mechanism is made of a few numbers of wood pieces that regulate the amount of grain according to the millstone speed, and is one of the best examples of mechanical regulator before Industrial Revolution in XVIII century. Figure 12 shows some pieces of this regulation system, like moega, quenlla, and tarabelo. Figure 13 shows flour collection and storage (in the same sack used for grain).

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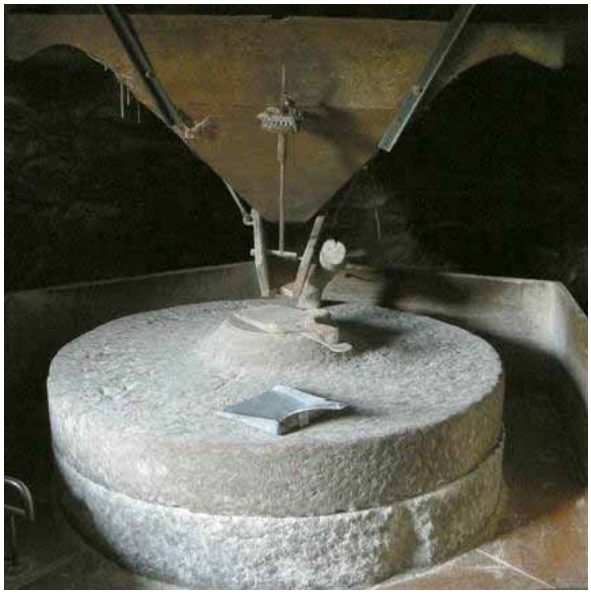

Figure 7. Millstone and grain supply

Figure 8. Mill wheel (rodicio)

Figure 9. Grain transportation to the mill

Figure 10. Water input and output

Figure 11. Flow and speed controls

Figure 12. Grain supply regulator

Figure 13. Flour collection and end of milling

4.3. Hydraulic energy

In this section we will try to calculate the amount of hydraulic energy needed to mill one kilogram of grain. Numerical data have been obtained from real milling process in Beade (Vigo).

a) Height of water column=3.5m
b) water flow=10l/s or 10kg/s (density=1).
c) Power=9,8*3.5*10=343W=0,343kw
d) Time: 2h to mill 20kg of grain=0,1h/kg
e) energy=0,343kw*0,1h/kg=0,0343kwh/kg
f) 0,0343*860.4kcal/kg=**29.5kcal/kg**

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5. Baking

5.1. The Traditional Wood Oven

Figure 14. Traditional Wood Oven

Galician traditional houses had often their own wood oven that could be inside the main house or as a separated construction. In other cases all the families in a village shared a common oven and used it by turns. Figure 14 shows a typical oven ready to use.

5.2. Kneading Process

Figure 15. Kneading process

Figure 16. Bread piece ready for baking

Kneading is the first step of bread baking. It is done in a special tool called artesa, adding water, salt and a small portion of flour with yeast (formento) that must be stored until next baking. Figure 15 shows three steps of the kneading process. After kneading bread mixture must be left in a hot place until raises (leveda). This operation can be made beside the oven while it is heating or in another warm place like the kitchen. Figure 16 shows a piece of bread ready for baking.

5.3. Oven Heating

One of the most important steps of baking is to achieve and maintain the right temperature inside the oven. A certain amount of wood must burn inside the oven until its inner wall changes its colour. This wall is made of a special type of brick that stores thermal energy and radiates it for a long time. The colour of these bricks reveals its temperature, and so there is no need for thermocouples or modern infrared thermometers. When the desired temperature is achieved wood is removed and bread can be placed inside the oven for baking. Figure 17 shows different steps of oven heating.

Figure 17. Oven Heating

5.4. Bread Baking

The baking process is very simple: bread pieces are placed inside the hot oven and kept there until they are cooked. The oven door is closed with a wood door covered with mud to

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avoid heat leakages. The oven has no windows and the cooking time is based in previous experience. Mud drying can be used as a method of measurement, but it is not very accurate. Figure 18 shows different steps of baking. Figure 19 shows the final product, that is stored in the artesa.

Figure 18. Bread baking

Figure 19. Bread pieces in the artesa

5.5. Bio-mass energy

In this section we will try to calculate the energy consumption of the baking process. The source of energy in this case is wood or bio-mass. Experimental data show that each kilogram of maize flour yields about one kilogram of bread. The amount of wood used to heat the oven is 5 small bundles (mollos) of wood (about 5kg). The other data are obtained from different sources.

a) Wood energy: about 2500kcal/kg
b) Oven consumption: about 0,5kg wood per kilogram of bread.
c) energy per kilogram of bread:
0,5*2500kcal/kg=**1250kcal/kg**

6. Conclusions

The different agricultural processes of cycle of maize in Galicia, constructions and renewable energies employed have been studied in this article.

The materials contained in this article will be the starting point to make an educational exhibition about traditional uses of renewable energies in the cycle of maize in Galicia.

This exhibition will be installed in a traditional flour mill that will be itself an important part of the exhibition.

From the point of view of energy, calculations have been made to show the consumption of different type of renewable energies in every step of growing and processing of maize:

- solar energy:**756750.6kcal/kg**
- human (food) energy: **29kcal/kg**
- milling (hydraulic) energy:**29.5kcal/kg**
- baking (bio-mass) energy: **1250kcal/kg**
- total energy: **758059,1kcal/kg**
- maize energy: **3000kcal/kg**
- percentage: 3000/758059,1*100**=0,39%**

From the above calculations the following conclusions have been obtained:

Solar energy is the main source of energy used to produce one kilogram of maize or bread.

The cultivation process uses a high amount of terrain and collects solar energy with a very small performance, but at this time it is the only way of produce food for humans and animals.

In particular, baking is a very demanding process that consumes almost as much energy as that contained in the resulting product, but provides a system of conservation and facilitates human consumption of cereals.

Moreover, agricultural food production has been working well for many centuries, is environmentally friendly and allows sustainable development.

7. Acknowledgements

The authors wish to thank Suso, Marita, Pepe, Luz and Rafa from Beade (Vigo) for their collaboration in this article and for keeping traditions alive.

8. References

[1] X. Lorenzo, Etnografía: Cultura Material, Nós, 1962.
[2] E. Lorenzo, Sobre el papel de la Energía en la Historia, Progensa, 2006.
[3] X.L. Ripalda, A cultura tradicional do pan, Ir Indo, 2002.
[4] D. Pimentel, M. Pimentel & M. Karpenstein-Machan, Energy Use in Agriculture: An Overview, CIGR Ejournal, Vol. I, January, 1999.
[5] Maize in human nutrition, FAO Document

 ISBN 978-989-95095-3-5

repository 1993, http://www.fao.org/docrep/T0395E/T0395E00.htm
[6] http://www.mapa.es/estadistica/pags/encuestacultivos/boletin2007.pdfhttp://www.mapa.es/estadistica/pags/encuestacultivos/boletin2007.pdf
[7] http://proval.meteoproval.es/estudio_solar_2006_2007_resultados.pdf
[8] J. Lastanosa, Los veintiún libros de los ingenios y las máquinas (codex, 1576), Biblioteca Digital Hispánica, 2008.

Research Interpretation in University

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Abstract. Interactive centres are significant informal learning sources for Science and Technology where interpretation and hands-on activities are employed as learning tools. An interdisciplinary science and technology museum at formal learning environment has been designed, consisted on interactive modules with hands-on experiments related with scientific research done in the Higher School of Mining Engineering (Escola Técnica Superior de Enxeñeiros de Minas or ETSEM) at the University of Vigo. In this essay we present the more noteworthy results in relation to the context and methodology used, a description of the selected contents and the creation process, the design and implementation of the activity and the degree of fulfilment of the objectives which were analyzed through questionnaires given out to a notable sample of over 250 people who visited our tailored interactive centre in ETSEM.

Keywords: Science Education, Hands-on Science, Interpretation, Research, Interactive Centre.

1. Introduction

The currently accepted paradigm for learning scientific-technological subjects requires, among other things, the use of collaborative strategies such as group work and critical thinking, and skills for practical problem solving, which, in addition, take the subjects closer to an individual's social, cultural and personal concerns [1,2]. The use of hands-on activities can contribute to such objectives as yet another tool to make learners active participants in the process: constructing in order to learn and learning in order to construct [3]. A hands-on activity in a knowledge acquisition context means the use, whether in a formal learning environment or not, of any real material or object employed with the intention of learn a properly contextualised concept, principle, law or application [4]. These are well-known methods for presentation and communication regularly employed in interactive centres or science museums, where the message being transmitted appears in an informal, fun context [5-7]. In this case the interpretation is chosen for revealing meanings and relationships by using original objects, direct personal implications and

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illustrative means instead of mere audiovisual communication of the facts [8-10], in an inclusive experience in which personal, social and physical contexts of participants intervene to a unique, individual experience [11].

There are innumerable examples of such resources being imported into the educational sphere [12-15] backed up by the use of everyday items, videos, simulations, models and demonstration teaching material or instruments themselves from research laboratories [4,16]. Thus, the teacher can integrate [17-18] them into traditional, large group, master classes as subject area experiences [4,16], propose to learners the creation of a hands-on experimental module in the form of a challenge activity undertaken individually or in small groups [19-20] or even suggest the cloning of a science and technology museum within the educational environment, a collective and cooperative activity in which learners are co-responsible for its definition, set up and monitoring [21-24].

Photo 1. Key ideas for the ETSEM activity: its installations and research

Within the framework of Science Week 2007, organised by the General Direction for Research, Design and Innovation (R&D&i) of the Xunta de Galicia Regional Authority [25], the above strategy of using hands-on activities as a link between learning and popularisation was used to carry out an interpretive experience related directly to research undertaken in the Higher School of Mining Engineering (Escola Técnica Superior de Enxeñeiros de Minas or ETSEM) at the University of Vigo [26]. The main aim was to show the relationship between this research and energy, new materials and the environment (Photo 1), in a similar way to a science and technology museum, but run by student monitors and employing real hands-on activities backed up by tailor-made audiovisuals, with representative photos, videos and simple, clear, direct, easy-, and quick-to-read texts that in all events transmitted the correct message to create "places of informal fun learning" within the ETSEM itself. This activity fitted within the aims of the Social Communication and Awareness Programme of the Galician R&D&i Plan inasmuch as it attempted to create an experience in educational innovation at the university by trying, amongst other things, to promote greater social recognition of its research activities, make potential students aware of these or even promote the ETSEM's participation in science and technology experiences by means of contextualised hands-on activities.

The educational innovation experience was centred on work with a small group of selected students from the ETSEM who were involved in a process in which part of the teaching staff carried out corresponding tasks in a coordinated, collective and cooperative way. The students worked as guides, interpreters, intermediaries, monitors or mediators with the visitors for whom a two-hour guided tour was designed: science and technology pupils from nearby secondary and high schools (14-18 year olds), usually accompanied by two or three teachers (Photo 2).

2. Context and methodology

Mining Engineering studies, with a long tradition and great prestige in the EU, started in Spain in 1777 and were the first Civil Engineering qualification to be created there. Its name originally comes from the traditional location of mineral and energy sources. Nowadays the versatility of qualifications means it can be adapted directly to new technologies. Mining engineers are essentially responsible managers of the Earth's natural resources and contrary to popular opinion, most of them do not work in mining exploitations, as the fields for work are numerous and, at the same time, unknown to the public, such as, for example: energy and fuels, metallurgy, the iron and steel industry, resource and environmental management, geology, civil works and construction, business management, explosives or safety and risk prevention in the workplace.

The studies were established at the University of Vigo in the 1992-1993 academic year. ETSEM is now one of five offering higher level qualifications in Spain and the only one in Galicia.

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Photo 2. The public during the activity

The recently built installations made it possible to unify the technology area of the University Campus at Lagoas-Marcosende (Vigo), given the fact that the ETSEM occupies a space in the centre, with corridors going out from it to the three Higher Engineering Schools of the Vigo Campus. Sixteen years on from its start up in Galicia, the scientific and technological activities related to the ETSEM are in part unknown by the general public and for this reason the theoretical proposal for this activity was aimed essentially at showing close up and explaining the work going on in the labs, showing the great range of career possibilities available to future graduates and what is on offer in terms of education and services from the ETSEM, and, furthermore raising awareness of participants with regard the importance of preserving the Earth's natural resources (energy and materials) and the environment, with the specific objectives of:

1) Increasing interest for scientific and technological aspects developed at the ETSEM.
2) Bringing the ETSEM's scientific and technological research to the public.
3) Showing scientific technological applications at the ETSEM in a fun, interactive way.
4) Making society aware of the importance of preserving the Environment and our Heritage.
5) Showing the scientific technological work at the ETSEM as an interdisciplinary task.

In order to achieve these objectives an educational innovation experience was drawn up under the general, eye-catching title of "Energy, materials and environment: this qualification is a mine", which consisted of a guided visit designed to take visitors around the ETSEM facilities whilst everyday teaching and research activities were going on.

Photo 3. Some students as guides, interpreters, intermediaries, monitors or mediators

Within this architectural framework, which in itself warrants a guided tour, the monitor work (Photo 3) was essentially carried out by final-year students from the ETSEM, in a context of explanation among peers or equals. The teaching staff worked together to establish the contents, the corporative image of the audiovisual presentations and the protocols for interpretive presentation. It was understood that the media could not offer more than someone had thought, prepared or represented, and should therefore be complemented by the direct personal contact of the interpreter [10]. Likewise the students worked on their own to prepare the material for providing more or less support depending on the case, which was then unified with all the modules. Some of the activities required additional training or preparation of the students by the teaching staff, so that they could handle instruments easily and with confidence. This design and interactivity work with the students was completed by their presence every day in the modules, verbally presenting the contents, carrying out hands-on activities and generally dealing with the visitors. This all resulted in them achieving important learning goals regarding the particular abilities for this type of activity, and the strengthening of several linked competences: some instrumental (ability to analyse and sum up, problem solving or organisation and planning skills, etc.), some personal (teamwork, interpersonal relationship

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skills, critical reasoning, etc.), and some systemic (autonomous learning, creativity, initiative, enterprise spirit, etc.).

The two-hour visits are distributed sequentially and in parallel in several of the ETSEM's spaces and with various timings, which were maintained to a greater or lesser extent. Two morning sessions were scheduled and were used for most of the five days that the activity lasted. On most occasions the visitor groups needed to be split into smaller groups for ease of work, enjoyment and to take better advantage of the visit. After a general reception in the ETSEM's main lobby by two people from management who introduced themselves, the ETSEM, and its facilities, the support material for the visit was handed out in the form of a leaflet together with general information about the education on offer and services at the University of Vigo, and material provided by the General Direction for R&D&i.

Also in the main lobby, two monitors ran activities dealing with energy, aided by audiovisual material projected onto a portable screen. Later, one of the monitors took a group to the upper floor to be shown some of the ETSEM services: photocopying, academic administration and the library. Later, on the upper floor, the visitors were received in the degree hall by a teacher who gave an informative talk on the qualification and the visit. This was finished by forming small groups of visitors who were circulated independently around the rest of the interactive themed modules (new materials and environment) located at various areas within the facilities, all of which were backed up with the corresponding audiovisual presentation. At the end of the visit all of the visitors converged once again in the lobby as a meeting point and received a souvenir gift of their visit to ETSEM and an individual evaluation questionnaire to take back to their centres for later return. After the event they received further support documentation about what they had seen and a photo report made during their visit, which included, for example, 2D thermal images or 3D scans of themselves.

3. Contents and undertaking

The hands-on modules attempted to relate the contents with the participants' own experience, employing whenever possible some everyday elements to link the unknown to the familiar. They were focussed on a specific research topic, around which the general context and applications were shown at the same time (Photos 1 and 4). Thus the visitors could:

a) attend a handling demonstration of different explosives (a specific Mining Engineering function) provided by the former "Spanish Explosives Union", now MAXAM, together with explanations of tasks and procedures that mining engineers carry out in underground civil works (tunnels, car parks, etc.) and quarries; or individualised demonstrations of rock compression resistance testing;

b) take part in fieldwork demonstrations undertaken at the ETSEM with actual technology from the research labs, such as 3D scanning of part of a building or different structures by using high precision 3D laser scans of the area, such as those used by Mining Engineers to analyse bridges, heritage sites, etc. Here, data collection was taken of the group itself for them to see afterwards on the screen used to project the accompanying audiovisual;

c) get to know the possibilities of alternative energies in general and biomass in particular, by watching the operation of a real research model, moved from the lab into the lobby, in which detailed study is made of the combustion process for this type of renewable energy; or the features and properties of the most representative materials in industry (ceramics, metals, hybrids and polymers), explaining, for instance, how a PET mineral water bottle or a toothpaste tube is manufactured by using injection, or, with the help of the student monitors, the creation of polyurethane, or carrying out nickel plating as an example of corrosion protection or;

d) participate in taking non-destructive 2D thermal images with a thermal camera such as those employed in heat efficiency studies on buildings. Here, visitors saw different applications and participated in small experiments such as viewing the thermal contours in a small piece of PVC tubing which was subjected to internal sedimentation with silicon, or even the observation of their own body temperature, in which case, once the activity was over, a thermal image was taken of the group as a souvenir.

The teaching staff and students involved took responsibility for general organisation and coordination of activities, planning and design of work, and the compilation of graphic and bibliographic documents for the interpretative audiovisuals, poster and leaflet. They were also involved in defining the guided tour of the ETSEM, in design and creation of the audiovisual presentation material, in acquiring material and booking the equipment and instruments for demonstration, and the teaching staff were involved in the training of the student monitor guides.

A plan for diffusion, follow up and evaluation was drawn up. A section of the ETSEM webpage was prepared, where general information on the activity along with downloadable PDFs of the

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poster and leaflet were published beforehand together with preparatory background reading for accompanying teachers aimed at gaining a more useful educational experience. When each daily session was over, a selection of photos was sent to the General Direction for R&D&i [25] and five galleries were published. The activities undertaken were also diffused in the media (press, radio, web and TV) thanks in good measure to the work of the University of Vigo Press Office [27]. All this meant a significant increase in the ETSEM's external visibility during the days of activity.

Photo 4. Some examples of the hands on activities developed: 2D thermal imaging, 3D scanning, explosives handling demo, and materials with shape memory

4. Evaluation

The questionnaires employed for evaluation of the activity were designed by the General Direction for R&D&i of the Xunta de Galicia for Science Week 2007. The questionnaires of around 250 participants were analysed. The main results, in the form of percentages reached for each of the possibilities, can be seen in Figures 1-3, where general information on the origin and membership is given for the visitors who were essentially a captive audience, obliged to attend the activity during school hours, exposed to an optional learning activity and without the possibility of free choice about participating, which is an important factor to take into account. There is also information about their knowledge of other similar activities and experiences, whether part of the Science Week organised by our government or of a different origin. With regard to evaluation of activity undertaken at the ETSEM, it appears that they far exceeded the participants' expectations. Predictably, lack of initial knowledge was great, whereas after the visit there was a palpable perception that it had helped in the acquisition of new knowledge, increasing interest in the contents presented. Also of note was that the majority of the participants felt that the contents were suitable for their degree of knowledge, which means there has been relative success in the process of adapting and presenting the contents in a way that is understandable to the layperson, an idea supported by the high average overall rating obtained (7.6 out of 10). Finally, and also very high, was the rating for the work of the monitors, the material and the organisation.

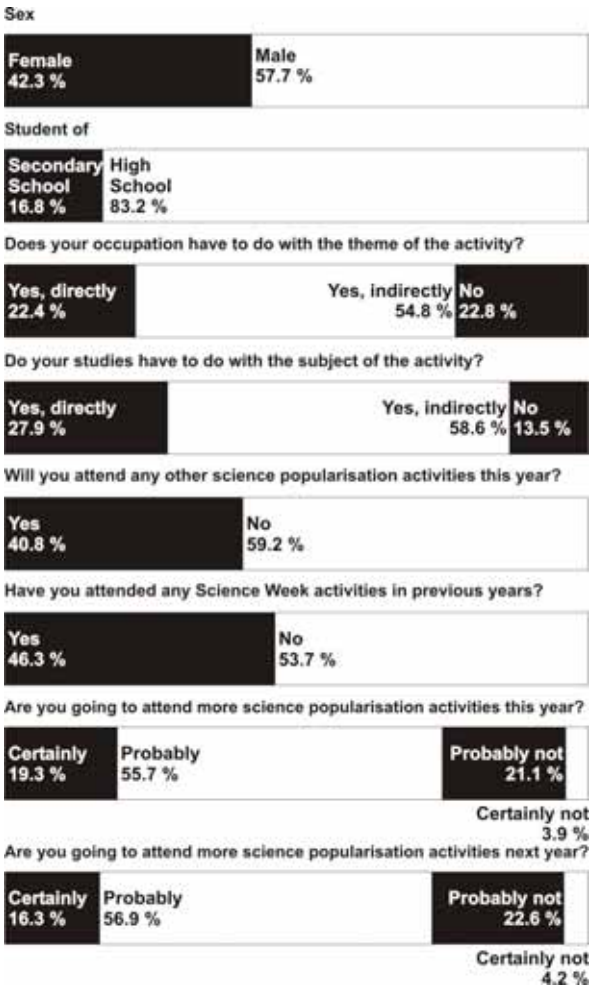

Figure 1. Evaluation: characteristics of the sample with regard to their origin and experience in popularisation activities

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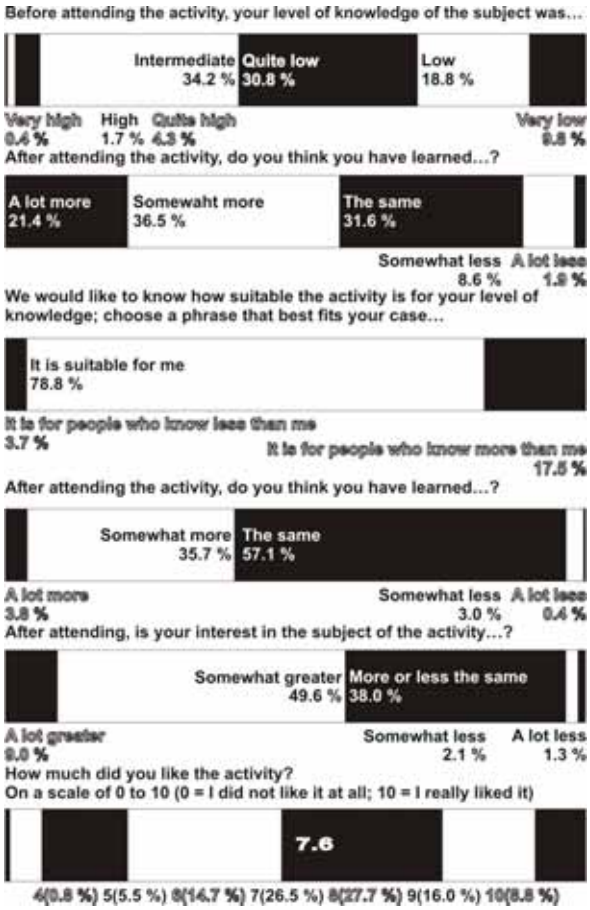

Figure 2. Evaluation: degree of suitability, knowledge, learning and satisfaction

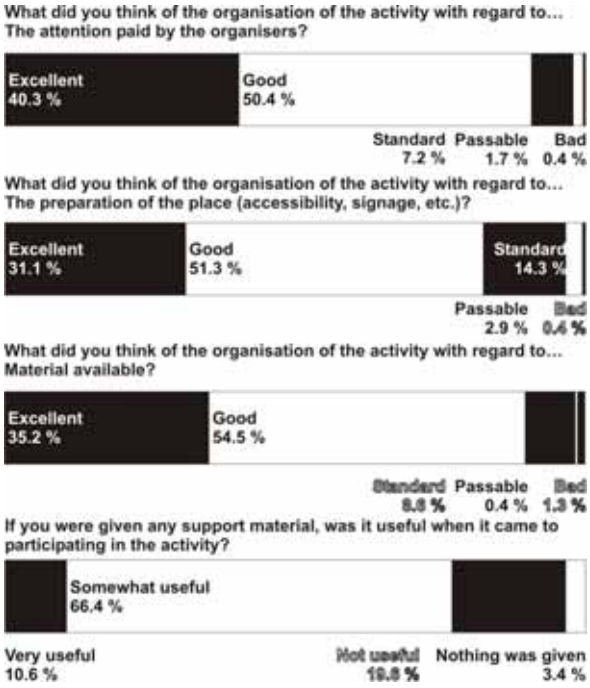

Figure 3. Evaluation: attention paid, material and organisation

5. Conclusions

This work presents the methodology for planning, organisation and coordination together with the most noteworthy results gained during an educational innovation experience related to the creation of an interactive museum and a guided tour of the ETSEM facilities at the University of Vigo as part of Science Week 2007, organised as a learning activity aimed at acquiring essentially transversal competences, knowledge and skills by means of autonomous work carried out by a small number of selected students, oriented by teaching staff acting as coordinators.

The activity attempted to engage participants with research going on at the ETSEM, recreating it technologically and increasing empathy towards it by employing interpretive resources for demonstration and participation. It is understood that the questionnaires reveal a high degree of satisfaction among participants, who consider it to have been a special and novel experience that was important to them. The activity, fun, enjoyable and motivating, appears to have awoken their interest in the contents presented and shifted in the majority of cases, the ignorance and ideas previously held. The participants thought that the experience was a fount of useful information and that is was possible to learn new things from it.

A large part of the success achieved must be put down to the student monitors who, with clear and straightforward messages offered a general broad-ranging idea of their modules within the context of the ETSEM, including details with their own personal impressions, awakening the interest and desire to see new things, becoming the vital medium to aid in understanding and help enjoy these facts. The enthusiasm seen by participants during the activity also constitutes an important achievement. Finally, it is important to also mention that in general the rest of the teaching staff and students of the ETSEM not directly involved in the activity also felt highly satisfied with the experience, as did most of the accompanying teachers from the visiting schools.

6. Acknowledgments

Thanks go to the General Direction for R&D&i of the Xunta de Galicia for funding as part of the Science Week 2007 programme. Thanks also go for the logistic support of the OTRI (Arístides Huerga and Javier González) at the University of Vigo, the diffusion tasks to the media by the University of Vigo Press Office and the demonstration material provided by MAXAM. Finally, thanks go to the teachers, students and

 ISBN 978-989-95095-3-5

support and service staff of the ETSEM who participated by giving their help, particularly to: Pedro Arias, Natalia Caparrini, Enrique Granada, Carmen Pérez, Fernado Cerdeira, Enrique Orche, Javier Taboada, Fernando García, Pedro Merino, Marta Cabeza, Ramón Nóvoa, Iria Rodríguez, Jaime Martínez, Diego Copena, Antonio Soliño, Carmen Moreira, María Rodríguez and Karolina Biskup.

7. References

[1] D. Hodson, In search of a meaningful relationship: an exploration of some issues relating to integration in science and science education, International Journal of Science Education, 14: 541-566, 1992.

[2] S.A. Barab and D. Karns, Rethinking methodology in the learning sciences, Journal of the Learning Sciences, 10: 5-15, 2001.

[3] L.B. Flick, The meanings of hands-on science, Journal of Science Teacher Education, 4: 1-8, 1993.

[4] B.V. Dorrío, E. García Parada and P. González, Introducción de demostraciones prácticas para la enseñanza de la Física en las aulas universitarias, Enseñanza de las ciencias, 12: 62-64, 1994.

[5] P.M. McManus, Topics in museums and science education, Studies in Science Education, 20: 157-82, 1992.

[6] L.E. Maxwell and G.W. Evans, Museums as learning settings: The importance of the physical environment, Journal of Museum Education, 27: 3-7, 2002

[7] S. Allen, Designs for learning: studying science museum exhibits that do more than entertain, Science Education, 88: 16-33, 2004.

[8] L. Beck and T. Cable, The meaning of interpretation, Journal of interpretation research, 7: 7-10, 2002.

[9] C. Lee and A. Brown, Bibliogaphy of interpretative resources, Journal of interpretation research, 8, 2003.

[10] F. Tilden, La interpretación de nuestro patrimonio. Pamplona: AIP, 2006.

[11] J.H. Falk and L.D. Dierking, Publics institutions for personal learning. Washington: TISAAM, 1995.

[12] C. Morris, Importing “hands-on” science into schools: the Light Works van programme, Physics Education, 25: 263-267, 1990.

[13] W.J. Boone. and M.K. Roth, Organizing school science shows, The Physics Teacher, 30: 348-50, 1992.

[14] K.E. Johansson and Ch. Nilsson, Stockholm Science Laboratory for schools: a complement to the traditional education system, Physics Education, 34: 345-350, 1999.

[15] S. Rodríguez, J. Fernández, J.A. Asín, A. Lago and B.V. Dorrío, An informal interactive science and technology centre. Proceedings of the 2nd International Conference on Hands-on Science. Science in a changing education, P.G. Michaelides and A. Margetousaki, (Eds.), Rethymno: University of Crete, 190-195, 2005.

[16] B.V. Dorrío and A.R. Vieites, Actividades manipulativas para el aprendizaje de la Física. Revista Iberoamericana de Educación, 42/7, 1-15, 2007.

[17] B.V. Dorrío, Museos interactivos na escola. Revista Galega de Educación, 35: 20- 22, 2006.

[18] B.V. Dorrío, As actividades manipulativas como ferramenta de aprendizaxe científico-tecnolóxica, Experiencias de Innovación Educativa na Universidade. Ourense: Tórculo Artes Gráficas, Universidade de Vigo, 11-16, 2006.

[19] B.V. Dorrío, Hands-on Physics activities with the overhead projector, Proc. 4th International Conference on Hands-on Science. Development, Diversity and Inclusion in Science Education. M.F. Costa, B.V. Dorrío, and R. Reis (Eds.), Ponta Delgada: Universidade das Açores, 199-200, 2007.

[20] B.V. Dorrío, 101 Hands-on electromagnetic induction activities, Proc. 4th International Conference on Hands-on Science. Development, Diversity and Inclusion in Science Education. M.F. Costa, B.V. Dorrío and R. Reis (Eds.), Ponta Delgada: Universidade das Açores, 201-202, 2007.

[21] B.V. Dorrío and R. Villar, Indoor interactive science museums in school, Proc. 3rd International Conference on Hands-on Science. Science Education and Sustainable Development; M.F. Costa and B.V. Dorrío (Eds.), Braga: Gráfica Vilaverdense, 623-628, 2006.

[22] B.V. Dorrío, J. Rodríguez, J. Fernández, J.A. Ansín, and A. Lago, Ciencias en las manos: aprendizaje informal. Alambique, 51: 107-116, 2007.

[23] R. Villar and B.V. Dorrío, Aproximación a la arqueología: un ejemplo de interpretación del hecho científico, Íber, 48: 115-125, 2006.

[24] R. Villar and B.V. Dorrío, Science interpretation in high school, Proceedings of the 2nd International Conference on Hands-on Science. Science in a changing education, P.G. Michaelides and A.

Margetousaki (Eds.), Rethymno: University of Crete, 184-189, 2005.
[25]http://www.conselleriaiei.com/ga/dxidi/index.php
[26]http://webs.uvigo.es/etseminas/
[27]http://www.duvi.uvigo.es/

Itinerant Museum of History Chemistry – Soap

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Abstract. Due to the lack of activities aiming the increase in interest in science in the North Fluminense region, the Itinerant Museum of Chemistry History was created. The Museum's goal is to promote experimental chemistry to students and public school teachers through the adaptation of classical experiments in the history of science and technology. In the specific case of soap, the experiments were developed seeking low-cost materials and safety. This work describes experiments for soap formation using different kinds of fat, and the use of the produced soap in experiments that demonstrate surfactants properties, such as water superficial tension and emulsification.

Keywords. Soap, Science Education.

1. Introduction

According to an international evaluation of quality in science teaching to 15 years-old students performed by Programme for International Student Assessment (PISA), Brazil is in one of the last positions in comparison with more developed countries. This fact might be explained by Brazil's great socioeconomic inequality. Nevertheless, this situation is particularly concerning when considering countries of the same region and economic reality, e.g. Argentina, Uruguay and Chile [1]. Brazil's ranking in PISA 2007 is a result of the lack of investments in science teaching in addition to the lack of adequate structure for science laboratories in educational institutions.

Another research was promoted by the Ministry of Science and Technology (MCT in Portuguese) in 2007 [1]. This study also involved the Brazilian Academy of Science, FIOCRUZ Museum of Life, FAPESP and Unicamp's Laboratory of Advanced Studies in Journalism. The study showed preoccupying results regarding the public perception of science:

- 58% of the interviewees have little or no interest in science and technology (37% of them said this was mainly due to the fact that they do not understand it);
- 73% of the search little or no information on science and technology (32% of them said this was mainly due to the fact that they do not understand it);
- only 4% of the interviewees visited a museum of science in the last year;
- from the 96% that did not visit museums of science in the last year, 47% said this was mainly due to the museums' location (35% declared there were no museums of science in their area and 12% declared that the museums are very far).

Nowadays, museums and centres of sciences are not recognized as a place of scientific production anymore [2]. Instead, they are a place of representation of science and a link between society and scientific production [3].

Some authors have been emphasizing the importance of visits to spaces of science as a means to develop a more critical perception of the world.

"Museums of science and technology enable visitors to look at the world in a different way after the visit. They see things that they have never seen and, eventually, make things that they have never made because they thought they were not able. The Centres and Museums of Science's goals are raising awareness to scientific culture; avoiding possible "anti-scientific" resistance and encouraging attitudes and processes of science, especially curiosity and critical thinking." [4]

Aiming to help the reversion of science education's current situation and to establish interactions between society and science, the Itinerant Museum of Chemistry History was created in the North Fluminense region, promoting strategies of improvement in Chemistry teaching.

Based on MCT research's results, we decided for the museum's mobility in order to assist the several North Fluminense regions and to minimize the problem of museums' distance.

Another objective of the project is to improve students and teachers' knowledge on History of Sciences by developing specific activities on the topic. The activities for teachers will be trainings that are being implemented at the Regional Coordination of Education of North Fluminense Region. The training's aim is the actual application of Science History in the teaching of

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sciences. The activities for students will be presentations of experiments related to the History of Chemistry, focusing on technologies that are part of students' everyday life. Some research has been made on this area, namely the application of History of Science when teaching Electrochemistry topics (e.g. pile) presented positive results favouring the learning and increasing students' interest during classes [5].

The Itinerant Museum of Chemistry History nowadays works with four topics that are related to classic experiments in the History of Science and Technology. These topics are part of students' everyday life and offer the possibility of approaching current Chemistry topics in high school. The topics are: candle, beer, soap and food conservation. The four topics were presented in Scientiarum Historia - 1st Congress of History of Sciences and Techniques and Epistemology.

1.1 Soap

In this study, the topic soap will be developed with experiments based on its history. The preparation of experiments will require materials such as ashes and soda. Support texts will be made to explain the chemistry involved. These texts will be used by students and by high school teachers who do not hold a Bachelor degree in Chemistry (in Brazil, only 13% of public school Chemistry teachers have Bachelor's degree in Chemistry) [6].

Soap is a common topic in Chemistry lectures as it is approached several times in high school's curriculum, i.e. organic chemistry, carbon chain's nature, saponification reactions and intermolecular interactions.

In this article, experiments will be developed in order to help discussions regarding water superficial tension, formation of surfactant monolayer on water's surface and emulsion agents.

1.1.1. Soap in health

Soap has a simple production process, which has happened since ancient times. It is worth to remark that changes in soap production contributed to human being's evolution in a direct way. Today it is practically impossible to imagine life without soap or similar products. When somebody from a tropical country does not take a shower one day, it is easily noticed by our sense of smell. It is important to remind that that bad smell that we feel is human being's characteristic smell (that we hide with perfumes of soap and of deodorant that we use everyday).

Baths as hygiene practice and health of the body only happened in the 19th century, when science identified a series of diseases [7].

1.1.2. Reactions

In the most primitive way of making soap, the basic reagents were animal fat (for instance, ox tallow) and plant ashes. In animal fat there are several glicerides that, in alkaline environment, can be decomposed in glicerol and soap. The abundant alkaline environment in antiquity was found in plant ashes, i.e. the sodium and potassium carbonates.

Figure 1 illustrates a saponification reaction.

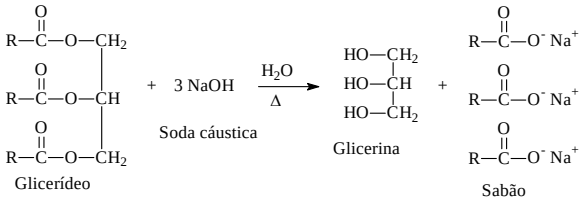

Figure 1. Representation of saponification reaction

The alkaline hydrolisis of glicerides is called saponification reaction. Depending on the alkali used in this production, different types of soaps are obtained. When the reaction involves sodium hydroxide, or sodium carbonate, harder soaps are produced. If the reaction involves potassium hydroxide or potassium carbonate, the resulting soap is softer.

1.1.3. Soap chemical structure and properties

Soap has two different characteristics in their molecular structure: great apolar hydrocarbonic groups and a polar extremity (Figure 2).

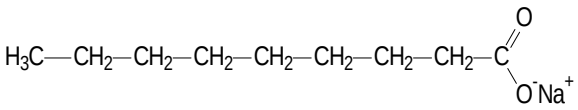

Figure 2. Representation of a soap molecule

The polar extremity can interact with water (also polar) and the hydrocarbonic chain interacts with the fat (also apolar).

1.1.4. Soap as a cleaning agent

Water surface behaves as an elastic film. This property of liquids is called superficial tension, and it happens due to the attracting forces among the internal molecules of a liquid and the molecules of the surface. Soap reduces the water's superficial tension, which is why soap is called a surfactant agent.

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Soap has the property of concentrating oil particles in micelles, i.e. microscopic droplets of fat involved by soap molecules. Micelles are self-organized systems of soap molecules, or surfactants, and they have the following shape (Figure 3).

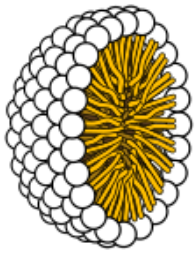

Figure 3. Representation of a micelle system

In a micellar structure, the apolar part of soap molecules is guided to the interior of the micelle (interacting with the fat), and the polar part is guided outside the micelle, interacting with water, as shown on Figure 3.

The micelles stay dispersed in water generating an oil emulsion. This happens because their coagulation is avoided by electronic repulsion.

2. Potash

The delay in industrial and scientific development in Brazil during colonial period was mainly due to D. Maria I, who prohibited manufacture activities in the colony in 1785. In 1808, the Portuguese royalty migrated to Brazil and finally some actions to stimulate technology, labour education and, consequently, scientific thought were undertaken.

In the 18th century, during the period when modern Chemistry appeared, Frei Jose Mariano de Conceição Veloso translated some books about industrial activities to Portuguese. Veloso was devoted to Botany, leading the first botanical expedition (1779-1790) through the interior of Rio de Janeiro state, being considered one of the main names of science and technology of the Portuguese empire in the end of the 18th century and beginning of the 19th century. Veloso wrote books that helped the beginning industry, agriculture and natural history in Brazil. Veloso also described around four hundred new species of Brazilian plants.

In Brazil, one of the first written registrations related to soap was a book written by Veloso in 1798. The book's main subject was large-scale production of potash, one of the main ingredients of soap. The book "Alographia dos álcalis fixos vegetais ou potassa, mineral ou soda e dos seus nitratos, segundo as melhores memórias estrangeiras, Que se tem escripto a este assunto parte primeira" described the species of Brazilian plants which are rich in potassium.

Veloso had the assignment of promoting potash industry in Brazil. Potash was very significant for the beginning industry because it was used in the production of several products, such as fabrics, glass, paper, sugar, medicines and dyes. On Veloso's book, there are illustrations indicating plans for the construction of potash factories that, when in operation, would yield profits for Portugal. The book also gives instructions to those who decided to set up potash factories in Brazil.

Until half of the 19th century, potash and soda were obtained from combustion of certain types of plants. After that, the practice disappeared with the exploration of Stassfurt's mineral deposits in Germany in 1861. With Leblanc's process, industrial production of sodium carbonate in the beginning of the 19th century [8].

3. Experiments

3.1. Soap preparation varying the fat type

Soap preparation was tested with varying types of fat, which showed that several different products can be obtained depending on the type of fat used as a reagent.

The different fat types were obtained in different ways. Some were bought in trades, such as ox tallow from slaughterhouses and soy oil from supermarkets. Others were extracted during the preparation of meals, such as chicken fat, obtained by separating the skin from the fat during its cleaning, and rib fat, obtained after the rib cooking.

To guarantee that all fats were in the same conditions, the reaction began with warm fat so that all of them were in liquid state (at room temperature, rib fat and ox tallow are in the solid state). In a beaker, twenty millilitres of warm fat were added. Afterwards, five grams of soda (bought at a construction store) were added. The mixture was slowly stirred for thirty minutes in a heating plate, at 100 °C. After the soap cooling, three different products were obtained (Figure 4).

The resulting soap presented different properties. The order of hardness was (from the hardest to the least hard): ox tallow, rib fat, chicken fat and soy oil. This practice demonstrates that the various kinds of fat's different properties (i.e. insaturation level, glycerine concentration and chain size) influence the final product's physical properties. It is also possible to obtain soaps with intermediate characteristics, mixing different fat types.

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With the aim of characterizing the foaming capacity of each piece of soap obtained, we made a quantitative comparison with water in test tubes. 0,1 gram of different pieces of soap was mixed in 5 ml of water. The resulting foam formed on the different pieces of soap is shown on Figure 5.

Figure 4. Soap made from several kinds of fat. A) ox tallow; B) soy oil; C) chicken fat and D) ox rib fat

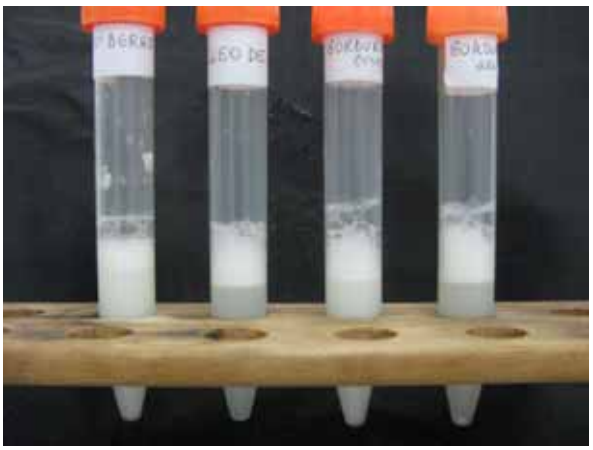

Figure 5. Samples of soap foam from different kinds of soap, just shaken. From left to right: ox tallow, soy oil, ox rib fat and chicken fat

It is possible to observe that there is no significant difference in the amount of foam on different soap types. After one hour of rest, different stabilities of foam were observed (Figure 6). The foam from soy oil soap is less stable than the others.

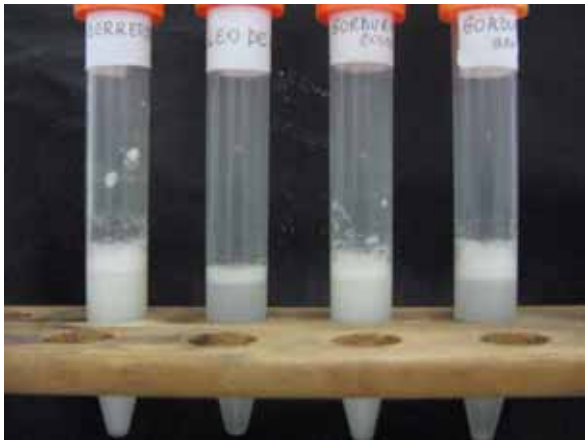

Figure 6. Samples of soap foam from different kinds of soap, one hour after the shaking. From left to right: ox tallow, soy oil, ox rib fat and chicken fat

This kind of practice, where reagent can be varied using materials from everyday life (i.e. the several fat types and different types of vegetable oils) and where the different products obtained are predictable and verifiable, stimulates the raising of students' scientific curiosity.

3.2. Influence of water hardness in efficiency of the soap

This experiment was developed to approach the influence of metallic cations, namely calcium and magnesium in soap's action. Different samples containing hard water and soap were analyzed, observing the variation in the amount of foam in function of Ca^{2+} concentration.

Solutions	Ca^{2+} concentrations
1	Saturated solution
2	50,0% of saturated solution
3	25,0% of saturated solution
4	12,5% of saturated solution
5	6,3% of saturated solution
6	3,2% of saturated solution
7	1,6% of saturated solution
8	0,8% of saturated solution
9	Water

Table 1. Solutions used in the hard water experiment. All solutions have 20 drops of detergent

Water's hardness is defined in function of calcium and magnesium concentration. Hard water prevents foam formation when soap is used [9]. Water hardness is a regional factor, because the calcium and magnesium ions

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concentration depends on the type of rock, e.g. calcareous rocks [10].

This kind of effect occurs because Ca^{2+} and Mg^{2+} ions interact with soap's carboxilate, generating an insoluble substance before foam formation. A common problem involving hard water is the formation of insoluble deposits in water pipes and kettles [11]. In the hard water experiment, whitewash (used in constructions), plastic bottles, commercial detergent and coffee filter were used. Thirty grams of whitewash were added to 500 millilitres of water. This mixture was stirred and left to rest, decanting. In order to remove suspended impurities, the mixture was filtered twice using paper filter. The saturated and filtered solution was diluted several times in the following way: 250 ml of saturated solution was mixed with the same amount of water, diluting the solution's concentration in 50%. 250 ml of this solution was separated for the experiment and the other 250 ml were diluted again in 250 ml of water. This procedure was repeated 7 times, producing solutions with concentrations of around 0,8% of the original solution (Table 1).

3.2.2. Results and Discussion

By reducing the concentration of whitewash, an increase in the foam column was observed, as illustrated on Figure 6.

Figure 7. Picture of solutions 1, 2, 7, 8 and 9 immediately after agitation

Four hours after agitation, two facts could be observed: 1) all foam formations are stable and 2) less foam is generated in function of Ca^{2+} concentration (7).

Figure 8. Picture of the solutions 1, 2, 7, 8 and 9 six hours after the agitation.

The metallic ions responsible for water hardness react with soap, precipitating the carboxilates that consume the soap (Figure 9).

$$Ca^{2+} + 2\ CH_3(CH_2)_{16}COO^- \rightarrow Ca(C_{18}H_{35}O_2)_{2(s)}$$

Figure 9. Representation of the formation of $Ca(HCO_3)_2$.

3.3 Lava Lamp

A mixture of water and oil was used in a proportion of 1:3 (water: oil). An effervescent pill was added to generate an ascending effect and thus, the visual effect is similar to a lava lamp. A double of this system was made and, having the two bottles in front of students, we added soap to the aqueous environment in only one of the two bottles. The result illustrates, with interesting visual appeal, the influence of detergent in emulsion formation.

The materials utilized in the experiment were kitchen oil, potassium permanganate, 600ml plastic bottles, effervescent antacid, water and a syringe adapted with a hose. The solution contains a tip of spatula of $KMnO_4$ in 200 millilitres of water. It is important to remark that permanganate is only used in this experiment due to its appealing colour. Another coloured substance could be used, if more easily available. One hundred millilitres of the permanganate solution was added in each bottle. Afterwards, 300 millilitres of oil were added to each. In one of the bottles, some millimetres of a solution of detergent (15 ml in 85 ml of water), was added in aqueous phase with a syringe coupled to a fine hose.

Finally, a tablet of effervescent antacid was simultaneously added to both bottles, and the differences between the two bottles could be analyzed.

The effervescent tablet is mainly made of sodium bicarbonate, which reacts with water to form sodium hydroxide and carbonic acid, (an unstable acid that easily decomposes to H_2O and

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CO_2). In both bottles, the formation of CO_2 bubbles was observed due to the effervescent tablet's addition. In the bottle without surfactant, the CO_2 bubbles carried the permanganate solution. After coming to the oil's surface, the permanganate solution went down due to its higher density. This ascending-descending movement resembles the functioning of a lava lamp.

In the bottle where detergent had been added in the aqueous phase, there was an emulsion formation of the system permanganate-oil, and foam formation during reaction. Both effects are due to the ascension of CO_2 bubbles carrying portions of water. After the reaction, the foam remained on surface.

The ascension of water bubbles in the bottle without detergent was still observed after the end of effervescence. An interesting activity is to visually follow one of these water bubbles coupled with remaining bubbles of gas. Halfway to the surface, some gas bubbles are detached from the water bubbles. The interruption in the ascending motion and the fact that they go down illustrate the density concept.

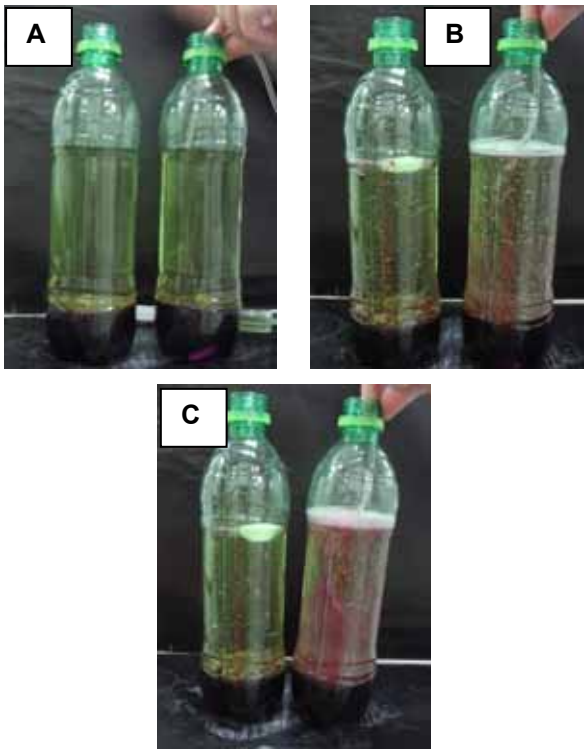

Figure 10. The bottles in different moments of the experiment. A) Before the addition of the effervescent tablet; B) just after its addition; and C) after the emulsion formation

4. Conclusion

From the experience with high school visits of the Itinerant Museum of Chemistry History, we learn that dynamic experiments, i.e. the lava lamp, have an immediate impact on students' reaction. Moreover, experiments such as soap preparation and hard water encourage students to reproduce them due to their flexibility and easy execution. Thus, the students are encouraged to try them more than once, with variations in the conditions. All experiments described here stimulate students' interest in experimental practice and promote the association of everyday life experiences with scientific concepts approached in classes.

5. Acknowledgements

The authors thank UENF for Juliana Contarini's fellowship and Prof. Fernando Luna for the access to papers related to the subjects approached in this study. The authors are also thankful to Roberta Gregoli for the help with translation.

6. References

[1] http://www.estadao.com.br/ext/especiais/2007/11/oecd.pdf
[2] http://www.mct.gov.br/index.php/content/view/50875.html
[3] M.M. Lopes, O Brazil Descobre a Pesquisa Científica: os museus e as ciências naturais do século XIX, HUCITEC, São Paulo, 1997
[4] P. Rodari and M. Merzagora, The role of science centres and museums in the dialogue between science and society, Journal of Science Communication, 6 (2) June, 1-2, 2007.
[5] F. B. Gil and C.M. Lourenço, Que ganhamos hoje em levar os nossos alunos a um museu. Comunicar Ciência. 3(1999)4-5, translated by the authors.
[6] 46º Congresso Brazileiro de Química http://www.abq.org.br/cbq/2006/trabalhos2006/6/335-503-6-T1.htm)
[7] A.I. Ruiz, M.N. Ramos and M. Hingel, Escassez de Professores no Ensino Médio: Soluções Emergenciais e Estruturais. http://portal.mec.gov.br/cne/arquivos/pdf/escassez1.pdf
[8] P. Le Couteur and J. Burreson, Os botões de Napoleão: as 17 moléculas que mudaram a história, Cap. 1, translated by Maria Luiza X. de A. Borges, Editora Jorge Zahar, Rio de Janeiro, 2006.
[9] F. Luna, The production of Potash from plants in colonial Brazil as described in Fray Conceição Veloso's Alographia dos Alkalis, Química Nova, accepted for publication.

 ISBN 978-989-95095-3-5

[10]J.D. Lee, Quimica Inorgânica não tão Concisa, Editora Edgard Blücher, translated from 5th Edition, Chapter 1.
[11]G.S. Mol, A.B. Barbosa and R.R. Silva, Água Dura em Sabão mole. Química Nova na Escola, 2:32-33, 1995.

Nanotechnology Education on a Local Scale

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Abstract. Progress in nanotechnology depends on availability of well educated specialists. The response from European higher education institutions to the need for nano-education focuses mainly on Masters courses, but other forms of education are also being developed. At Rzeszow University this problem is of high importance because the Nanotechnology Centre will be launched in 2010 to become a technology and research base in the southern-eastern Poland for BA, MA and PhD degree courses and for research projects. The most important matter while developing educational materials in nanotechnology is a rapid growth of new information and a quick transition from generating new ideas to implementing those ideas in industry. This makes e-learning the most efficient teaching strategy. Its potential is used to compile a laboratory course on nanostructure characterization. A 7 step strategy is developed to conduct workshops on the methods of characterization based on teacher-guided reading the research literature.

Keywords. E-learning, Nanotechnology, Web, Laboratory Course, Electronic Tutorial, Reading Strategy.

1. Introduction

Nanotechnology is a too complicated phenomenon to have a single definition. The simplest one defines nanotechnology as the engineering with anything smaller than 100 nanometres with novel properties. It integrates multiple disciplines, technologies, materials, and processes to enable the creation, assembly, measurement, or manipulation of materials, devices and integrated systems at the nano and molecular scales with great potential. Further progress in this field depends on availability of well educated specialists.

The fields of nanoscience and nanotechnology are broad and still exploratory, with connections to almost all disciplines and areas of relevance. Thus the most important matter to be taken into consideration while developing educational materials in nanotechnology is an exponential growth of new

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information and an accelerated transition from generating new ideas to implementing those ideas in industry.

In this communication we examine the training in the nanotechnology, which derives from microelectronics, surface and interface science, and focuses on fabrication of structures in silicon, carbon and other inorganic materials that will be, as we expect, one of the main direction of the evolution for the nanoelectronics.

2. Current issues in nanoscience education

While planning educational initiatives for nanoscience and nanotechnology, it is very useful to have estimates of how many specialists are needed, because "training people is a key component for long-term success" [1].

According to M.C. Roco, Senior Advisor for Nanotechnology of the National Science Foundation, a need for a multidisciplinary trained nanotechnology workforce in the years 2010-2015 is of 900 000 in the USA, 400 000 in Europe, and about 2 million persons in total [1].
There is an interesting estimate for a proportion of staff with different qualification levels: "experts have estimated that future demands will require 15 trained technicians for each scientist in a nanotechnology manufacturing business" [2].

2.1. International initiatives in nano-education

The response from European higher education institutions to the existing need for nano-education focuses mainly on Masters courses, but other forms of education including short courses, formal PhD programs and undergraduate education, and vocational training courses are also being discussed and developed. European or international standards for good quality education in nanosciences and nanotechnology should be developed and initiatives taken for sharing best practices between professors and vocational trainers. The EU can stimulate this under the People programme in FP7 for university graduates funded by DG Research and the new Lifelong Learning programme funded by DG Education (2007-2013) [3].

A five-year goal of the U.S. National Nanotechnology Initiative (NNI) is ensuring access to the full range of nanoscale research facilities to 50% of US research institutions' faculty and students, while students' access to education in nanoscale science and engineering is enabled in at least 25% of the research universities [1].

The European Materials Research Society (E-MRS) is planning an "European Whitebook on Nano-Science Education" with contributions from scientists of diverse backgrounds and disciplines presenting an overview of the state of the art in this existing fields from European and global (by the International Union of Materials Society - IUMRS) international perspectives [4].

Four leading research and educational institutions in Europe (Chalmers Tekniska Нцgskola, Sweden; Technische Universiteit Delft & Universiteit Leiden, the Netherlands; Technische Universitдt Dresden Germany and Katholieke Universiteit Leuven, Belgium) have proposed a joint Erasmus Mundus Master Course entitled "Nanoscience and nanotechnology". This is an integrated program, with a strong research basis and an international outreach. The objective of this course is to provide top quality multidisciplinary education in nanoscience and nanotechnology [5].

2.2. The Nanotechnology Centre at Rzeszow University

However this does not mean that less known educational institutions are not able to train specialists for this field. E-learning is just right to ensure a high quality of education.

At Rzeszow University this problem is of an increased importance because the Nanotechnology Centre currently being under construction will be launched in 2010. To meet the forthcoming demand for nanotechnologists, we have to develop and implement relevant teaching strategies here and now. The Nanotechnology Centre will become a technology and research base in the southern-eastern Poland for BA, MA and PhD degree courses as well as for research projects concerning the growth, characterization and application of nanostructures based on II-VI semiconductor materials. This decides which methods we pay special attention, however students will be given an overview of basic instrumentation and metrology needs across all nanoscience and nanotechnology. Everybody goes his/her own way to the nanoscience guided by previous research experience, and a way we choose decides what we will do in a new field. We have been kept to the straight and narrow path leading from microelectronics to nanoelectronics - low dimensional structures, such as: quantum wells, quantum dots and super-lattices grown by MBE-technology.

2.3. E-learning in nanotechnology

Combination of multiple time-limiting factors in nanotechnology makes e-learning the most efficient teaching strategy. We have used the e-

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learning potential to compile a laboratory course on nanostructure characterization. This is a very important component of a curriculum for nanoscience education because a proper measurement of nanostructure parameters critical to realizing its underlying physical ideas is as challenging as the development of nanostructure technology because even classic methods become specific when applying to nanostructures.

Presently a central problem is not how to locate a proper material in the Internet, but how to implement it in a right way. There are both general-purpose and specialized resources. The first to be referred to among general-purpose resources is NanoEd Resource Portal launched by National Centre for Learning and Teaching in Nanoscale Science and Engineering, available at http://www.nanoed.org/. The site is designed to both gather and disseminate information on nano-education related topics, including education research, nanoconcepts, teaching materials, seminars, and degree programs. The NCLT is the first national centre for learning and teaching of nanoscale science and engineering education in the United States. The centre was created in October 2004, through a National Science Foundation award of $15 million for five years. The mission of NCLT is to develop the next generation of leaders in nanoscale science and engineering teaching and learning. Its educational materials are addressed to science teachers and students in grades 7-12, college and university students and faculty, researchers, and post doc students. Additionally the National Science Foundation provided a five-year $20 million grant to the Nanoscale Informal Science Education (NISE) Network (http://qt: Exploratorium.edu/nise-resources/) to bring researchers and informal science educators together to inform the public about nanoscience and technology.

However extensive materials relevant to our goal, i.e. teaching the nanostructure characterization, are developed by many university laboratories and analytical equipment producers. Some examples of their web sites are discussed below.

3. Characterization and imaging methods in the nanotechnology curriculum

Advances in fundamental nanoscience, design of new nano-materials, and ultimately manufacturing of new nanoscale products will all depend to a great degree on the capability to accurately and reproducibly measure properties and performance characteristics at the nanoscale. The revolution in nanoscale science and technology requires instrumentation for observation and metrology, otherwise we are not able to see and measure what we build. Though Richard Feynman challenged the scientific community to explore the "space at the bottom" since 1959, nanoscale R&D activities have been initiated on a full-scale only few years after Gerd Binnig and Heinrich Rohrer have invented the scanning tunnelling microscope for seeing and touching nanostructures on surfaces in 1981. Instrumentation and metrology have been identified by the U. S. National Nanotechnology Initiative (NNI) as one of critical nanotechnology areas as they are both vital to the success and commercialization of nanotechnology.

3.1. Characterization techniques

However a number of methods used in nanostructures research have turned a hundred. Additionally, they are being improved and updated according to specific research goals. Therefore it is a primary task to select the most relevant methods and explain students why they answer the purposes of research. Over the past 30 to 40 years a wide range of surface and microanalytical techniques found an application in nanotechnology have evolved. Each technique has its own unique capabilities that are related to the particular physical interaction involved with that technique. With the exception of SPM/AFM, all of the techniques involve the interaction of some type of particle (electron, ion, or photon) with the sample material. The physics of each particular interaction affect the limits of lateral resolution, depth resolution, and detection sensitivity for each technique. Understanding these interactions, and more importantly the limitations they impose on a technique, can be crucial when selecting an analytical technique for specific problems to be solved. The main parameters characterizing technique - the required spatial resolution and the sensitivity (detection limits) are strictly interconnected.

Students study many of surface analysis techniques being used today: AES -Auger Electron Spectroscopy; XPS / ESCA - X-Ray Photoelectron Spectroscopy / Electron Spectroscopy for Chemical Analysis; SIMS - Secondary Ion Mass Spectrometry; TOF-SIMS - Time-of-Flight Secondary Ion Mass Spectrometry; Raman Spectroscopy.

All these techniques are the “classical” methods developed to surface analyses, however recently their main parameters have been substantially improved to keep pace with nanotechnology increase resolution.

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3.2. Nanoscale imaging

Because nano-devices can operate on the level of a few molecules, or even a few atoms, accurate atomic-scale imaging is important. The sphere of nanoscale imaging belongs largely to electron microscopy and scanning-probe microscopy. Electron microscopy relies on the fact that electrons have much shorter wavelengths than visible-range photons and can thus resolve much finer details while maintaining a large depth of focus. Electron microscopy is now the most universal and *de facto* obligatory technique for atomic-scale structural characterization.

It is divided into two very different techniques: scanning electron microscopy (SEM), and transmission electron microscopy (TEM). In SEM, a focused electron beam is scanned across a conductive surface, releasing secondary electrons that are collected by a detector placed above the object at an angle that determines the perspective view. Magnification is changed by adjusting the size of the scanning area. Resolution ranges down to a couple of nanometres for the most-advanced tools-not fine enough to resolve atomic detail. Transmission electron microscopy takes a different approach: electrons are passed through the specimen, producing a shadow that is magnified by magnetic lenses and projected onto a sensing screen.

In scanning transmission electron microscopy (STEM), a variation of TEM, an electron spot is raster-scanned across the specimen and the secondary transmitted electrons detected. Magnification ranges up to 1 million, allowing the imaging of atomic lattices. High-resolution aberration-corrected electron microscopes (both TEM and STEM) already today can provide valuable measurements at the sub-Engstrom level. In general, resolution is accepted as the ability to determine if an image feature represents two objects rather than one. In high-resolution electron microscopy these objects are atoms.

Scanning probe microscopy (SPM) is a branch of microscopy that forms images of surfaces using a physical probe that scans the specimen. An image of the surface is obtained by mechanically moving the probe in a raster scan of the specimen, line by line, and recording the probe-surface interaction as a function of position. By using such a probe, researchers are no longer restrained by the wavelength of light or electrons. The resolution obtainable with this technique can resolve atoms.

Scanning Probe Microscopy is a general term, used to describe a growing number of techniques that use a sharp probe to scan over a surface and measure some property of that surface. Some examples are STM (scanning tunnelling microscopy), AFM (atomic force microscopy), and NSOM (Near-Field Scanning Optical Microscopy). Many scanning probe microscopes can image several interactions simultaneously. The manner of using these interactions to obtain an image is generally called a mode.

3.3. Web-base resources

A useful list of excellent surface science courses, from introductory to graduate levels, each emphasizing different aspects of the subject is available on the UK Surface Analysis Forum (ttp://www.uksaf.org/tutorials.html).

Evans Analytical Group has collected and presented on its web site (www.eag.com) materials on most known methods of surface characterization, their practical use and the interpretation of measurement results.

Interesting materials on specific techniques are posted on web-sites supported by producing companies, e.g. Kratos (www.kratos.com) provides materials on XPS, and Jeol (www.jeol.com) – on SEM and TEM.

Though in comparison with other methods SPM is a fairly new one, nevertheless there are extensive e-collections related to different aspects of those methods. We would like to emphasize some of them. First of all – the James Madison University SPM Education website (http://spmeducation.virginiananotech.com/) - the clearinghouse for SPM experiments, techniques, labs and ideas that have been published in the scientific educational literature or developed by educators to be used primarily for educational purposes.

As to SPM producing companies, NT-MDT Co. should be mentioned first and foremost (http://www.ntmdt.com).

Nanoscience Instruments publishes the Nanoadvisor educational newsletter, which offers reviews on nanoscience programs, funding, resources, and nano-teaching information (http://www.nanoscience.com/).

4. Literature-based study of imaging and characterization methods

Research publications, both printed and electronic, provide information on the most current accomplishments which is indispensable to successful learning any subject. In nanotechnology, however, they also somehow compensate a lack of expensive equipment

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which many educational institutions cannot afford.

4.1. Formats of research publications

Published research generally follows an established format. It is important that students understand each part of the research paper. Typically it includes the following parts [6]:

- **Abstract** "serves to briefly answer the basic questions about what was studied, how it was done, and the results. Its primary purpose is to allow readers to make an initial evaluation of whether a study is of interest without having to read the complete paper". Structured abstracts make it easier for readers to select appropriate articles. The introduction, methods, results, and discussion (IMRAD) format [7] is well known and widely adopted for structured abstracts in original articles.
- **Introduction "**explains *why* the study will be conducted... It also expands a little more on *how* the research will be conducted. The introduction can be divided into two major parts: the Background section and the Purpose section. *Background* …should reflect a comprehensive knowledge of the body of research on the subject and should brief the reader on both the previous studies that support the concepts or theories of the current study and those that do not…*Purpose* … dictates how a study will be conducted: the research design, the variables that will be measured, how information will be collected and analyzed, and what conclusions may be drawn".
- **Methodology** "…explains how the research was conducted and should give information in enough detail for the reader to evaluate the study. It should also enable the reader to understand to whom or what the study results apply".
- **Results** section provides the data and its analyses.
- **Discussion** section "gives the reader some insight into the study subject area and often sheds new light on the results and their meaning. Alternative explanations for the results and the implications of the research may also be presented". Sometimes conclusions may be not adequately supported by the data for many reasons (collection of insufficient or inadequate data, overgeneralization of results, methodological problems, or inherent limitations of the study design). This is why it is important to review the methodology section.
- **References** always can tell experts "if key research has been omitted from the reference list…Also, a reference list that includes both older and newer relevant research can reassure the reader that the author has thoroughly reviewed the entire body of research for background and has not just considered the last few or first few studies conducted on the topic".

4.2. Reading strategy to study techniques applied in nanotechnology

A workshop which involves a thorough consideration of research articles is the final stage of learning characterization and imaging methods. These articles are selected by teachers according to their instructional utility and are analyzed by students according to the following 7-step strategy:

- Students' reading is controlled in a step-by-step manner when they are offered all parts of an article one after another.
- An object of studies is analyzed, e.g. a method of fabrication, possible application, methods providing the most complete characterization. Students suggest a set of methods, the research purpose is discussed.
- Methods used by authors are considered; specific equipment used in experiments is discussed with a focus on its potentials and limits; user manuals available from a producer or on a Web site are read. Students make assumptions regarding an outcome to be achieved if the selected methods are applied.
- Sample preparation for the investigation methods are considered (e.g. ion beam milling, angle lap etc.). This stage is not always paid a proper attention. However it is this point that ensures correct findings, especially for nanostructures.
- Results achieved with each specific method are analyzed with a focus on their completeness, reliability and informative capacity.
- All results are considered as whole; authors' conclusions are discussed.
- Directions of further studies are suggested. Two options are possible depending on a purpose of the research under discussion:
- a purpose was to characterize a structure. Possible continuation may be additional studies with an extended set of methods,
- a purpose was to study a particular phenomenon. Then the question is whether this structure is optimum to observe that phenomenon and, if it is not, which structure would be better. Answering the latter question requires not only the knowledge of research

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methods and nanostructure physics, but basic experience in materials science and technology as well.

Students' efficient work during the workshop is supported through continuous referring to different resources including not only common electronic tutorials developed at our university but mostly web-based resources, both research and industrial. The quality of students' learning depends on how accurate is teacher's selection of materials to be used at workshops. This requires that a teacher should make a great deal of pre-workshop literature research.

5. Conclusions

Nanotechnology poses new challenges to education in many ways because existing paradigms are evolving – new physical ideas are being discovered and then some technologies are revolutionary transformed, other ones are getting out-of-date, or completely new approaches are introduced to solve the problems which seem to have been solved.

E-learning allows a timely response to new trends regarding the fundamentals of nanotechnology methods and provides application examples to explain students which method or combination of methods is good for a particular experiment, how to plan an experiment, and how to interpret its results.

6. References

[1] M.C. Roco, International Strategy for Nanotechnology Research and Development, J. of Nanoparticle Research, 3, 353-360, 2001.

[2] J. Lighteather, Nanoscience Education, challenges and opportunities, Presentation at the Expert Group Meeting "North-South Dialogue on Nanotechnology, Challenges and Opportunities", 10-12 February, Trieste, 2005.

[3] M. Ineke, Nano-education from a European perspective, Journal of Physics: Conference Series, 100, 1-7, 2008.

[4] P.A. Glasow, How should the Higher Education in Materials Sciences and Technology be performed in Europe, 2007 E-MRS.EU.Quest.29.08.07.doc

[5] Erasmus Mundus Master Nanoscience and Nanotechnology,2008. www.emm-nano.org/indexnano.htm.

[6] How to Understand and Interpret Food and Health-Related Scientific Studies, Review from the International Food Information Council Foundation.

[7] T. Nakayama, N.Hirai, S. Yamazaki, and M. Naito, Adoption of structured abstracts by general medical journals and format for a structured abstract. J Med Libr Assoc., April; 93(2): 237–242, 2005.

Enhancing Women Presence in Science – from "De Jure" to "De Facto" Situation

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Abstract. The paper is reporting a comparative situation of promotion women in science in the origin country and in other EU countries according to the recommendations of European Commission (2005). Besides some statistical figures, specific features regarding the presence of women in science in Romania are discussed, stressing the general political and economical environment related to the long transition of the country from totalitarian to a democratic system and the consequences of EU accession. Some good practices to enhance the interest of young girls for science are presented, as well. The importance of the international contacts and change of experience is discussed.

Keywords. Women in Science, Competition, Good Practices, Innovation, International Contacts, Excellence.

1. Introduction

Romania and Bulgaria are the last countries accepted in EU in 2007, the chapter of science and education being among the first open for discussions and accomplishment of the Aquis Communitaire. The international contacts developed in the frame of projects and cooperation represented the opportunity to be closer to the common rules adopted in EU by the other members. Nevertheless the preparation works for the access had been much facilitated and Romania began to contribute to the common funds much before the date of accession. The last 18 years were the scene of important changes in the history, economy, society as moving from an autocratic to a democratic system and it was not easy and costless. It is important the notice that Romania had a quite good economical situation and a qualified labour force at the end of the autocratic system in 1989.

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Women represent in this country about 51.4% and the qualification was similar to that of men, as the access to study was not affected by discrimination in the former system. In the last time due to the regression of the industrial units, the limitation of many industrial activities, privatization of many units, the appearance of new activities, services, a.s.o. a storm was happening in the jobs opportunities according to the economical changes.

The law of Equal Chance between women and men had been adopted in 2002, but thinking at the fragile democracy in a country in which the autocracy was active for more than 50 years and recalling that in Norway a similar law is valid since 1978 the differences are quite clear

2. Romania realities

As concerns the education due to the autonomy of the higher education units, the ever increasing number of private universities, and the reform in the education system imposed by the implementation of Bologna Agreement the result seems not to be that expected, no university being in the Shanghai top. The free access in the European countries and all around the world determined a large movement of the people for study or work reasons with consequences at the level of the local labour force.

If the access to the scientific domain was not the subject of gender bias, neither the remuneration in the former communist time, there were problems of bias concerning the access of women in the decision positions because of the political reasons and moreover because of the “unfair” presence in the scientific space as academician of the wife of the ex dictator Ceausescu. It was not a model to be alike and the access of women scientists was limited to avoid any concurrence, although there were important results in many scientific domains as chemistry, biology, medicine, pharmacy, physics where there were many women to work in the laboratories.

Women educated in the former system, having the same responsibilities as their male partners were better prepared for a concurrent system, since they used to face the home problems, as well. The lack of political experience in a plural parties system and some specific feature regarding the position of women in the former system made women to be reserved to be involved in the politics.

As considering the figures in the table 1. the number of women in the Parliament is the smallest and unfortunately their voices are quite faint as they have been elected on Party lists and the reason was political in the majority of situations.

Romania Parliament composition nowadays:

Deputy Chamber: 35 women out of 326 total, representing 10.74 %

Higher Chamber : 14 women out of 136 members, representing 10.29 %

Education, a sector with one of the lowest income level in the Romanian economy is also a sector where female work force prevails. Between 1990-1997 the female teaching personnel was 99% in preschool education, 74% in primary and lower secondary education, 60% in upper secondary education.

Table 1. Gender Parliament structure by 2004

Country	Total number	Female		Male	
		number	%	number	%
Romania	331	37	11.2	294	88.8
Bulgaria	240	53	22.1	187	77.9
Portugal	230	49	21.3	181	78.7
Spain	350	126	36	224	64
Slovenia	90	11	12.2	79	87.8
Sweden	349	165	47.3	184	52.7

In spite of some real progress made during the last years, at the level of education gender discrimination is the result of the conservative curricula, textbooks and teaching methods. Romanian education system still ignores the education for private life, and discourages women graduates both intellectually and socially by lack of models of feminine successful enterprises including their participation in history. Curricula also ignore women’s specific life experiences (pregnancy, birth giving, child rearing etc.) treating them as trivial or unimportant issues [1].

Our talk is about a country in which there is no woman in the present government, despite the Law of Equal Chances between women and men L202/2002 [2]. The ex ministry of justice Monica Macovei was removed because of her insistent position to fight against corruption in Romania. It was mainly because of her efforts that Romania was accepted in EU. The ex vice president of the Liberal Party was removed, as well, accused to have been a collaborator of the “ex security system” but also because she had a higher coefficient of sympathy among the people. Some of the female members in the Parliament had been promoted by the Parties in which their husbands are prominent business people. Generally they have not an independent position but form the vote machinery.

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Romania is still a traditional mentality country in which women do not appreciate much the solidarity, and after the bad example of the ex single woman in politics Romanian women are not much attracted by politics. Fokion Fotiadis one of the Chief of the European Community delegation in Bucharest recalling the efforts made by the Delegation in 1999 in order to prepare the accession to EU of Romania said that 90% from the staff was constituted from women: "I think women in Romania constitutes the essential segment of the nation due to their innovating spirit, but also because of their stubbornness very often higher than that of men". Very often the activity of women is better appreciated outside than at home.

3. Education in Romania

Speaking about women professionals it could be necessary to stress that many women are involved in the education activity, probably because this is a vocation profession, as first of all women, as mothers, are educators of their children from infancy, on the other hand it seems that this activity offer more free time for the house management.

Nowadays the profession of teaching is not very simple, as complementary to the profession the teachers have to improve their level all the time: using new methods of teaching, attending courses to improve the professional level, extra curricula activities to discover student's gifts, up-dating the methods of teaching to avoid didacticism and practice interactive methods. In this way women teacher educators develop all the time a scientific activity to improve their own professional level and the methodology of teaching, which represent an innovating activity.

To prove the reality of this hypothesis is the good results the Romanian scholars received in the international Olympiad contests. This year 2008 (at the moment this paper is written) Romania won 53 medals at the International Olympiad contests 13 gold medals, 25 silver and 15 bronze, while in 2007 the total number of medals was 88. The large majority of the winners in these competitions are invited to continue their studies abroad mainly in USA, where the Romanian Math school is well renown.

Many schools and teachers are involved in different international projects. This opportunity is an important stimulus both for students and for teaches to develop new activities, to have contacts, to be involved in managerial activities as well, to extend the curricula and approach practical problems: environment, animals, history and monuments protection, according the local situation. The participation in international projects offer the opportunity of intercultural exchanges, practice international languages, better know the traditions, the history and geography of other countries by bi-lateral contacts, not in the last contributing to build the edifice of a future unified Europe.

A successful project engaging scholars, school teachers, university professors and scientists is «Hands on science». The project developed in the last years represented the opportunity of both scholars and teachers from pre university system to make a large step forward as regard to enlarge the possibilities to adopt unconventional methods to teach, use the experiment to better understand the nature phenomena, to learn to stimulate the initiatives, to promote good practices but all the time to extend and try new ideas.

Country	**%**
Latvia	53
Bulgaria	47
Portugal	44
Romania	43
Greece	37
Sweden	36
Finland	31
Italy	29
EU-25	**29**
France	28
Germany	19
Netherlands	17

Table 2. Proportion of women researcher by 2003 (She Figures 2006 pg.25)

The extra curricula activities is the opportunity to approach interdisciplinary, new activities taking into account the very specific conditions in the different regions of the country: problems connected to the environment: Danube Delta, Black sea, the mountains and the forest and fauna protection, the specific geographical values (the mud volcanoes, the oil resources etc. The possibilities to study such phenomena in the nature to use the very different knowledge: physics chemistry, geology, clime, atmosphere but working together in small teams is the opportunity to stimulate the methods of work, collaboration, the moral values avoiding the didactic methods in the classroom.

On the other hand the common work teacher-students in non formal frame, allow them to be closer, to better understand each other; it is a continuous source of innovation, stimulus and good results. It depends on the teachers qualities to offer, to pretend and contribute to create new values.

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3. Women in Science

The total percentage of women in science in Europe is presently 18-35%, which justify the efforts the figure to be stepped up.

The number of women involved in science in Romania is among the largest in the statistics in Europe [3]

Country	HES	GS	BES
Germany	25	27	12
Switzerland	28	24	17
Austria	30	35	10
Italy	31	39	19
France	34	32	20
EU-25	**35**	**35**	**18**
Hungary	37	40	25
Spain	38	45	27
Bulgaria	38	50	48
Romania	40	49	42
Sweden	44	36	25
Portugal	46	58	30
Latvia	53	56	54

Table 3. Proportion of female researches by sector of activity 2003 [3]

Country	1-2004	2-2006	3-2006
Latvia	52%	49%	69%
Lithuania	49%	50%	67%
Bulgaria	46%	47%	57%
Portugal	44%	46%	57%
Romania	43%	46%	52%
Estonia	43%	50%	69%
Slovakia	42%	44%	58%
Croatia	41%	45%	58%
ENWISE 10	41%	46%	61%
Greece	37%	39%	48%
Spain	36%	41%	53%
Sweden	36%	47%	50%
Cyprus	32%	44%	53%
U.K.	31%	47%	45%
Italy	30%	39%	45%
EU-15	30%	44%	46%
Finland	29%	48%	50%
Czech. Rep	29%	43%	50%
Denmark	28%	47%	43%
Austria	24%	45%	44%
Germany	19%	49%	40%
Netherlands	17%	45%	47%

Table 3. Women as percentage in 1- researchers; 2 - employment; 3 – professionals

The conclusions of the statistics according [4] Figure 7. pp.26 shows that 8 countries have a higher percentage of women in science than the average figures for ENWISE [5] (Enlarge Women in Science in East) 10 and EU-15 in 2006, as shown in Table 3. As regards the number of women grade A professors (%) in 2004 Romania was on the first place Figure 8. pg.28 [4] and only other 4 countries Turkey, Latvia, Portugal and Finland could report a proportion of women full professors above 20%. The target proposed by EU [6] 25% by 2010 seems not to be realistic, despite the efforts made by some countries to implement different programmes to stimulate the promotion of women in science. There are some universities in Austria receiving special funds to employ women in high positions.

In Romania the promotion at the top professional levels was for long time restricted by the policy imposed by ex communist system. After 1990 the liberalization even in the university system, the organization of many private universities produced a large number of professionals on the highest top levels, the classic hierarchy pyramid was reversed us side down. It is hardly to believe such a rash promotion was based on rigor reasons. Nowadays there are 8 female rectors, but only 2 in public universities, the others in private ones.

What is true is the number of women in decision positions is not proportional with the number of women in research.

Now when the EU is in favour of women promotion in the decision positions and there are many special programs to recompense the universities promoting women in such positions the question to arise: are the figures reported by different countries absolutely true?

I'd like to mention that on 27 February 2007 was officially launched the European Research Council (ERC) a new EU funding body for frontier research. It was during the German Presidency of the Council of EU and Ms Angela Merkel the German Chancellor highlighted the importance of ERC as a milestone. She mentioned three aspects that will be the key to the ERC's success allowing Europe to grow: excellence, international involvement and research freedom. As former researcher (she was scientist in chemistry) the German Chancellor referred to her previous experience and acknowledged that there are many factors coming into play during drafting of a research proposal, but she appealed for excellence to remain the sole criterion for funding. She petitioned the present EU Research Commissioner Mr. Potečnik to take up the role of "protective patron" of excellence even after German Presidency of EU Council is ending.

Isn't the election of a woman scientist as Chancellor of Germany a proof of "parti pris" for the excellence? Isn't her diplomatic activity as politician a proof of the managerial qualities of a researcher? Is it a chance that all these qualities belong to a female scientist?

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4. Recent news

As many other countries Romania registers a lower number of students interested in science, as there are many new professions much attractive for them. The interest to develop activities to attract young people for science, to stop the brain drain and encourage the graduates to return back is a task for school, universities and the scientists, as well.

The presence of women in decision positions seems to be encouraged, either because some male researchers decided to migrate toward the business sector or in science management, but also because they are very good female managers.

There are many directors of research institutes who consider easier to work with women and who promoted them in decision position:

At the Institute for Micro Technologies the vice director is a woman and many of the staff members as well, much possible because the general director as EU expert was eager to adopt the most recent recommendations regarding gender balance in science. The often presence of the general director to Brussels was an opportunity to apply for every new program and take profit of every new offer.

Among the many projects in which this institute is involved was the project " Shadowing days" 4 girls from the High School for Informatics "Tudor Vianu" from Bucharest have been invited to spend a whole day in the laboratories of the institute, to follow the steps of the nano to micro technologies, to assist in the laboratories the investigations using AFM (atomic force microscope) or laser assisted mask design, to discuss with the scientists women, to know about their profession and responsibilities, to be better informed about the magic of a profession, where the gifts of women for minute activities could offer important satisfactions. They asked different questions and were interested to know the steps of a very new micro technology. The director of the technology – a woman engineer and university professor as well explained and at the end of the day both the mentor and the mentored had to express the impressions.

It is not sure all the girls will choose a scientific career, but it was an interesting experience and a possible open door toward a new profession: combining the gift of journalist with the right scientific information to have a profession in communication. The project was launched by Viviane Reding, Commissioner for Information Society and Media, at the European Commission Shadowing.

Figure 1 Shadowing days at the Institute for Micro Technologies 1. presentation, 2. scientist in the lab 3, protection clothes for clean room, 4 mask production

 ISBN 978-989-95095-3-5

A CD ROM [7] containing the interviews with the women scientists talking about their profession, the impressions of the girls, visits in the institute and not in the last the visit of these girls at Brussels the meeting at high level with other participants in this project. - a very interesting experience that deserves to be promoted.

The 2007 edition of the IT Girls action was finalized in 2008, through the **"European Commission Shadowing Conference", March 6,2008,Brussels"** (source: http://ec.europa.eu), where IMT participated with a delegation, the attendees receiving participation diploma.

5. Conclusions

The paper is not a pleading for women in science, it is not to impose them anyway, but to try to pay more attention to their contribution in science and technology as a possible enlarged, complementary vision.

As scientist working on the side of my male fellows I'm positive, that what it is necessary is to promote an enhanced and deeper expertise. This is possible by cooperation, by respect and fair appreciation for the other's expertise- this means expertise not only in science but in morality, as well.

6. References

[1] Art 10, Women's Status in Romania, A Shadow Report to the CEDAW 23rd Session (2000) posted August 2, 2007.
[2] Law 202/2002, republished in 2007, regarding the chance equality between women and men
[3] She Figures 2006 Women and Science Statistics and Indicators
[4] Benchmarking policy measures for gender equality in science EUR 23314 /2008 DG for Research Capacities/Science in Society pg 26
[5] ENWISE Report (2003) European Commission-Directorate General for Research Science and Society – Women and Science "Waste of Talents: turning private struggles into a public issue, Women and Science in the Enwise countries "
[6] European Commission (2005) Women and Science, Excellence and Innovation- gender Equality in Science, Working document.
[7] IT Girls – Great careers for great women in http://www.imt.ro/ICT%20girls.pdf

Electronic Resources in Patient Education: Issues and Solutions

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Abstract. Management of electronic resources has become a critical function for successful patient education. The aim of our project is to promote relevant life style changes in the city of Lviv and the nearby region by direct provision of health care consumer educational services that focus on education of patient and caregiving families in the proper ways of modifying life style to improve cardiovascular health conditions. By accessing the most current sources of health information through access to the Internet; development and dissemination of current information for health care providers and educational materials for the general public on cardiovascular disease and lifestyle modification, improvements in both primary and secondary prevention of cardiovascular disease could be achieved..

Keywords. Public Health, Health Care, Literacy, Electronic Health Information, Internet, Patient Education, Computer Network, Consumer Health Information.

1. Introduction

Health literacy is a public health goal for the 21st century. More than ever, the public health employs information technology to promote health and aid in health care – or what can be called eHealth. Health information is obtained from different contexts including electronic resources such as the World Wide Web and other technologies that now play an increasing role in consumer health. To benefit from electronic health resources, people should be able to use them to their optimal level that requires eHealth literacy which combines "basic reading and writing skills, working knowledge of computers, a basic understanding of science, and an appreciation of the social context that

 ISBN 978-989-95095-3-5

mediates how online health information is produced, transmitted, and received…" [1].

Until 2004, no formal programs in Ukraine existed to provide healthcare education to sick/disabled people and their caregivers to assist in coping with cardiovascular disease and needed lifestyle changes related to this health problem. To overcome the long-term consequences of the lack of such a program, the project "Educating Health Care Consumers to Prevent Heart Disease" was conjointly developed and implemented to introduce formal patient and family cardiovascular health education, disseminate printed instructional/reference materials regarding cardiovascular disease, and take advantage of group learning opportunities and patient-to-patient peer support. The project focuses on integrating information literacy into patient education, accessing the most current sources of health information through access to the Internet and explaining how to interpret numerical consumer health information. This healthcare project was made possible by a grant from the Bureau of Educational and Cultural Affairs of the United States Department of State (ECA) through a program administered by International Research & Exchanges Board (IREX).

2. Access barriers to consumer health information

Health care in recent years puts greater emphasis on the active and informed consumer that has led to understanding that both access to and adequate comprehension of health information is still a problem. A report from the US Institute of Medicine entitled "Health Literacy: A Prescription to End Confusion" considered the relationship between health and literacy and showed that those with limited literacy skills have less knowledge of disease management and health promoting behaviours, report poorer health status, and are less likely to use preventive services than those with average or above average literacy skills [2].

2.1. eHealth Literacy Model

According to C. Norman and H. Skinner [3] eHealth literacy is comprised of six core skills, or literacies:

- traditional literacy,
- health literacy,
- information literacy,
- scientific literacy,
- media literacy, and
- computer literacy.

The authors use the metaphor of a lily to describe that the petals (literacies) feed the pistil (eHealth literacy), and the pistil overlaps the petals, tying them together. Within the lily model, the six literacies are organized into two central types: analytic (traditional, media, information) and context-specific (computer, scientific, health) [3].

The eHealth Literacy Scale (eHEALS) has been developed to provide a general estimate of consumer eHealth literacy skills for a wide range of populations and contexts. The eHEALS is a self-report tool that can be used by a health professional. It is "an 8-item measure of eHealth literacy developed to measure consumers' combined knowledge, comfort, and perceived skills at finding, evaluating, and applying electronic health information to health problems" [3].

2.2. Professional and consumer language

Apparently, consumers and healthcare professional speak and think about health-related concepts differently. This vocabulary gap is becoming a more important problem as consumers increasingly explore eHealth resources for their own. Thus, professional language is a barrier to eHealth literacy. Consumers are prefer using a combination of "everyday language", technical terms (no matter if they understand or don't understand those terms) and various explanatory models, all influenced by many contributing factors.

What could be a bridge or crosswalk between consumer expressions and professional terms to aid information communication and retrieval? To address this problem, a concept of a consumer health vocabulary (CHV) was introduced, and "CHV is refers to a collection of expressions, concepts, attitudes, and beliefs observed to be used by most members of a consumer discourse group to communicate about health-related issues…" [4]. Although developing an open-access draft "first-generation" CHV has been reported [4], we had to solve our specific local problem related to the Ukrainian speaking audience and to develop a Ukrainian CHV to be used by consumers in a variety of situations:

- Face-to face communication between patients and physicians,
- Comprehension of information on diagnoses, lab results, personal risk factors, prescribed drugs,
- Submission personal health data in-person and through electronic media,
- Formulation of information retrieval queries to biomedical databases and other

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information systems that is also a problem to professionals [5, 6].

There are several types of professional terms that are difficult for lay comprehension:

- Difficult general language words which have the same meanings in the professional language (for example, intermittent),
- Medical terms requiring the subject knowledge to understand (for example, diastolic or angina),
- General language words which have different meanings in the professional language (for example, negative (not good) means "absence of a disease condition").

2.3. Why studies are contradictory

Consumers look for simple certain data to help them being healthy. The problem is that single studies rarely provide such certainty. Instead, contradictory studies appear in the media almost weekly. The general public is becoming increasingly sceptical about advice on health and ask why researchers can't get it right the first time.

The IFIC Review explains the nature of the scientific process which is "a road of discovery", but "not necessarily a straight line". It is "characterized by cycles of revisions, conjectures, assertions, and contradictions... In addition, although such cycles often frustrate non-scientists and can contribute to increasing public scepticism about advice on food and health, it is important to understand that science is evolutionary, not revolutionary… Because scientific research explores the unknown, uncertainty is an unavoidable part of current investigations. Only through repeated research and analyses do certainties emerge" [7].

Everybody will agree that consumers read health-related literature to get answers. However the results section of a study provides "data" instead, and these data should be properly interpreted to become answers.

2.4. Understanding numerical data in consumer health materials

Much consumer health information regarding disease or treatment risks and benefits is essentially quantitative in nature that makes it difficult to understand to consumers because the interpretation of this type of information requires significant quantitative skill.

Consumers choosing between health care alternatives need to understand the likelihood of both the negative outcomes (risks) and the positive outcomes (benefits) associated with the available options to make informed choices between them. For example: a women making decisions about hormone replacement therapy to treat menopausal symptoms must understand and weigh the reduced risk of osteoporosis, cardiovascular disease, colorectal cancer, and Alzheimer's disease against the increased risk of breast cancer, myocardial infarction, cerebrovascular disease, and thromboembolic disease [8]. Even fractions and proportions used to present risks and benefits are challenging for the average person. Furthermore, even highly educated people have difficulty performing the quantitative operations that are commonly required in the interpretation of likelihood (for example, converting from percentages to proportions and vice versa). This shows that "the understanding of information regarding risks and benefits proves challenging for many, if not all, people" [8].

However there is an evidence that "the format in which likelihood is presented—verbal, numeric, or visual—influences understanding" [8]. Below is a brief summary of recommended formats.

- ***Verbal format***. Verbal labels are used only to describe probabilities that are unknown or vague. The meaning of a verbal label changes with the outcome being described, particularly if the outcomes range from very low-probability events to higher-probability events. As a result, verbal labels should not be used to describe multiple likelihoods in a single communication. For example, for low-probability risks a 1% chance is labelled high, but when verbal labels are used in a more general context (for example, to describe the likelihood of a false positive test result), a 10% chance is considered a small possibility. The interpretation of these two labels in a single communication presents difficulty for the information consumer that, increases the level of misunderstanding.
- ***Numerical format***. Numerical format of probability are better when likelihood can be precisely specified (for example, the likelihood of medication side effects can be precisely specified on the basis of clinical trial results). For numerical representations, frequency format (for example, 5 times out of 100) is most preferred, followed by percent (e.g., 5%).

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Probability format (like 0.05) is not recommended as being most difficult for consumers to understand. When frequency format is used to present multiple risks, the size of the comparison group should be held constant (for example, 1 in 100, 5 in 100, and 20 in 100, but not 1 in 100, 1 in 20, and 2 in 10).

- ***Visual format***. Pictographs showing frequency representations of likelihood tend to be the easiest format to understand. The only disadvantage is that they take up a large amount of space, particularly in comparison to numerical representations and, thus, may be inappropriate when there are many likelihoods to be communicated or when presenting very low probability events.

3. Educating health care consumers in Ukraine to prevent heart disease

Cardiovascular disease is recognized to be one of the most prevalent world health problems and is of considerable concern in Ukraine. According to the data from the Regional Medical Information & Analytical Centre in the city of Lviv, cardiovascular disease is known as the primary cause of death for 62 % of those who died in Ukraine during the year 2007. At present, 10.3 persons from every 1000 of the Ukrainian population die from cardiovascular disease. Overall, cardiovascular morbidity in Ukraine increased by 9.36 % in comparison with the year 2003. Morbidity of cardiovascular origin not only causes a deterioration of health status and shortened life expectancy but also has increased the rates of related disability, which has negatively affected the quality of life for people in Ukraine.

3.1. Patient education project

Although patients in Ukraine get adequate medical treatment they remain at high risk of continued cardiovascular sequel because the medical treatment provided is not adequately reinforced by relevant modifications of patient life style in such areas as diet, exercise, smoking cessation, and reduction of alcohol consumption, for example. Most cardiovascular patients have poor knowledge of how to change their behaviour using disease specific lifestyle modification in the outpatient rehabilitation period, and moreover, they seldom are educated to understand that lifestyle modification is a lifelong commitment toward maintaining or improving their own health. The aim of our project was to promote relevant life style changes in the city of Lviv, Ukraine and the nearby region by direct provision of health care consumer educational services that focused on educating patient and caregiving families in the proper ways of modifying life style to improve cardiovascular health conditions. By accessing the most current sources of health information through access to the Internet; development and dissemination of current information for health care providers and educational materials for the general public on cardiovascular disease and lifestyle modification, improvements in both primary and secondary prevention of cardiovascular disease were achieved. Additionally, health professionals, social workers and caregivers were trained to provide outreach educational programs about cardiovascular disease prevention in the community at large.

3.2. Patient education program and educational materials

Classes for patients and other health consumers on modification of life style, disease management and social rehabilitation were conducted once a week. Educational presentations to healthcare/socialwork professionals on the design and provision of educational programs about heart disease prevention were conducted once a month. Workshops for socialwork/healthcare professionals and interested community groups in the general public about heart disease and related issues were conducted once a month in Lviv Regional Cardiology Center.

A series of consumer pamphlets titled “Learning Ways to Protect Your Cardiovascular Health” was published and distributed to a selected target audience and mailed to regional health and academic libraries, hospitals and cardiology centres in Ukraine. Additionally, patient handouts are available from the http://www.ukrcardio.org website. Initially this series was planned to include 5 pamphlets. However, physicians from Lviv Railway Hospital and specialists from the Ukrainian-American Birth Defects Program provided so much additional material on vital related topics that this information was formatted as three more pamphlets and included in the printed educational series. As a result, the final printed educational series now consists of 8 pamphlets on the following topics:

- Blood Pressure Notebook
- Ischemic Disease
- Eye Conditions in Hypertension Patients
- Birth Heart Defects. Hypertension in Pregnancy.

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- Diabetes in Hypertension Patients.
- Hypertension
- Complementary and Alternative Therapy: Diet and Exercises
- Complementary and Alternative Therapy: Herbal Therapy and Hirudotherapy.

Pamphlets and patient handouts were discussed at patient meetings and at Ternopil Medical Library in particular. The educational program, based on a 5-step strategy was developed and improved according to opinions expressed by physicians from Lviv Regional Cardiology Center and Lviv Railway Hospital:

1 - what is a disease and risk factors;
2 - what warning signs are;
3 - what diagnostics techniques are used;
4 - what drugs are administered and why;
5 - lifestyle to follow.

3.3. Project evaluation

Questionnaires and evaluation forms were completed by health care professionals and consumers so that the researchers could learn of beliefs and attitudes towards the patient education system and materials developed during the project.

Our analysis of questionnaires and evaluation forms (completed by 162 patients, 43 physicians and nurses, 36 librarians and information specialists, and 23 administrators) shows that overall participant attitude has been positive regarding the educational program on cardiovascular health.

All respondents considered attending patient classes to have been a very useful adjunct to the drug therapy.

All participating physicians reported that they recommended the pamphlets and handouts to their patients.

Several physicians and information specialists (12 people) joined the project team to present patient classes and develop the pamphlets.

A focus group of patients (20 people) demonstrated an improved level of cholesterol, weight and exercise activity and better understanding of risk factors related to lifestyle (diet and smoking).

3.4. Patients' attitude

A brief review of the project evaluation questionnaires indicates that:

(1) all patients know a normal blood pressure level, but only 20 % patients know a normal cholesterol level;
(2) respondents highly rated the utility of the educational pamphlets (4.9 score out of a 5 point scale), but they are slightly less positive about the comprehensibility of the pamphlets that were developed (4.1 score out of a 5 point scale);
(3) healthcare professionals indicated that a formal patient education system makes their work less time-consuming and more effective provided that patient learning groups are kept small in size, otherwise patients indicated that they prefer speaking to a doctor individually during a healthcare visit.

4. Conclusions

Implementing improvements will be the aim of our continued effort after initial project completion to include the development of additional more focused educational materials and improvements to the delivery of the educational program itself based on the questionnaire recommendations noted above. We think that the educational project could be improved if in future:

(1) a cholesterol-related class would be added to the program;
(2) pamphlets would be peer-reviewed for readability and comprehension;
(3) training in understanding and interpreting health-related numerical information would be added to the program;
(4) patient groups should be limited to 5-7 persons instead of the typical 12-15 members attending each class during the initial project. Attending the patient classes has become very popular among the patients in Lviv Regional Cardiology Center but it remains important to keep each class size small for improved communication.

Both Ukrainian health care professionals and consumers have responded positively to the idea of continuing these patient education services. The increasing number of participants in this project is further evidence that the initial conjoint cardiovascular project we have described has dealt with important topical and meaningful health issues and concerns of both the

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healthcare provider and the consumer populations in Ukraine.

5. References

[1] C.D. Norman and H.A. Skinner, eHealth Literacy: Essential Skills for Consumer Health in a Networked World, J. Med Internet Res, 2006 Apr–Jun; 8(2): e9, Published online 2006 June 16. doi: 10.2196/jmir.8.2.e9

[2] Institute of Medicine, authors, Health Literacy: A Prescription to End Confusion, The National Academies Press, Washington, DC, 2004.

[3] C.D. Norman and H.A. Skinner, eHEALS: The eHealth Literacy Scale, J. Med Internet Res, 2006 Oct–Dec; 8(4): e27, Published online 2006 November 14. doi: 10.2196 /jmir. 8. 4. e27

[4] Q.T. Zeng and T. Tse, Exploring and Developing Consumer Health Vocabularies, Journal of the American Medical Informatics Association, 13, 24-29, 2006.

[5] I. Berezovska, The Use of Proper Terminology as a Prerequisite for Effective Information Retrieval in Biomedical Databases, Proceedings of the workshop on Information Support in Health Care Services, Biomedical Research and Education, Liga-Press, Lviv, 123-125, 140-159, 2002.

[6] M.C. Sievert, T.B. Patrick and J.C. Reid, Need a bloody nose be a nosebleed? or, lexical variants cause surprising results, Bull Med Libr Assoc, 89(1): 68–7, 2001.

[7] How to Understand and Interpret Food and Health-Related Scientific Studies, Review from the International Food Information Council Foundation.

[8] J. Burkell, What are the chances? Evaluating risk and benefit information in consumer health materials, J. Med Libr Assoc., 92(2): 200–208, 2004.

Itinerant Chemistry History Museum - Discussions on "Biotechnology"

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Abstract. The approach on the subject 'biotechnology' by the Itinerant Chemistry History Museum includes the explanation of the theme to demystify the term and the science that is involved with it, together with the development of easily executable experiments using readily available materials for demonstration of the concepts.

Keywords. Biotechnology, Beer, Museum.

1. Introduction

In recent evaluation by PISA (Programme for International Student Assessment) carried out with 15 year-old students all over the world, it was shown that Brazil had the worst performance in sciences among countries with similar economic and geographical situation, like Argentina, Uruguay and Chile [1]. For the authors, some of the important facts for this lower performance are the lack of interest in science by the students and the high deficiency of teachers with specific formation in sciences.

Regarding the lack of interest in sciences [2], research done in 2007 by the Ministry of Science and Technology (MCT) revealed that 58% of the Brazilians interviewees have little or any interest in science and technology and 73% gets little or none information on science and technology. In both cases, the main alleged reason was to do not understand the subject (respectively 37% and 32%). In the same research, only 4% of the interviewees declared to have visited a museum of science in the last year. The 96% of the interviewees that did not visit any museum of science in the last year, 35% alleged that there are not any museums of science in their area and 12% alleged that the museums are very far, in other words, 47% alleged problems of location of the museums for not visiting them. Once science museums are supposed to be a place for dialog between the society and the scientific production [3], this absence of contact with science museums may have strait connection with the lack of interest in sciences observed for a significant part of the Brazilian teenager population.

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Low salaries and inadequate work conditions has shrunk the number and skills of teachers in sciences to inadequate numbers, been necessary even to count on teachers without specific formation for the discipline that they teaches. For secondary schools, only 9% of physics teachers and 13% of the chemistry teachers have academy degree in the discipline that they teach [4], to this point it is common that history or portuguese teachers goes on science teaching. This lack of specific formation may be one of the components responsible for students' low motivation by the inability to do experiments that could connect theory with reality. Together with this deficiency in the science teacher formation, we must to consider the inadequate structure of the schools for practical activities.

The "Itinerant Chemistry History Museum" (ICHM) appears in this context to deliver experiments that could promote historical background to theoretical concepts and its link to day by day life and technology. Allchin demonstrated that historically backgrounded experiments may be more efficient than the usual experiments in teaching of sciences [5]. The historical approach adopted by the ICHM is clearly stated in the declaration of I.I. Rabbi, physics professor of the University of Columbia, in "Project Physics" first page [6]:

"I propose that science be taught, at whatever level, from the lowest to the highest, in the humanistic way. It should be taught with a certain historical understanding, with a certain philosophical understanding, with a social understanding and a human understanding, in the sense of the biography, the nature of the people who made this construction, the triumphs, the trials, and the tribulations."

The experiments are planned to be low cost and easy to made, employing house hold goods or ones easily available in stores. The experiments will be followed by explanations of the concepts in simple terms, in order to make them useful also by chemistry teachers without specific formation.

The experiment chosen to demonstrate biotechnology was brewing. Beer was probably discovered by the sumerians in the year 9.000 B.C. it is believed that stored grains, especially barley, were observed to become sweet if in contact with water. That happens due to the action of enzymes that are present in the grains, which are activated with watering and convert the starch of the grain in malted sugar. These enzymes are present in larger amount in the barley. Those grains were used to make thickened porridge like soups. When left aside for some days, the porridge became effervescent and somewhat alcoholic. The fermentation occurred due to wild yeasts that converted the malted sugar of the grain in alcohol and CO_2. That was a primitive form of beer [7].

Beer had a very important role for Egyptian culture. In several documents it is mentioned the great variety of beers that existed at that time. Beer was the most mentioned food in an analysis done on the Egyptian literature. According to the legend, the beer existence might have saved mankind from the destruction. Rá, the god of the Sun, noticed that mankind was plotting against him and ordered the goddess Harthor to punish humans. Although, later, Rá was afraid that nobody would remain to worship him, due to the Harthor's great cruelty. He then prepared a great amount of beer and it dyed it red so that it was similar to blood and spread it on the fields, the spilt reflected Harthor image as in a great mirror. Admired with her own image, the goddess approached it and tried the beverage, got drunk and felt to sleep, forgetting about her bloody mission. From them on, Harthor became the goddess for beer and fermentation.

1.1. Nutrition and potability of water

In the beginning most of the beer was consumed with little time of fermentation. At that time beer had low alcoholic content compared with the current patterns, and great amounts of suspended yeast, which made it rich in proteins and vitamins. Proteins were mainly finding in meat, a scarce commodity at the transition from hunting to agriculture.

The use of hot water for the production of beer made it much safer for drinking than fresh water that was usually contaminated with microorganisms from human waste. This took no long to be noticed, if it was not possible to get clear running water from sources somewhat distant from villages, then beer was preferred for consumption. Beer was then a nutritious safe to consume liquid.

1.2. Medicinal beer

Besides being nutritious and a safe source of water, beer was also a source of medicines, and so was used by the Egyptians and mesopotamians. In Egypt the beer was used as moderate sedative, and was the base for the production of several medicines done with herbs and spices. The oldest registration about the use of the alcohol in the medicine is a cuneiform writing from Nippur, about 2100 B.C. that contains a list of prescriptions that used beer as main ingredient.

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2. Experimental

All of the experiments were designed with seeds of integral wheat instead of barley, due to it easy to find in stores at Campos of Goytacazes city, where UENF is located.

2.1. Control of the malting condition

For this experiment, it was used integral wheat, water, ordinary whitewash, absorbent paper, coffee filter paper, funnel and pots with cover.

First it was made about 100ml of saturated solution of ordinary whitewash. The solution was left to allow for decantation of undissolved whitewash. The suspension was then filtered to obtain a translucent solution. This filtration can be made with two coffee filters assembled one inside the other. The obtained filtrate, 80ml, was called original solution (OS). Half of the OS, 40 ml, was put aside for the experiment, the other half was diluted to 80ml again. this procedure was repeated twice. If no volumetric flasks are available, the volume measurement for the dilutions may be done with small coffee cups, each coffee cup holds about 40 to 50 ml. Five pots were prepared by covering the bottom with a filter paper bent three times. It was poured 40ml (one coffee cup) of water in pot 1; 40ml of the OS in pot 2; 40ml of 50% diluted OS (called OS 1/2) in the pot 3; 40ml of the 25% diluted OS (called OS 1/4) in the pot 4 and 40ml of the 12,5% diluted OS (called OS 1/8) in pot 5. One dozen of grains of integral wheat were then put in each pot and allowed to germinate.

Table 2. Identification codes for germination pots

Pot	Solution
1	Water
2	OS
3	OS 1/2
4	OS 1/4
5	OS 1/8

2.2. Fermentation as a function of stirring

For this experiment, one will need sugar, bakery yeast, water, kitassato, glass tube, basin, universal support, latex hose, heating plate with stirring and thermometer. A system for measurement of CO_2 was assembled as follows: In a basin half full of water three graduate cylinders completely full of water were carefully introduced upside down letting no air to enter the cylinders, the cylinders were clamped to the support. Each fermentation system was linked to one of these cylinders by latex hose so to bring the CO_2 formed in the fermentation to the measuring cylinder. For the fermentation, three kitassato flasks were prepared with 30g of sugar and 20g of yeast in 200ml of water for each flask. The flasks were topped and a hose was connected to the lateral opening, the other end of the hose was introduced in the measuring cylinder. All solutions were kept in 30^{o}C constant temperature. The flask 1 was kept under moderate agitation for thirty minutes. The flask 2 stood still during the experiment and was stirred at the end of the time. The flask 3 was stirred during one minute, every four minutes, summoning six stirring cycles by the end of 30 minutes time.

2.3. Fermentation as a function of grain processing

For this experiment wheat, bakery yeast, water, backer and heating plate were used. Three different systems were prepared for fermentation: (1) with grain of raw integral wheat, (2) with grain of integral wheat cooked during one hour and (3) with grain of malted integral wheat, using the conditions determined in the experiment described in **2.1**. To each flask was added a mixture of 30g of mashed grains, 200 ml of water and 10g of bakery yeast.

3. Results and discussions

3.1 Control of the malting condition

For the malting of the grain it is necessary to leave it in moisture to allow for germination and then to the transformation of starch into sugar. However, the moisture condition also allow for fungi growth, which is harmful for the process. To avoid fungi, the grains were left to germinate in the presence of whitewash. This experiment was conducted to identify what is the ideal concentration of whitewash for the control of fungi during the malting of the grains, with no influence in germination, with low cost materials and minimum of laboratory apparatus. The pot 1 (water) presented great proliferation of fungi with low development of the seeds. For pot 2 (OS), no fungi was observed, although, the germination was also low. In pot 3 (OS 1/2) the seeds had an excellent germination, and it didn't happen proliferation of fungi (Figure). It was observed that in the pot 4 (OS 1/4) happened a good germination, but large proliferation of fungi. In pot 5 (OS 1/8) few grains germinated and large amount of fungi was observed (Table).

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Figure 1. Germination results as a function of the solution with 50% from saturated solution used for hydration

Pot	Fungi proliferation	Germination
1	Yes	Not good (Fungi presence)
2	No	Not good (Ca^{2+} in excess)
3	No	Good
4	Yes	Good
5	Yes	Not good (Fungi presence)

Table 2. Germination tests results

When irrigated with water only or with low concentration of whitewash proliferation of fungi is observed, therefore the malt obtained in these conditions should not be used because of contamination risk and the interferences on flavour. With the saturated solution of whitewash fungi were not observed, although the seeds did not germinate, probably due to the high pH of the solution. The best results were obtained for the 50% dilution of the original solution. In this condition all seeds germinated and no fungus was observed. This solution was chosen for the malting of the grain.

3.2. Fermentation as a function of stirring

This experiment was done to check out for the amount of CO_2 produced in different agitation conditions at 30°C constant temperature. Some laboratory goods are required to accomplish with this experiment, especially for keeping constant temperature.

It was observed that the solution 1 did not liberate CO_2, probably due to stirring that oxygenated the solution allowing for the aerobics breathing of the yeasts that produces neither CO_2 nor ethanol. From flask 2, 136ml of CO_2 were collected, the lack of stirring allowed for yeast anaerobic metabolism liberating ethanol and CO_2. For flask 3, 92ml of CO_2 was observed, an intermediate value, in good agreement with intermediate stirring condition.

3.3. Fermentation as a function of grain processing

It was observed that no fermentation happened over two hours nor with the raw integral grain, nor with the cooked integral grain, however with the malted integral grain a constant production of small bubbles of CO_2 was observed after 40 minutes stand, evidencing the fermentation process. The fermentation did not occur in flasks 1 and 2 because the seeds are rich in starch that is not available for immediate consumption by the yeast, which prefers sugars as sucrose, glucose or maltose. On the other hand, with the malted grain, the fermentation began quickly, being noticeable by the bubbles. The fermentation happened quickly because of the malting process that converts starch into simple sugars that are readily consumed by the yeasts. For experiment with grain of raw integral wheat, after around a week, a characteristic odour of fermented beverage was noticed.

4. Conclusions

The germination experiment allows for alternative procedures, the dilution of the whitewash solutions could be done with smaller gaps, allowing for better precision in the determination of the best concentration for the malting process and better visualization of the results. It is an introductory exercise to the scientific methodology and allows for interdisciplinary approach with the biology.

The fermentation with stirring experiment is of easy execution, despite of the need for some laboratory goods, and allows observing, in one hour time, the effects of the introduction of oxygen in the fermentation system.

The fermentation as a function of grain processing experiment allows visualizing the importance of the malting process in the fermentation of grains, attributed to the alteration of the chemical composition of the grain.

The proposed experiments permit flexible execution conditions, in spite of some experiments that need some laboratory apparatus for its accomplishment. The execution easiness of the suggested experiments incites the students to reproduce them varying the conditions, stimulating the interest for the experimental practice.

 ISBN 978-989-95095-3-5

5. References

[1] http://www.estadao.com.br/ext/especiais/2007/11/oecd.pdf
[2] I.C. Moreira and L. Massarani, Percepção Pública da Ciência e Tecnologia no Brazil. http://www.mct.gov.br/index.php/content/view/50875.html
[3] P. Rodari and M. Merzagora, The role of science centres and museums in the dialogue between science and society, Journal of Science Communication; 6(2):1-2, 2007.
[4] A.I. Ruiz, M.N. Ramos and M. Hingel, Escassez de Professores no Ensino Médio: Soluções Emergenciais e Estruturais, http://portal.mec.gov.br/cne/arquivos/pdf/escassez1.pdf
[5] D. Allchin, History of Science-With Labs. Science and Education 1999;8:619-632 *apud* A. Stinner, B.A. McMillan, D. Metz, J.M.Jilek and S. Klassen, The Renewal of Case Studies in Science Education, Science & Education, 12:617-663, 2003.
[6] The Project Physics Course. 1st edn. New York: Holt, Rinehart & Winston; 1970 *apud* G. Holton, What Historians of Science and Science Educators Can Do for One Another. Science and Education, 12:603-616, 2003.
[7] T. Standage, História do mundo em seis copos, Jorge Zahar Ed, Rio de Janeiro, 2005.

The Wonderful World of Crystals

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Abstract. We, as educators, are considering that a pupil is like a gem stone, which needs to be daily polished. After years and years of careful work, the diamond will finally shine and will be a real wonder. In the project "The wonderful world of crystals", we tried to involve many pupils, who studied and created interesting things about crystals. Our lessons have started at the Mineralogy Museum in Bucharest, where there is the most beautiful collection of crystals in Romania.

We were fascinated of what we have seen there and we further discussed about the importance of crystals, and then tried to improve our knowledge by reading books and searching on the net.

We then continued the lessons in the Science Museum and further in the Natural Sciences Museum in Bucharest.

After visiting the two Museums, the pupils were divided in groups of four, according to their preferences: each group has chosen a scientific, philosophic, or artistic topic to study, all about the fascinating world of crystals.

After studying the crystals from different approaches, the groups prepared their presentations. Finally, each group received the appreciation from their colleagues and from the teacher.

Some of them achieved even CD's with crystals, others shaped the crystals as good they could, others even have written poems - published then in the school journal or uploaded on school site.

They have presented everything they have learned about the crystals: shapes, properties, photos, movies, etc. Some presented the experiments with chemical properties of some crystals and made movies with their work. Others presented physical properties like solving crystals, re-crystallizing, growing crystals, piezo-electric properties, liquid crystals, and so on. Some presented the colour and shining properties with scientific explanations. Others studied about crystals -therapy and Feng Shui as a medical application. Some studied the historical background of crystals as geographical issues.

Some of the pupils created models of crystals, using items found in the houses or simply growing themselves the crystals. All tried to find examples, to describe the beauty of

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crystals, in poetry or prose as well as in paintings or photography or even in architecture. And – as the most important - some of the students tried to create some works of art or poems about crystals and life. As a coordinator teacher I highly appreciated the results of their work.

Strategy for Innovation and Quality in Research

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Abstract. Working for the implementation of Lisbon strategy, the paper is dealing with the strategy adopted in a research institute in order to improve the quality of the research activity, both as working conditions and the quality of the scientists. Both aspects are important as the scientific activity means innovation and to improve the quality of the endowment is a need to be able to assure the performance; on the other side the ever interest to improve the quality of the young scientists means to develop the different opportunities: access to grants, conferences, working stages, conditions to continue the activities initiated during the PhD. The paper presents some statistics regarding the evolution of the institute in this respect.

Keywords. Implementation of Lisbon Strategy, Innovation, Young Scientists, Performance.

1. Introduction

1.1. S&T Characteristics in Romania

In order European Union to become the most competitive economy in the world the "Lisbon Strategy"stresses the need for an accelerated scheme for economic development based on science, technology and innovation (S&T&I) and implicitly unification. The objective according Lisbon strategy is the investment in research to reach 3% GDP.

Romania's aim is to meet the requirements related to the harmonisation with the Acquis Communitaire and the full integration of Romania into the European System.

The process of Romania access to EU was initiated much earlier than 2007 and education and science were among the first chapters to be worked. Moreover the international contacts made the work to be done faster.

The regulations introduced and the obligation to respect them pushed the things forward and the approach of funding by competition represented an important opportunity for the institute: the high expertise of the scientists allowed to promote many projects and to improve the working conditions and the scientific endowment

Recently accepted as full member of the EU Romania make efforts to valorise the tradition in science and technology enhancing the new market-oriented management skills.

The delay of Romania with respect to EU is due to the long transition from a command based economy to a market economy, from the investment based economy towards a knowledge based economy.

In the last years the alignment to the EU standards by adopting the research funding based on project competition allowed an impressive improvement in the status of the research. The partnership in the international projects in FP6 and FP7 is another opportunity of real progress for Romania.

1.2. Results in INFLPR

The institute, we are talking about has a quite long history, as it derives from the former laboratory "Optical Methods in Nuclear Physics" of the Institute for Atomic Physics founded in 1956, the topics being mainly high resolution spectroscopy. In 1996 it was accredited a national institute www.inflpr.ro the main goals being to develop research in using lasers in different applications, plasma treatments to enhance the hardness of materials, accelerated beams for medical applications a.s.o.

The management of the institute was conceived as to develop both the human resources and the quality of the scientific act by access to modern endowment.

1.3. The human resources

As regards the human resources policy the goal was to rejuvenate the scientist corpus, to enhance its expertise and to establish a right report between the scientists and auxiliary personnel.

Nowadays, the average age of the scientists in the institute is 39 years.

The policy adopted by the institute was to employ the best graduates from the Faculty of Physics or engineers in IT, electronics and chemistry to be involved in international projects. They have the opportunity to continue their formation as professionals by PhD stages, or post doc stages in the prestigious laboratories

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from different universities and research institutes, to develop their personality by having their own responsibilities in the project development. Since 1996 it became the National Institute for Lasers, Plasma and Radiation Physics[1].

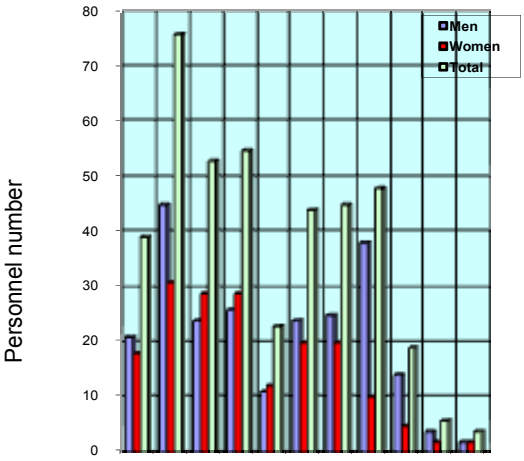

Figure 1. Personnel configuration in INFLPR by 2007

The senior scientists from the institute have the opportunity to developed academic activities as well, at the Faculty of Physics from Bucharest University by giving special courses organized for last year's students, while the young collaborators prepare practical works, based on their experience acquired in the research laboratories. In this way the students are helped to be in contact with up-dated endowment, measuring instruments and be in contact with elder colleagues, who could share their experience acquired abroad and during the common works in the professional teams.

The system is flexible and much more efficient. These young scientists are stimulated to promote in the professional hierarchy by organizing promotion competitions. The human resource evolution is one of the most important tasks of the institute, since nowadays Romania could take profit from the opportunities offered by EU to access the development funds. To be able to obtain project finance it is necessary to have a qualified labour force and this is possible in the scientific institute, using the experience of the senior scientists and contributes to the formation of the new ones.

The promotion is made based on publications in the ISI journals and in this respect the institute has a very prodigious activity which was recognized in the national competitions. The research funding based on the system of participation in the competitions represents the opportunity to obtain money for investment and also for human resource qualification.

The contacts between the students and the senior scientists begin during the scholarship, since the Faculty of Physics is in the Physics Campus Magurele and students are interested in the special courses held by scientists, while the practical laboratory activities are coordinated by the young scientists. The students could conceive their thesis under the coordination of the scientists from the institute. The best students choose to have a job in the institute after graduation, to take profit of the opportunities offered nowadays in the field.

Many of them are already project coordinators. The young scientists having improved their professional level are encouraged to return home; they apply for all the specific opportunities offered by the National Authority for Science and Technology as grants. These grants allow purchasing up dated equipment and accessories necessary to continue the scientific activities, developed abroad and also have decent salaries [2].

The system of funding the scientific activity through competitions was very stimulating and contributed to enlarge the possibilities to improve the professional endowment as well as the working conditions in the laboratories.

Laser metrology http://metrology.inflpr.ro/ was developed in the "Laser Metrology and Standardization Laboratory" having for long time collaborations with the laboratories specialized in the topics, participation in round robin experiments, services and international expert bodies.

The mission of the laboratory is to offer metrology services as measurements and calibrations of coherent and non coherent radiation, as well as metrology services using the optical radiation as transducer.

The Metrology and Laser Standardization Laboratory is accredited by the Accreditation Association from Romania –RENAR and the accreditation as calibration laboratory according SR EN ISO/CEI 17025:2005 is in progress

Laser metrology is developed in a special laboratory accredited for control of laser based equipment used in medicine, entertainment and education.

The Centre for Science Education and Training was organized since 2006 to assist the activities to enhance the interest for science in schools and civil society. The international contacts are extended by attending international conferences and symposia by encouraging teachers to approach new forms of teaching, using the modern facilities, to attend courses for improving the professional level, to organize different events to promote talents, to make students to be involved in innovation, to promote

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the participation in the international projects and take profit of all the facilities, that EU offers to spread the good practices in teaching

Figure 2.The laboratory accredited for laser metrology

INFLPR is partner of LASERLAB-EUROPE/ 2008; about 60 scientists are involved in the 10 European projects in progress, while 25 are partners in EURATOM Program, since 2001.

The three national projects co-coordinated by INFLPR dedicated to the research infrastructure development :

1. "Capacities for Facilities" Solid State multi TW laser in femtoseconds pulses and high repetition frequency and materials processing equipment
2. "Capacities for Infrastructure 2008: Integrated centre for advanced laser technology
3. "Extreme Light Infrastructure" Preparatory Phase/FP7

The interaction between hyper intense laser pulses and matter is approached experimentally [3] and theoretically, as well [4,5]. Very recent topics as "advanced femtosecond laser beams for metamaterials and photonic crystal nanostructuring " is of high interest in co – operation with other scientific groups from Romania and abroad. Integrated Centre for Advanced Laser Technologies Based on the experience already acquired the very recent project is the organization of an integrated centre for advanced exploratory and frontier laser photonic technologies. This centre of advanced research in photonics is the single one in Romania and in South-Eastern Europe.

The activity will be focused mainly on frontier research on the interaction of hyper intense laser beams with the matter.

Figure 3. Experimental set-up for direct fs laser writing

The Centre will contain 3 laboratories :

1. Laboratory for frontier research on the interaction of hyper intense laser beams with the matter
2. Laboratory for advanced, frontier technologies by photonic processing using lasers
3. Laboratory for investigation in photonics

The partnership in the professional associations RSP (Romanian Society of Physics), SPIE (Society for Photo-Optical Engineering, EOS (European Optical Society, British Carbon, etc. represents another opportunity to stimulate morally the scientists, as making them conscious about the importance of the field of activity and the responsibility of their own contributions to the top subjects.

There are collaborations with professionals from different universities or research institute all around the world, the young scientists have the opportunity to develop working stages in other laboratories, there are co-tutelle PhD activities and in the jury to defense the PhD title foreign professors are invited.

The participation in conferences and seminars as well as organizing international conferences represents other forms to enhance the professional level of the scientists.

INFLPR is organizer of the international conferences in the field: at every 3 years since 1982, the first editions "Trends in Quantum Electronics", then since 1994 «ROMOPTO» reporting the most important results in optics and applications of lasers. INDLAS is another international conference organized each year to

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report the industrial applications of optics and lasers.

INFLPR has quite a long experience in organizing the international conferences in the topics ROMOPTO since 1994 (and the previous 3 conferences "Trends in Quantum Electronics" since 1982) and recently INDLAS. A sharp priority in the institute is to valorise the most prominent ideas and the scientific results able to become useful tools or technological processes. The two devices produced have been exposed at "Hannover Messe 2008" and at the "European Sallon of Research and Innovation" on June 5-7 Paris-Porte de Versailles:

- DTL medical laser designed to be used in physiotherapy, medical rehabilitation, rheumatology, dermatology, sport medicine
- DTL ophthalmologic model
- the deposition of thin and thick layers of Tungsten by using "Combined Magnetron sputtering and Ion Implantation" a process of simultaneous magnetron sputtering and energy ion bombardment. Hard nano composite coatings of nc-Ti_2N/nc-TiN, 10 nm grain size,2,500-4,000 HV0.1hardness and 10-30 μm thickness had been deposited on cutting tools enhancing the life time up to 12 times[6].

2. Characteristics

As a result of the periodical ion bombardment the following effects occur:

- An increase of the surface mobility of the deposited atoms which leads to a high densification of the layer. Using a titanium magnetron target, nc-Ti2N/nc-TiN nano-composite layers with a hardness of 30 ÷ 50 GPa have been obtained.
- A featureless, extremely dense, pore free nano-structure is produced. The typical columnar structure of TiN does not exist anymore. TEM analyses have shown crystallites with a size of less than 10 nm.
- A stress relief at the interface and within the layer. Due to this effect, layers with a thickness of 10 – 30 μm have been produced.

Figure 4. Industrial Unit for Tungsten thin films deposition by "Combined Magnetron Sputtering and Ion Implantation"(CMSII) technology

3. Applications

A. Synthesis, characterization and testing of nc-Ti2N/nc-TiN for tooling applications - Nano-composite nc-Ti2N/nc-TiN coatings with a thickness of 8 – 12 μm and a hardness of 2500 - 4000 HV0.1 have been deposited on high speed steel and cemented carbide milling cutters. As a result of this coating, their service lifetime increased by approx. 300 % when steel components has been processed. For particular turning cutters working on bronze B11G21 and aluminium alloys the service lifetime increased up to 1200 %.

B. 10 μm W coating of CFC (Carbon Fibre Composite) tiles for thermonuclear fusion applications.
This unit is supposed to be used to deposit tungsten layers on 1 000 CFC tiles for Joint European Torus (JET) wall in the frame of the EURATOM Programme. JET is the biggest Tokamak in the world. The deposition chamber (Φ 800 x 750mm)is equipped with 24 magnetrons and provides a useful volume of Φ420x370mm. CMSII technology was selected by competition among other nine PVD and CVD techniques as being the single able to produce tungsten coatings withdrawing the thermal tests without delamination

C. 10 μm W coating of particular components for a low pressure plasma electron source. In order to improve the discharge stability at high temperature the plasma chamber walls are coated with approx. 10 μm W by CMSII technology.

D. 5 – 10 μm Cu coating of alumina wafers for microwave components

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4. Conclusions

The paper suggests the efforts of the managerial body to align the policy of a research institute to the nowadays realities, to integrate the scientific activity into the national economy to accomplish the international agreement in the field and finally to contribute to build a knowledge based society in Romania

5. References

[1] The White Book of Research, Development and Innovation in Romania-2006, CTI-IRECSON – ISBN 973769410-4, 19-23, 2006.
[2] Public Service Review: European Union, issue 14, 168-169, 2007.
[3] R. Dabu, "Optical Parametric Oscillators and Amplifiers", in Encyclopedia of Optical Engineering, Editor Ronald Driggers, U.S. Army Research Laboratory, published by Marcel Dekker, New York, 2004.
[4] A. Popa, "From Quantum to Classical Effects in Interactions Between Electrons and Very Intense Laser Beams", IEEE Journal of Quantum Electronics, Vol. 43, December 2007.
[5] A. Popa, "Accurate calculation of high harmonics generated by relativistic Thomson scattering", Journal of Physics B: Atomic Molecular and Optical Physics, 41,(2008), 015601(7pp)doi:10.1088/0953/075/41/1/015601
[6] C. Ruset, E. Grigore, H. Maier, R. Neu, X. Li, H.Dong,R. Mitteau and X. Courtois, «W Coatings Deposited on CFC Tiles by Combined Magnetron Sputtering and Ion Implantation Technique, 11th International Workshop on Plasma-Facing Materials and Components for Fusion Applications (PFMC-11), October 10-12, 2006, Greifswald, Germany, Phys. Scr. 2007, T128,1174, doi:10.1088/0031-8949/2007/T128/033

Hands-on Activity as a Source of Motivational Effectiveness of Learning Tasks in Science Education

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Abstract. Learning tasks are very important part of science education. The teaching/learning technology based on constructivism considers students' heuristic hands-on activities crucial for effective learning process. A lot of learning task in lessons are not motivated for students and therefore have a low level of educational effectiveness. Our research discovered and proved the fact that hands-on activity is a strong source of motivational and educational effectiveness of learning tasks. We found out the taxonomy of learning tasks based on hands-on activities in science education. Concrete examples of hands-on activities into learning tasks are presented in the paper.

Keywords. Hands-on Activity, Learning Task, Motivation, Science Education.

1. Introduction

The learning task is a specific requirement set to students during learning/teaching. Learning tasks have specific form from the elementary tasks demanding only memory reproduction of knowledge to the complicated tasks demanding creative thinking. Learning tasks fulfil various functions, primarily based in the teaching phase (motivation, exposition, fixation, diagnostics and application).

One of the main science educational objectives is creation and development of skills necessary for problem solution. Not only memory knowledge is needed to understand natural phenomena and patterns but also its application during meeting with problem situation which has to be completed successfully by a student. Teachers can evoke problem situations by means of learning tasks, especially the problem ones. The significance of the learning tasks solution is emphasized by Talyzinova ([3], p. 76): "…without problems, without tasks, neither skills nor knowledge can be acquired".

Analogously to other factors of education, there is needed to assure effectiveness of application of learning tasks during teaching. Quality of learning tasks is therefore an important research topic to which is paid attention [2]. Our research into physics education in lower secondary schools with use of video-study

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brought conclusions that teachers solve the learning tasks most frequently in interactions with students, most of the learning tasks require verbal solution and experimental learning tasks are rare [7]:

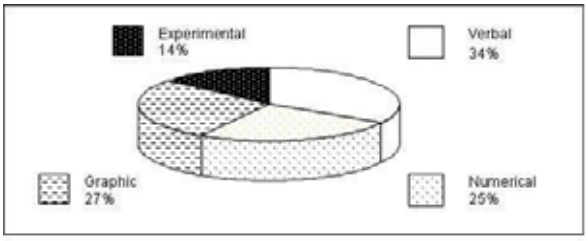

Figure 1. Frequency of types of learning tasks (form of setting and solution)

Low frequency of learning tasks based on experiments leads to low students' motivation [6]. The finding that some teachers did not even use any experimental tasks is alarming. Therefore we tried to use hands-on activity as a source of motivational effectiveness of learning tasks in physics (science) education.

2. Learning tasks based on hands-on activities

Learning tasks sorting can be based on various sorting criteria, primarily on: educational objectives, difficultness of cognitive operations needed for task solution, level of calculations use during task solution, form of task setting and solution and especially teaching phases.

Students make psycho-motor activity during the learning task solution and that's why the task serves primarily for skills acquirement. Hands-on activity in learning tasks is useful mainly during fulfilment of **educational objectives** in the form of skills. Elementary partial skills, so as reading with understanding of the task text, graphs drawing, modification of algebraic expressions, etc., are being developed during learning task solution. Partial skills form complex skill of learning task solution as a problem. Hands-on activity itself can serve as an educational objective or tool for acquirement of other educational objectives.

Tollingerova [4] classified learning tasks on the basis of Bloom taxonomy into five basic categories based on **difficultness of cognitive operations needed for learning task solution**:

1. learning tasks demanding memory reproduction of knowledge when students use memory operations,
2. learning tasks demanding simple mental operations with knowledge so as analysis, synthesis, comparison, categorization,
3. learning tasks demanding complicated mental operations with knowledge so as induction, deduction, interpretation, transformation, verification,
4. learning tasks demanding knowledge interpretation when students interpret not only the results of their own solution but also its progress, conditions and phases,
5. learning tasks demanding creative thinking based on the previous operations, ability to combine these operations into wider complexes and come to new solutions.

Hands-on activities can occur in all these groups of learning tasks but their importance grows from the first to the last one.

Learning tasks are classified as qualitative and quantitative according to the **level of calculations during task solution**. Hands-on activities belong mainly to the group of the qualitative learning tasks demanding a minimum of calculations. Appropriately connected with measurements and ICT, they can also be a part of the group of the quantitative learning tasks when an output is a numerical value of the wanted physics quantity.

According to the **form of setting and solution,** learning tasks can be classified as verbal, numerical, graphic, experimental, etc. Hands-on activities are primarily the part of the experimental learning tasks.

According to the **teaching phase**, learning tasks can be classified as motivational, expositional, fixation, diagnostics and application. Hands-on activities can occur in all these groups of learning tasks but they play the most important motivational role in the motivational tasks.

As we mentioned above, hands-on activities can be included in various types of learning tasks and they can play various roles. We focus especially on motivational effectiveness of hands-on activities in learning tasks.

3. Motivation of hands-on activities

Hands-on activities are strongly motivational activities [5]. Students are motivated mainly by the fact that hands-on activities are incentives exciting students' cognitive needs. Hands-on activities are therefore considered to be motivational education techniques [6]. The basic feature of motivational education technique is its incentive and/or impulse effect on some of students´ needs, which are excited in education.

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Every suitably chosen hands-on activity has motivational effect. This activity, mostly in the form of experiments, has strong motivational effect because the hands-on experiment becomes an incentive activating several cognitive needs at the same time. It concerns particularly the following cognitive needs [6]:

- problem solution
- senses and muscular activity
- modelling of natural phenomena

Hands-on activity could be a complex incentive in activating all these cognitive needs. This simultaneous activation of some cognitive needs can result in strong motivation of students in physics (science) education. An evidence of motivational effectiveness of hands-on experiments is also in their commercial use in form of toys both for children and adults (yo-yo, click-clack, some wooden toys etc.).

4. Motivational learning tasks based on hands-on activities

According to the above mentioned classification of learning tasks based on hands-on activities, there is a need to form these learning tasks for their application during teaching. Thus the students can be more motivated in physics and science lessons. We use our applied research to form these motivational learning tasks and divide them into groups. Concrete examples of these learning task groups follow:

4.1. Problem learning tasks

The problem based teaching is the significant innovation of science education. Psychological substances of problems determine the taxonomy of learning tasks. Motivational effectiveness of problem learning tasks based on hands-on experiments results from increasing students' cognitive needs and their consequent satisfying by way of students' active cognitive working. Psychological base of increasing cognitive needs is "perception and conceptual conflict" [1]. This conflict becomes an incentive which causes strong motivation and thus students become active which heads towards conflict elimination and satisfaction of the need. An induction of that conflict has several variants [1], namely surprise, paradox, doubt, uncertainty and difficulty.

An example of problem learning task based on hands-on experiment follows:

Problem cylinder

We glue a coin on the base of a polystyrene cylinder. The coin has the same diameter as the cylinder. Height of the polystyrene cylinder will be adapted so that only the coin extends from the surface of the water. We turn the cylinder coin down and place it in the water again. How deep will the cylinder with the coin dip?

(a) the height of an extending polystyrene is the same as the height of the coin
(b) polystyrene will not extend from the surface since the coin pulls it to the bottom
(c) the higher part of polystyrene than the coin will extend from the surface

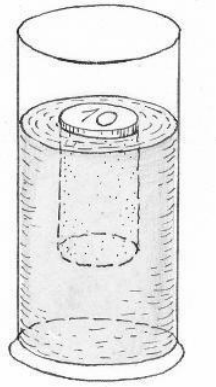

Figure 2. Problem cylinder

Correct learning task solution: (a). This is about Archimedes' principle application. Weight of the cylinder does not change during turning and therefore buoyant force and volume of the sunken part of the cylinder will be the same.

4.2 Play learning tasks

We define a toy as an object which displays a feature that is remarkably emphasized (elasticity, colour, distinctive behaviour etc.). The toy in the role of hands-on activity stimulates the needs to have sense and muscle activities. The relaxation function of the play is also remarkable. There are many toys manufactured commercially but students can create their own. We can form the play learning task based on hands-on activity and apply it in education.

An example of play learning task based on hands-on experiment follows:

Balance:

The objects with a lower centre of mass do not capsize. It is recommended to use the commercial toys, oval covers or polystyrene eggs. Explain the base of the demonstrated phenomenon.

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Correct learning task solution: The phenomenon to understand is the balance of the objects. The centre of gravity of the object is so low that it cannot be overturned.

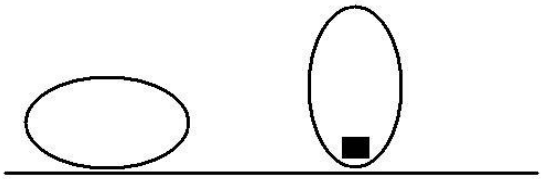

Figure 3. Balance

4.3 Modification learning tasks

Strong motivation and support of creativity development is brought by learning tasks which contain creation of hands-on activities modifications. Students are familiarized with a hands-on experiment and their learning task is to create similar hands-on experiment or, on the contrary, an experiment with additional physics phenomenon. These learning tasks are appropriate especially for gifted students.

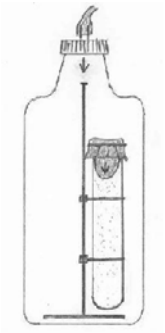

Figure 4. Overpressure

As an example of modification learning tasks based on hands-on experiment follows the learning task aimed at demonstration of an additional phenomenon:

Underpressure and overpressure:

Behaviour of an apparatus in an underpressure chamber is often demonstrated. An experiment with membrane flex in an underpressure container is well-known. Make an apparatus for demonstration of the inverse phenomenon in an overpressure chamber. How does this phenomenon appear on human body?

Correct learning task solution: Test tube covered by rubber membrane arches by overpressure in the plastic bottle. The rubber membrane simulates behaviour of ear-drum during swimming, bathing and diving. Water in ear canal pushes on ear-drum at this time. The result is deflection of the ear-drum.

5. Conclusions

Learning tasks based on hands-on activities are an important part of physics and science education. They are a source of significant motivation because they excite and satisfy primarily students' cognitive needs. Learning tasks sorting should be done according to educational objectives, difficultness of cognitive operations needed for task solution, level of calculations use during task solution, form of task setting and solution and especially teaching phase. Because of the quick increase of physics and science education efficiency, information about learning tasks based on hands-on activities should be inserted into both pre-service and in-service teacher training.

6. Acknowledgements

The paper was created and supported within the project projects "Special Needs of Pupils in Context with Framework Educational Program for Primary Education"(MSM0021622443).

7. References

[1] D.E. Berlyne, Notes on Intrinsic Motivation and Intrinsic Reward in Relation to Instruction, In: H.F. Clarizio, R.C. Craig, W.A. Hebrens, Contemporary Issues in Educational Psychology, London, 1977.

[2] D. Leutner, H.E. Fischer, A. Kauertz, N. Schabram, J. Fleischer, Instruktion-spychologische und fachdidaktische Aspekte der Qualität von Lernaufgaben und Testaufgaben im Physikunterricht. In Thonhauser, J. (Hrsg.). Aufgaben als Katalysator von Lernprozessen. Münster, New York, München, Berlin: Waxmann, 169-181, 2008.

[3] N.F. Talyzinova, Utvareni poznavacich cinnosti zaku, Praha, SPN, 1988.

[4] D. Tolingerova, Uvod do teorie a praxe programovane vyuky a vycviku, Odborna vychova, 21: 77-78, 1970/1971.

[5] [J. Trna, Motivation and Hands-on Experiments, In HSci2005, Hands-on Science in a Changing Education, University of Crete, Rethymno (Greece), 169-174, 2005.

[6] J. Trna, E. Trnova, Cognitive Motivation in Science Teacher Training, In Science and Technology Education for a Diverse Word,

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Lublin (Poland), M. Curie-Sklodovska University press, 491-498, 2006.
[7] I. Vaculova, J. Trna, T Janik, Ucebni ulohy ve vyuce fyziky na 2. stupni zakladni skoly: vybrané vysledky CPV videostudie fyziky. Pedagogicka orientace, 2008: 18(4): (in press)

Consequences of a Quadratic Law of the Lever

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Abstract. We present the discussion which exists in the literature related to Archimedes's demonstration of the law of the lever. One important aspect of the argument concentrates on the meaning of his postulates. In order to clarify this whole subject, we analyze what consequences would arise if nature followed a different law of the lever. We concentrate, in particular, in the case of a torque proportional to the square of the distances of the bodies to the fulcrum. We consider not only a linear lever but also a horizontal triangle which can rotate around a horizontal axis parallel to one of its sides.

Keywords. Archimedes, Classical Mechanics, Law of the Lever.

1. Introduction

Archimedes (287-212 BCE) demonstrated the law of the lever in Propositions 6 and 7 of his work *On the Equilibrium of Planes*. In an earlier work, [1], we quoted all his words as taken from Dijksterhuis's book, [2]. In the present paper we quote all of them from Heath's translation, [3, p. 192]: "Propositions 6, 7. Two magnitudes, whether commensurable [Prop. 6] or incommensurable [Prop. 7], balance at distances reciprocally proportional to the magnitudes."

To demonstrate these results he utilized seven postulates, [3, p. 189-190]: "I postulate the following: 1. Equal weights at equal distances are in equilibrium, and equal weights at unequal distances are not in equilibrium but incline towards the weight which is at the greater distance. 2. If, when weights at certain distances are in equilibrium, something be added to one of the weights, they are not in equilibrium but incline towards that weight to which the addition was made. 3. Similarly, if anything be taken away from one of the weights, they are not in equilibrium but incline towards the weight from which nothing was taken. 4. When equal and similar plane figures coincide if applied to one another, their centres of gravity similarly coincide. 5. In figures which are unequal but similar the centres of gravity will be similarly situated. By points similarly situated in relation to similar figures I mean points such that, if straight lines be drawn from them to the equal angles, they make equal angles with the corresponding sides. 6. If magnitudes at certain distances be in equilibrium, (other) magnitudes equal to them will also be in equilibrium at the same distances. 7. In any figure whose perimeter is concave in (one and) the same direction the centre of gravity must be within the figure."

Although the concept of the centre of gravity appears in postulate 4, it is not defined in any extant work of Archimedes. Heath, Duhem, Stein, Dijksterhuis, Assis and many others have studied how Archimedes implicitly utilized this concept to calculate the centre of gravity of many figures. For references see [4] and [5]. From these studies it seems that Archimedes understood the centre of gravity to be a point such that if the body were suspended from that point, released from rest and free to rotate in all directions around that point, the body would remain at rest and would preserve its original position no matter what the initial orientation of the body relative to the ground.

Archimedes's demonstration of the law of the lever was criticized by Mach, [6]. He thought Archimedes's demonstration was a fallacy due to the fact that, according to Mach, Archimedes had utilized the law of the lever in his demonstration. Dijksterhuis and others objected to Mach's criticism, [2, p. 289-304], [4, p. 177-185]. They pointed out the relevance of Archimedes's sixth postulate. They understood Archimedes to interpret "magnitudes equal to other magnitudes" as "magnitudes of the same weight" and "magnitudes at the same distances" as "magnitudes the centres of gravity of which lie at the same distances from the fulcrum." This interpretation conferred a reasonable meaning to the sixth postulate and removed Mach's objection to Archimedes's demonstration of the law of the lever.

We agree with Dijksterhuis's points of view. To illustrate the crucial role played by postulate 6 in Archimedes's demonstration of the law of the lever, we consider what would be the consequences if nature behaved in such a way that the law of the lever were quadratic in the distances of the bodies.

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2. A generalized law of the lever

Suppose a horizontal beam acts as a lever that can rotate around another horizontal axis orthogonal to the beam of the lever and passing through its fulcrum. We consider N bodies on one side of the fulcrum and M bodies on the other side. A generic body i has weight W_i, with its centre of gravity being suspended by the beam of the lever at a distance d_i from the fulcrum. We define a generic "alpha" torque τ exerted by these bodies as $\sum_{i=1}^{N} W_i (d_i)^{\alpha}$ and $\sum_{i=N+1}^{M} W_i (d_i)^{\alpha}$. The exponent α characterizes the behaviour of the lever as a function of the distance to the fulcrum. In real life $\alpha = 1$. In this work we wish to compare this normal condition with hypothetical situations for which $\alpha \neq 1$. To this end we postulate what we call a generalized law of the lever. That is, we postulate the following behaviour for the lever released at rest horizontally, being free to rotate around the fulcrum: If $\tau_N = \tau_M$, the lever remains in equilibrium. If $\tau_N > \tau_M$, the set of N bodies inclines towards the ground. If $\tau_N < \tau_M$, the set of M bodies inclines towards the ground.

We now consider simple symmetrical situations of equilibrium. First we have two equal weights W suspended at points B and D from a lever which can rotate around a fulcrum located at C between B and D. If $BC = CD$, the lever will remain in equilibrium for all values of α. This is our configuration (I). The lever will also remain in equilibrium for any value of α when the two weights W are suspended together at C. This is our configuration (II). That is, in this case we can replace the two equal weights at B and D of configuration (I) by a single body of twice the weight at the midpoint C without disturbing the equilibrium of the lever for any value of α. The centre of gravity of the two equal weights W_B and W_D can be considered their midpoint. Archimedes proved this fact in Proposition 4 of his work, [3, p. 191]: "If two equal weights have not the same centre of gravity, the centre of gravity of both taken together is at the middle point of the line joining their centres of gravity."

Now let us see how Archimedes demonstrated the law of the lever considering a very simple case. Consider three equal weights suspended at points A, B, and D. The lever is free to rotate around the middle point B. If $AB = BD$, the lever will remain in equilibrium no matter the value of α. This is our configuration (III). Let us call C the midpoint of the segment BD. By postulate 6 we will not disturb the equilibrium of the lever by replacing bodies B and D by a single body of twice the weight acting at C. This new configuration (IV) is a special case of the law of the lever because $W_A/W_C = BC/AB = 1/2$, or $BC = AB/2$.

Let us now assume that $\alpha \neq 1$ and our generalized law of the lever. In this case the configuration (III) continues to be an equilibrium configuration, no matter the value of α. But configuration (IV) is no longer in equilibrium. If $\alpha < 1$, the weights at C will incline toward the ground. In contrast, if $\alpha > 1$, the weight A will incline toward the ground. The new equilibrium situation according to the generalized law of the lever and the definition of the "alpha" torque is the configuration with the equal weights W_B and W_D acting together at another point E such that $W_A/W_E = (BE/AB)^{\alpha}$, that is, $BE = (1/2)^{1/\alpha}$. If $\alpha = 2$, $BE = (\sqrt{2}/2)AB \approx 0.707\,AB$. If $\alpha = 0$, the solution diverges. If $\alpha = 1/2$, we have $BE = AB/4$.

We can go from configuration (I) to configuration (II) without disturbing the equilibrium of the lever for all values of α. On the other hand, we can go from configuration (III) to configuration (IV) without disturbing the equilibrium of the lever only if $\alpha = 1$. If $\alpha = 2$, we can maintain the equilibrium of the lever only by combining the weights W_B and W_D at another point E given by $BE = \sqrt{2}AB/2 \approx 0.707\,AB$. This last situation shows that Archimedes's postulate 6, as interpreted by Dijksterhuis, would not be valid if $\alpha = 2$. This conclusion lends support to his interpretation of this postulate and to the fact that this postulate was essential in order to allow Archimedes to demonstrate the law of the lever.

3. Equilibrium of a Triangle

Archimedes also demonstrated how to locate the centre of gravity of a triangle, [3, p. 198 and 201]: "Proposition 13. In any triangle the centre of gravity lies on the straight line joining any angle to the middle point of the opposite side." "Proposition 14. If follows at once from the last proposition that the centre of gravity of any triangle is at the intersection of the lines drawn from any two angles to the middle points of the opposite sides respectively."

We now consider a generic horizontal triangle ABC with height H and base BC. This triangle can rotate freely around the horizontal axis DE which is fixed relative to the ground and is parallel to BC. We want to find the distance R

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between this axis and the side BC that will let the triangle be in equilibrium for a given value of α, with $0 < R < H$.

Our generalized law of the lever implies that equilibrium will happen when the alpha torque exerted by one side of the axis, $\int r^{\alpha} dW$, is equal to the alpha torque exerted by the other side of the axis, $\int r'^{\alpha} dW'$. Here r and r' are the distances between the rotation axis and the strips of weight dW and dW' on either side of the axis.

After performing these integrals we obtain that equilibrium will happen when [1]:

$$k^{\alpha+2} - (\alpha+2)k - (\alpha-1) = 0 . \qquad (1)$$

The constant k is defined by $k = (H - R)/R$.

For $\alpha = 1$ there are three solutions to this equation, namely, $k_1 = 2$, $k_2 = -1$ and $k_3 = -1$. Only the first solution is physically reasonable, implying $R = H/3 \approx 0.333H$. This is the usual solution of an axis passing through the centre of gravity of the triangle, which was Archimedes's solution. To demonstrate this result he also utilized implicitly postulate 6.

For $\alpha = 0$, there are two solutions to Eq. (1), namely, $k_1 = 1 + \sqrt{2} \approx 2.414$ and $k_2 = 1 - \sqrt{2} \approx -0.414$. Only the first solution is physically reasonable, leading to $R \approx H/3.414 \approx 0.293H$. This axis parallel to the side BC will not pass through the intersection of the medians. It will be closer to the base BC than the previous equilibrium axis for the case $\alpha = 1$.

For $\alpha = 2$, there are four solutions to Eq. (1), namely,

$$k_1 \approx -0.693 , \; k_2 \approx -0.546 - 1.459i$$

$$k_3 \approx -0.546 + 1.459i \text{ and } k_4 \approx 1.784$$

Only the fourth solution is compatible with the condition $0 < R < H$. We are then led to $R \approx H/2.784 \approx 0.359H$. This axis parallel to the side BC will not pass through the intersection of the medians. It will be closer to the vertex A than the equilibrium axis for the case $\alpha = 1$.

This conclusion shows once more that postulate 6 is essential to demonstrate not only the usual law of the lever, but also to find the usual centre of gravity of a triangle. If nature behaved with a generalized power law with $\alpha \neq 1$, the results demonstrated by Archimedes would not remain valid.

4. Acknowledgements

One of the authors (FMdMR) thanks PIBIC/SAE/UNICAMP for an undergraduate research fellowship during which this work was completed.

5. References

[1] Assis AKT, Ravanelli FMd. Consequences of a generalized law of the lever. Accepted for publication in the American Journal of Physics, 2008.

[2] Dijksterhuis EJ. Archimedes. Princeton: Princeton University Press, 1987.

[3] Heath TL, Ed., The Works of Archimedes. New York: Dover; 2002.

[4] Assis AKT. Archimedes, the Center of Gravity, and the First Law of Mechanics. Montreal: Apeiron, 2008. Available at: www.ifi.unicamp.br/~assis.

[5] Assis AKT. Arquimedes, o Centro de Gravidade e a Lei da Alavanca. Montreal: Apeiron, 2008.
Available at: www.ifi.unicamp.br/~assis

[6] Mach E. The Science of Mechanics, Open Court, La Salle, 1960.

5th International Conference on Hands-on Science
Formal and Informal Science Education
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Senses Built up the Students about Themselves as Learners

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Abstract. This work has as its general aim to investigate the deep hopelessness that could be learnt from the speech of three sixth grade students of a public school of Guarulhos, an industrial town in metropolitan area of São Paulo (State of São Paulo, Brazil). The specific objectives were to investigate the senses built up by the students about themselves as learners and about the reasons of their actions in the classroom. This research is based on the Social-Historical Cultural Activity Theory and it will discuss the following theoretical aspects: sense and meaning; learning and development, emotions and feelings. The data were collected during the months from October and November of 2006 in a public school in the outskirts of Guarulhos. The researcher and three students took part of this research. The methodology chosen for this dissertation had as objective to raise students' senses in order to understand their situation of hopelessness. In order to understand such matters, the following items were used as research tools: classroom data collection and video session (that were not analysed) questionnaire and interview with the focal students. In the data analysis it was used as category: surveying of theme content of researcher and students speech, the lexical choices of the participants and the interpersonal relations during the interview, focusing the verbal and paraverbal aspects. The results reveal students´ lack of hope to learn in school context, as well as the lack of significance of school for them.

Keywords. Teaching-learning, Senses and Meanings, Emotions, Affection.

Comparison between Orientation of Kindergartens Students by Traditional Distance Learning and e-Learning

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Abstract. This work compares two groups of teachers of kindergarten orientated by distance learning with two different methodologies, in an annual university discipline called Seminar. The aim of Seminar is teach to teachers of kindergarten how to implement didactic projects in biology field in their schools. The first group was orientated by traditional distance learning, telephone and e-mail, and the other group was oriented using e-learning with a page in Moodle platform. Some students prefer the new system other prefer the personal contact. But in general the students agree that an interactive page in a learning platform is very helpfully.

Keywords: E-learning Platforms, Kindergarten, Science Education.

1. Introduction

In a course for Kindergarten teachers that consists in Pedagogic and Scientific complement, the last discipline is called Seminar. This discipline develops along one year and consists in practical work done in each college by the students. The evaluations of the students were made by the written report, according by the manual [1], and by oral presentation of work and oral discussion.

The aim of this discipline is to learn the kindergartens teachers how to plain an activity and how to teach science to young kids. The students also evaluate the impact of these actions in children and involved community.

The students (kindergarten teachers) live and work in several parts of the country including Atlantic Islands (Madeira and Azores). Because of these facts the distance learning is the only possibility to have these students in the some class.

The types of work development by the students were mentioned in other paper [2]. The discipline Seminar can be considered that had four parts. The first part is where the students must fill a sheet and is where they choose the theme and made a scheme of how they intend to implement it. The second part is the application of what they propose to do. The third part is

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writing of work done. The fourth part is the oral presentation and discussion of it.

2. Methodology used

Distance learning was used. In school year of 2007/2008 the system used was essentially traditional distance learning using the telephone, e-mail and videoconference. Last year (2006/2007) a page of Moodle was put at student disposition but there were very few seeing and none put questions. By inquiry in the end of the year the students mentioned that they did not like to use learning platforms, because almost of them did not trust in it [2]. So, in this school year (2007/2008) it was decided to use a different approach for the Seminar. A page was opened in Moodle platform with information, insert of documentation and several forums to discussion. This was also done to encourage the students to share experiences between them and help each other.

3. Development of work

3.1. First part – choose the theme

When the discipline started the professor made an oral session. During this session the objectives of the discipline were presented and the methodology that will be used during the year was explained. This year, 2007/2008 the professor teach them how to use Moodle platform and turn an obligation the inscription in platform of university. In previous year, 2006/2007, they could make their inscription in platform and in discipline or not. This year all the students were insert by the professor in the page of discipline.

Initially in discipline page were open a placard of news and a forum to personal presentation (Figure 1).

Every time the professor inserted something in platform the students received in their personal e-mail a message referring it.

In Placard of News some students asked questions and solicited material to decide the theme want to development.

In presentation forum the students were encourage to mention their names, place where they live and things they like to do in free time. Some of them inserted a photo. The intention is that they start to contact each other. This was a success and all students made their presentation.

After all of them made their presentation another window was open below with the photo of manual and their index. The PowerPoint used in first session was also inserting. Were open a forum to doubts (Figure 2).

Figure 1. Page open in Moodle platform with placard of news and presentation forum

Figure 2. Page showed to students in first phase

They only participated after the professor insert a post with title “There are any doubts”. After this incentive they start to put questions about the theme. But, almost them preferred to telephone to the professor to discuss the theme individually. The reason of this was because they didn’t want that colleagues follow what they will do and had a little ashamed that the colleagues think that their doubts were not proper.

The themes chose, in this phase by students were:

Year 2006/2007

- Pine forest
- Country plants
- Vegetables gardens
- Domestic animals: cows
- Feline animals such as cats

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- Domestic animal - dogs a
- Diversity of turtles
- Zino´s petrel (bird from Madeira island)
- Monk seal - preserve
- Animals in general

Year 2007/2008:

- Vegetable gardens - its importance
- The world of aunts
- Azorean biodiversity
- Wild mammals in Portugal
- Fish and relation with environment
- Abandoned dogs
- The Azorean buzzard
- Animals in general

3.2. Second phase – development of project

In the second phase the students send to the professor the scheme and what they intend to do. They send to the professor, individually, the proposal of their work to be approved. After all the works were approved the professor inserted in page the themes chosen and the name of student responsible for it. It was open a forum to discussion between students and between students and the professor. The entire students were incentive to participate in forums and to share experiences between them. This did not result as expected. The students revealed very individualist and did not like to participate and help the colleagues.

3.3. Third phase – write the work done

When they finished the work and began to write, it was opened another item with roles to write a work, like how to refer the authors in text, rules to made references, etc. Three forums were open at that time with the titles:

- "How to made references"
- "How to made index"
- "Other doubts".

In this phase they only began to participate after the professor have inserted some messages to encourage their participation. The written works were sent to the professor by post. Some students asked if they can send it using the platform. After the deadline to send written works some students (20%) inserted their work in platform in a way that colleagues can read it.

3.4. Fourth phase – oral presentation and discussion

After the deadline to send written works, all the received works had their titles published on the page and the data of oral presentation. The intention was that they assist to colleague's presentations.

The professor opened another item with title "Advises to oral presentation of the work" and a forum to discuss it. The participation in this forum was above our expectations.

In this phase, they put some doubts in other forums and revealed that almost of them were very nervous when wrote the messages.

The presentation was made with a computer program Microsoft PowerPoint, in university installation by continental students and by videoconference for island students.

Only 50% of students assisted to colleague's presentation.

4. Conclusions

The methodology applied in year 2007/2008 conducted that these students discussed more with professor the theme to choose and the possibilities to their disposition than in year 2006/2007.

During the reading of the works written by our students it were noted that the students did not follow exactly what was recommended such as rules to text reference and references in end of work. The reasons appointed by them were that they forgot to apply the rules but all of them said that understand them.

The inquiry done after the classification revealed that student preferred individual contact, but 50 % of them said that the page was very useful. The reason appointed by them to justify not discuss the work with colleagues and share their own experiences were because they had ashamed of it.

The development of the works done by the kindergartens teachers with their children in year 2007/2008 had more visits to places outside kindergarten. Another interested point is that this year almost of them invited experts on area (subject studied) to visit kindergartens, and in last year only few done that. Of course this allowed children learn more and be more interested in project development by their teachers.

5. Acknowledgements

To all my students.

6. References

[1] Pereira, A., Miranda, B. Problemas e Projectos Educacionais. Universidade Aberta, 2003.

[2] Seixas, S., Work Done in Kindergartens by Our Students Orientated by Distance

 ISBN 978-989-95095-3-5

Learning. Proceedings of the 4th International Conference on Hands-on Science Development, Diversity and Inclusion in Science Education. 178-181, 2007.

Appropriate Technology in Biological Sciences for Developing Countries – A Do It Yourself Program

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Abstract. Instrumentation plays an important role in the development of Biological Sciences. Educators and researchers in countries under development have difficulties with instrumentation due to inadequate training and lack of funds to purchase, install, maintain and repair their equipment. The objective of this Program is to divulge alternative techniques, models and instruments many of which are simple, low cost and can be built using parts and resources which are available locally. This information on how to do, is supplied in form of blueprints. This paper describes how the program works.

Keywords. Appropriate Technology, Biological Sciences, Equipment.

1. Introduction

One of the problems which countries under development confront is lack of appropriate technology to manufacture equipment used in science laboratories. This forces institutions to import ready-made equipment or to pay royalties for purchase of know-how. In the field of Biological Sciences, most of the equipment used in these countries is imported from diverse origins with precarious repair and maintenance facilities. The funds that educational institutions can spare to equip laboratories with equipment are always scarce and limited, and when the time comes to repair, the situation is worse due to lack of adequate planning and stocking of spare supplies. There is also a shortage of trained people to carry on the repairs. Various alternatives exist to fulfil the increased demand of equipment:

(1) Importation of equipment according to demand. This requires foreign exchange, payment of custom duties, necessity of ordering and stocking spares etc.
(2) Manufacture under payment of royalties. This also implies evasion of foreign exchange and the technology transfer is never complete.
(3) Manufacture locally. Although attractive it is not always feasible. First of all there must be an adequate demand for the product. There is a need of an investment to build the manufacturing unit, of technical know-how, and of a marketing infrastructure. Insufficient demand leads to increase in the price of the product.

The establishment of a local industry to satisfy the limited demand of equipment of a few research and teaching institutions in underdeveloped countries really poses the question if it would be feasible to manufacture certain types of equipment with a limited demand in an industrial scale.

An option would be to each user to construct some of the simple equipment he would need, making use of locally available resources.

This alternative approach of matching equipment to local constraints and resources lead us to implement a “DO IT YOURSELF” program for Biological Sciences. This project has as its principle aim to help educators and researchers, and teach them how to choose, test, calibrate and carry basic maintenance procedures on their equipment.

2. General objectives

(1) To encourage educators and researchers to know better the equipment they use.
(2) To help to substitute some of the imported equipment by constructing them using locally available resources.
(3) To advise equipment users on the choice, purchase and maintenance of their instruments.
(4) To divulge information on what has been published on how to construct instruments.
(4) To further an exchange between teachers and researchers with a view to solve common problems.

3. Specific objectives

(1) To develop low cost Instruments/ prototypes, and techniques.
(2) To prepare “blueprints” of developed prototypes and distribute them among users.
(3) Test, evaluate and improve prototypes of instruments which have already been developed.

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(4) To examine the viability of using " alternative technology" to substitute imported equipment.

4. Method of implementation and operation

(a) User access:

The way an educator or researcher has access to the "DO IT YOUR SELF" blueprints is through a regularly distributed folder listing all the blueprints available. On consulting the list, he ticks the items of interest and remits the cost of photocopy plus postage. Before ordering the blueprints, a coding system on the folder permits him to identify:

(1) If the blueprint describes a technique (T), a construction project (C), or if it is an item of general information (G).
(2) If the item demands for its execution a working knowledge of workshop practice (M), electronics (E) or both (A).
(3) If the construction project listed is difficult to construct (D) or easy to construct (F)
(4) The approximate cost.
(5) If further bibliography is available.
(6) The number of pages comprising the article.

On receiving the blueprint, if it is a construction project, it describes the principle of operation, specifies the sensitivity, range and other characteristics. A block diagram, a schematic diagram, a parts list and description for mounting the components are given next, followed by testing, calibration and maintenance techniques which are required for good performance. The user is instructed to contact, if he runs into difficulty, or needs furthers bibliography on the subject.

(b) Blueprint preparation:

Blueprints are prepared in response to user needs. A questionnaire is sent to intended users and members of biological societies to evaluate user needs. The following flowchart (Figure 1) details the steps used in the elaboration of blueprints.

(c) Blueprint characteristics:

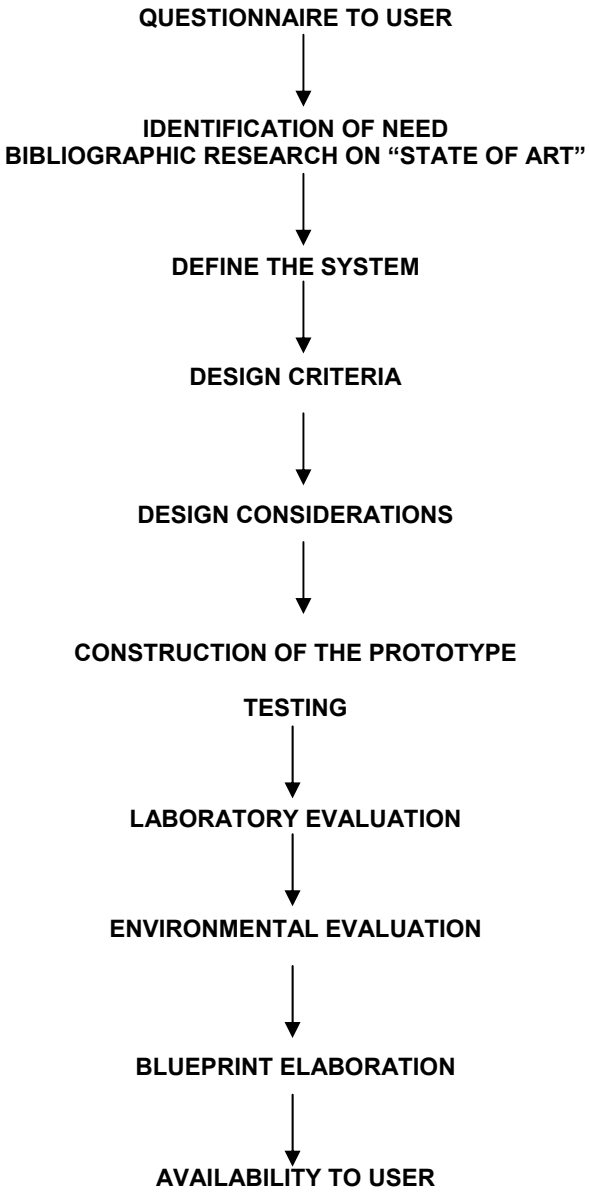

Figure 1. Flowchart for developing new instruments or techniques

In preparing the blueprints special attention is given to:

(1) Simplicity in the language of expression and terms used.
(2) Clarity in the detail of figures.
(3) Detailed specifications of the components to be utilized.
(4) Highlighting of the critical parts in the construction process.
(5) Incorporation in the instrument if a system to test (auto-diagnose) whenever possible.
(6) Listing bibliographic references which are available for consultation.

Here is a list of some of the blueprints presently available. Up to now we have 36 items available:

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CODE ITEM DESCRIPTION
CBPMF00012 - How to construct peristaltic pumps.
CCEEE00003 -How to construct a cautery.
CCDMF00S09 – How to construct Stobos-copes.
CDAAF00S06 - How to construct an apnea alarm.
CDGEF00003 - Drop detector with audio output.
CEEED00S08 - Electronic Stimulator for student use.
CFAFF00S14 - Designing electronic power supplies.
CGQEF00S04 – Modifying an electronic calculator for drop counting.
CLCAF00004 – Lighting system for small surgery.
CMVMF0002 - Venous Valves- a teaching model.
CQWMF0006 – Low cost student kymograph.
GF000000011 - Making proper use of tools.
MCQF00S10 - Guidelines for constructing instruments.

5. Conclusions

The "Do it yourself" program is an interesting and practical alternative to buying readymade (generally imported) equipment and has many attractive features: for underdeveloped.

1) It is educative:
2) It helps the user to learn how some of the instruments he uses, function.
3) It is challenging:
4) It helps the user to locate faults and carry basic repair on the equipment he uses.
5) It fosters creativity:
6) It helps the user to build some of the equipment he uses for his work. Sometimes the first result might not be perfect, but with practice it can be pretty good.
7) It saves time:
8) The user does not have to wait and depend for the arrival of purchased imported equipment.
9) It helps to save money:

By constructing the instrument by himself (or through locally available help) the user saves foreign exchange which can be spent to import equipment which cannot be easily built

The Brazil Chemistry Discovery. Itinerant Museum of the History of Chemistry - Approaching on "Food Conservation"

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Abstract. The Itinerant Museum of the History of Chemistry has the objective of complementing the science teaching in the public schools of the Rio de Janeiro State North region, introducing science practices and science history to the public school students. Teachers and students can have a closer contact with chemistry, through the adaptation of experiments for practicing in class and of the visits that we do at the schools for presentation of the developed themes. This work is about conservation of foods using spices as cinnamon and clove, and describing their properties and history. Samples of rice pudding were prepared with cloves and cinnamon under different conditions, and then compared using the emergence of visible microorganisms at the surface of the samples as a function of the time as a parameter. Both the cloves and the cinnamon, when cooked with the rice, showed activity in the control of the visible microorganisms. This activity showed great impact close to the students with the advantage of stimulating them to repeat similar experiments with other spices or seasonings.

Keywords: Cinnamon, Clove, Experiments, History of Science.

1. Introduction

The concern with a historical approach in the experiments of sciences is already known for some time. In the end of the 19th century, the Austrian physicist and philosopher Ernst Mach was a defender of this practice [1]. In the beginning of the 20th century, also touched with the problems faced by the teaching of sciences, Pierre Durheim also took the theme to the discussion, seeking to introduce the history of the science in the teaching of sciences [2].

A recent research of international assessment of the teaching of sciences quality, accomplished by PISA (Programme for International Student Assessment) with 15 year-old youths, showed discouraging results for Brazil that was in the last positions. In comparison with countries of similar economic situation and within the same region,

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like Argentina, Uruguay and Chile [3], Brazil still keeps the worst places: a solid evidence that the situation of the teaching in Brazil lacks improvements.

The result of this research, in the authors' interpretation, presents direct relationship with the lack of interest about sciences. The national research promoted by MCT in 2007, involving the Brazilian Academy of Sciences, the Museum of Life (FIOCRUZ), FAPESP and Labjor (UNICAMP) demonstrates this lack of interest [4]. The research found that, among all interviewees, 58% have little or any interest in science and technology and 73% have little or any knowledge on science and technology. The main reason answered by the interviewees in the two cases was not to understand about sciences (respectively 37% and 32%). In the same research only 4% of the interviewees visited a museum of science in the last year and of the 96% that didn't visit museums of science, 47% declared problems of location of the museums for not visiting, such as: 35% said there were no museums of science in his/her area and 12% said that the museums were very far.

Museums and science centres changed historically from a place of scientific production [5], to a place of representation of the science and finally to a mediation environment between the society and the scientific production [6]. Today a science centre or museum of sciences has as function to offer a meeting atmosphere between the scientific development and the social instances and of exhibition of the scientific accomplishments and their implications for society. Some authors have been highlighting the visit to spaces of science as valuable in the teaching of sciences and in the perception of the world, as it can be noticed in the following text:

> "*the Museums of science and technology help the visitors for, after the visit, look at the world in a different way, see things that they had never seen and, eventually, make things that they had never done because they thought they were not capable. This is the environment of the Centres and Museums of Science: the sensitization for the scientific culture, the removal of eventual "anti-scientific" blockades and the incentive of the attitudes and of the processes of the science, specifically the curiosity and the critical spirit.*" [7]

1.1. Itinerant Museum of the History of Chemistry

The Itinerant Museum of the History of Chemistry was created as an extension activity to contribute for the reversion of this situation in the Rio de Janeiro State North region, concerning chemistry teaching. Complementary to the situation presented above, regarding the public perception of science, other two factors guided the implementation of this project:

a) Poor chemistry teachers' qualification, mainly among those without specific background, resulting from the lack of chemistry teachers in the high-school [6]. In addition to the insufficient use of science history in the teaching of sciences, a powerful instrument for this purpose [8-9], this problem motivated the creation of courses of educational improvement starting from the historical approach of chemistry concepts studied in the high school, currently under implementation with the help of Regional Coordination of Rio de Janeiro State North Teaching I.
b) Museums of sciences with chemical approach have some problems that avoid its wide use, as development cost and maintenance of the modules, safety and management of the residues. [10] The Itinerant Museum of the History of Chemistry works four themes, present in the life of people that make possible the approach of scientific concepts in the high school. The themes approached by the museum are:

- **Candle:** Reproduction of the experiments of the book "the chemical history of a candle" of Michel Faraday, approaching the evolution from the raw material of the fat to the paraffin and production of didactic texts for understanding of chemical concepts,
- **Beer:** Experiments based on the history of the beer and production of didactic texts for understanding of the chemical concepts,
- **Soap:** Experiments based on the history of soap. Preparation of soap from ashes and soda and development of attractive experiments involving surfactants action. Production of didactic text for understanding of the chemical concepts.
- **Conservation of foods:** Techniques of conservation of foods. Development of easy-to-make experiments with spices, salt and smoking, and production of didactic texts for understanding of the chemical concepts.

The great concern of the museum is to develop low cost experiments, with little or no danger and of easy handling to make possible the replication at home or at the schools, and to help in the understanding of science history in practice.

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1.2. Conservation of foods

At this paper we will describe the work based on the theme Conservation of foods.

1.2.1 Historical context

Traditionally, the word "spice" didn't designate, specifically, any seasoning used at the kitchen, but just the exotic products, mainly, from India. These products were marketed intensely, therefore they were to disguise odours of the foods in rotting, they gave a pleasant flavour and they still symbolized status. Besides, the spices were so valuable that a pound of dry pepper (approximately 454 grams), for instance, was enough to buy a servant's freedom [11].

Between the centuries XI and XIV, during the feudal system, the farmers' exploration was remarkable. Problems such as climatic alterations and terrible crops resulted in low agricultural productivity and high prices of the products. The exhaustion of precious stones also generated economical difficulties. This picture had as consequence revolts, escapes and farmers' protests [12].

In addition to these problems, the epidemic of black plague killed about 1/3 of the European population. The pains were very strong, and death could happen within five days after the manifestation of the first symptoms. Everything that left the body of the patient, breath, perspiration, blood of the lungs, had very bad smell. Exotic medicines were prescribed by the doctors as serpent minced meat, myrrh, saffron, pearls or triturated emeralds, powder of gold and mainly mixing done with rare spices. It was already demonstrated at that time that some patient estimated the therapeutic value of the medicine for its cost [13].

The physicians used spices (Figure **1**) as prevention against the plague, because it was believed that the propagation of the disease was through "humours" emitted by the patients and the bodies in decomposition. The "humours", according to the faith of the time, would be the transmitters of the disease, hence the use of spices to filter them. [14]

The social, economic and health crisis were the starting point to understand the transition process from Feudalism to Capitalism. The servants, that then were "free workers", possessed neither machines nor other goods, so they were soon forced to sell their workforce in exchange of money. It was in that context that the Europeans rushed to the marine discoveries. The trade of the spices and consequently the flavour, the smell and the properties of the molecules in them contained, they were one of the motors of the Discoveries Age.

Figure 1. Representation of the physician prepared to have contact with the sick people. The beak at the mask was filled with spices

The several seasonings were used traditionally to stimulate appetite, to increase digestion, to relieve the tension and to give more energy. Spices are known for a long time to possess preservative properties, as antimicrobial and anti-oxidizers. Recent studies showed that clove, cinnamon and oregano suppress the growth of Escherichia coli, present in raw meats [15].

1.2.2 Chemical composition

The spices are dry, aromatic or spicy parts of the plants. They contain a volatile oil (also known as essential oil) and they are used mainly as seasonings, and do not like food. Although the chemical constitution of the volatile oils is much differentiated, they have characteristic odours in common and, normally, they are immiscible in water, but they are soluble in ether, alcohol and in the most part of the organic solvents.

The essential oils of some seasonings have inhibits the growing of microorganisms in meats, sausages, breads and juices, but in order to have this kind of effect, they would be necessary very big amounts of spices in the food, what would result in an unpleasant flavour.

1.3. Cinnamon

Cinnamon (Figure **2**) is derived of the dried inner bark of a tree that belongs to the laurel family. The tree is native of Asia (Sri Lanka), and, therefore, cinnamon was an article in the trade of spice from East to the West. Cinnamon was valuable for Egyptians for embalming and for culinary purposes. Cinnamon was described

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as magic, being used in love potions and also in medicines, a drink prescribed for colds by a Roman doctor - hot liqueur and cinnamon - it is still in use today. Formerly the cinnamon was more precious than gold. Cinnamon was a long time an essential ingredient in the Moroccan and Greek chicken and beef serves, and in Middle East it is usually used with meats, especially lamb. [16]

Figure 2. Picture of cinnamon - Cinnamomum zeylanicum [16]

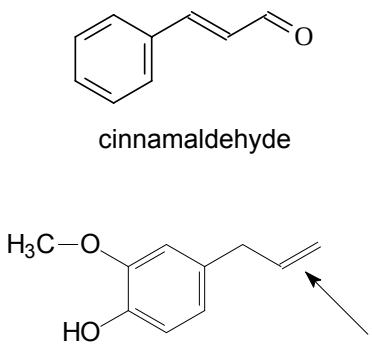

Figure 3. Representations of the molecular structures of Eugenol (below), and cinnamaldehyde (above)

Cinnamon is a spice since ancient times in the History, and its use is told since the biblical times as in Exodus 30:23, "*Take also for yourself the finest of spices: of flowing myrrh five hundred shekels, and of fragrant cinnamon half as much, two hundred and fifty, and of fragrant cane two hundred and fifty*" or in Proverbs 7:17, "*I have sprinkled my bed With myrrh, aloes and cinnamon*".

They possess pleasant smell, sweetened flavour and they are slightly spicy. They come commercially in peels or powdered. The cinnamon has an essential oil of the leaf, rich in eugenol and the one of the peel, rich in cinnamaledehyde (Figure **3**).

Studies were accomplished with cinnamon for the combat to the effects of the diabetes melitus type 2. It was verified the improvement in the cholesterol tax and significant reduction of sugar in the blood with the ingestion of around 3 grams of extract of cinnamon daily. It is not known for sure if the consumption of cinnamon is effective in the combat to the arterial hypertension. There are three studies in process monitoring the subject of the effect in the blood pressure. [17]

1.2.2.2 Cloves

Cloves (Figure **4**) the dried buds of trees originated in the Moluccas Islands in Indonesia, during a long time called also as Spice Islands. Centuries before the birthday of Jesus Christ, cloves were used by the Chinese, Egyptians, Greeks, and Romans. The name "clove" comes from the Latin word clavus, which means "nail" and describes its appearance. The Portuguese were the first from the West to reach the Spice Islands and create a monopoly on the clove trade. [18]

Figure 4. Picture of cloves: Syzygium aromaticum [19]

The main fragrant substance present in its volatile oil is the eugenol. Plants produce strong aromas to protect from insects and herbivore animals that suck its sap or eat their leaves, the eugenol besides contributing with its pleasant smell, still acts in the combat to the natural enemies.

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1.2.2.4 Pepper

Figure 5. Picture of pepper: Capsicum annuum [20]

There are different colours, sizes and forms of peppers that are present in the several species of the gender Capsicum. The capsaicine ($C_{18}H_{27}O_3N$) and the piperine ($C_{17}H_{19}O_3N$) they are the responsible active ingredients for the spicy sensation when we ingested it. (Figure **6**).

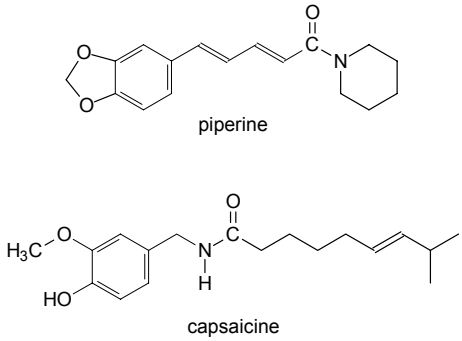

Figure 6. Representations of the molecular structures of Piperine (above), and capsaicine (below)

Some peppers present more piperine in its composition, as for instance the pimenta-do-reino, as it is called in Brazil, has more piperine while the chilli pepper has more capsaicine. However, both are quite burning, what can be explained by the similarity of their molecules.

Each pepper has characteristics of different flavour. The essential oil gives the flavour, while their piperine molecules and capsaicine give the pungency. Peppers contain potassium, calcium, sodium, magnesium and iron.

Good chemical reasons explain why we ate and we liked pepper. After we ingest a spicy meal, the brain produces as natural answer to the pain, endorfine that satisfies us of pleasure. The larger the amount of responsible capsaicine for the pungency of the pepper, the larger the pain, in other words, the larger the amount of produced endorfine and the larger the final pleasure.

Besides, the chilli peppers had a lot of therapeutic use and a lot of folkloric importance. The Inca considered them as sacred plants and they used them in offers to the gods, they also used to repel sorceries. Before Columbus, Indians mixed pepper with other ingredients for sore throat, coughs, arthritis, acid indigestion, ear pains, to improve the vision and to facilitate the childbirth.

In India and China, pepper is used thoroughly to improve circulation and to improve hypersensitivity to catch a cold, coughs, asthma, kidney inflammations, and muscle and committee pains.

2. Experimental Part

Chemistry teaching is a great challenge in the public schools, taking into account the lack of structure for practical lectures. In this work we propose an interdisciplinary experiment, easy, low cost and low risks, in order to involve and to motivate the student on the discussed subject. The experiment is based on the adaptation of a popular plate of the Brazilian cookery, the rice pudding, "*arroz-doce*" in native language, added of some spices and left out of the refrigerator to deteriorate. The comparison of the time for the emergence of signs of microorganisms was the parameter of the antimicrobial efficiency of the spices.

2 g of recently-grated cinnamon were used, 2 g of clove, 2 g of powdered cinnamon, 350ml of solution of sugar of concentration of 40g.L^{-1}, beakers of 100ml, heating plate, plastic pots and 140g of rice.

Was added in each beaker, 50ml of sugar solution and they were heated to the boiling. After the boiling, 20g of rice and 1 gram of spice were added in each beaker, except for the standard sample, cooked without spices (Figure **7**). The prepared samples were the following ones:

a) standard Rice pudding, without spices.
b) Rice pudding cooked with recently-grated cinnamon.
c) Rice pudding cooked with expired powdered cinnamon.
d) Rice pudding cooked with cloves
e) Rice pudding just added of expired powdered cinnamon at the surface after the preparation of the rice pudding.
f) Rice pudding just added of cinnamon recently-grated after the preparation of the rice pudding
g) Rice pudding just added of cloves at the surface after the preparation of the rice pudding.

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Figure 7. Samples preparation step, with and without spices

The rice was cooking during 30 minutes. After the cooking, the samples were cooled to room temperature, and transferred for plastic pots, covered with plastic film.

It is important to emphasize the flexibility of the experiment, because the cooking can be done in stove and the spices or seasonings can be chosen as a function of the habits of the students' region.

3. Results and discussion

3.1. Recommendations

All the experiments had as comparison parameter the presence of visible microorganisms in the samples of rice pudding. The absence of visible microorganisms at the surface of the sample does not mean that the sample is safe to eat, because there is the possibility of non-visible microbial forms, therefore the material used in the experiment is not to eaten. For the correct discard of the experiment, cook the used material with the microorganisms in a pressure cooker until boiling.

3.1. Spices effects

In this stage we compared the emergence of visible microorganisms at the surface of the cooked samples with and without the cloves and cinnamon.

Comparative experiments with samples of rice pudding left out of the refrigerator showed great difference in the formation of microorganisms, after five days to room temperature. As it can be observed in the Figure **8**, while it is not more possible to visualize the rice for the development of the microorganisms at the surface, in the rice pudding cooked with the cloves there is still no sign of microorganisms.

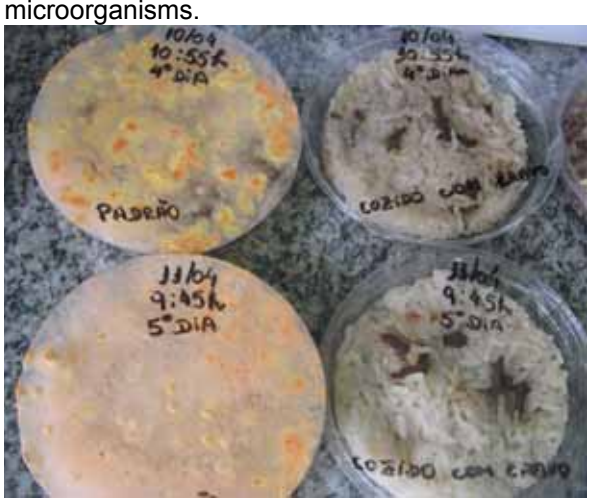

Figure 8. Efficiency of clove in the rice pudding conservation, observed after four days (below) and five days (above)

About this experiment it is important to observe that in the standard rice pudding of the Figure **8**, as well as in the prepared repetitions during the works of development of this experiment, different microorganisms are developed in each replicate. These differences happen due to the heterogeneity of the microbial population of the air that infects the samples during the cooling after the cooking. Therefore replicates done in different moments can have different results, however always with larger efficiency of the cooked samples with the clove and the cinnamon, tested in this work.

3.2. Volatility effect

Some spices are sold already grated to save the effort of their processing, as the cinnamon. Some cooks dissuade this practice due to the loss of the volatile components of these spices, preferring their grinding just before use. To test this statement with the experiments that we propose in this article, we compared a cooked sample with cinnamon just-grated with a cooked sample with cinnamon already grated and expired, to increase the contrast and the discussion with the students on the importance of the information of expiration at the foods.

As it can be observed, the cooked sample with powdered cinnamon, after expiration (Figure **9**, below) presented larger development of microorganisms than the cooked sample with just-grated cinnamon (Figure **9**, above).

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Figure 9. Evidence of the loss of active components for volatilization comparing cooked rice pudding with cinnamon just-grated with rice pudding cooked out with expired powder of cinnamon after 4 days of out of the refrigerator

This result can be explained by the largest superficial area of the grated samples that it can take to the loss of volatile substances with antimicrobial activities, as the essential oils. Another possibility is the largest superficial area of the grated spices to allow larger access of the air oxygen to the substances with antimicrobial activities, allowing its oxidation.

3.3. Kinds of addition

It is usual cover the surface of the rice pudding with a fine layer of powder of cinnamon before being served, because of the arrangement of flavours. With the experiment proposed in this article, it can be tested if the simple presence of the spice without cooking together of the rice has antimicrobial activities (Figure **10**). The weight of the spices used in the cooking and on the surface of the rice pudding was the same to allow comparison. We observed that the cooked samples with cinnamon just-grated (Figure **11**, left) present smaller development of microorganisms than the cinnamon just-grated added on the rice pudding after the cooking (Figure **11**, right). The samples with cloves just added after the cooking presented the same performance as the cooked sample with the rice pudding, with no significant effects of antimicrobial activity.

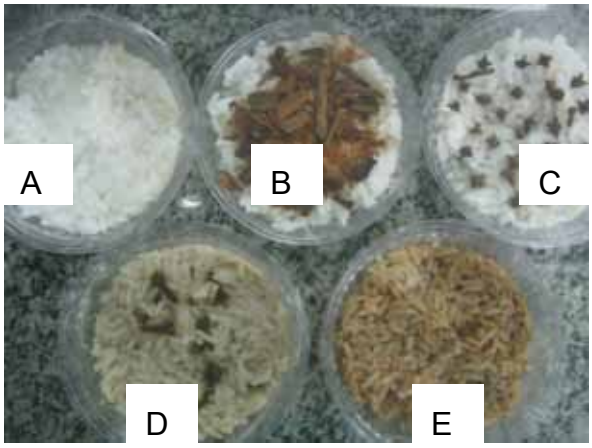

Figure 10. Prepared samples for comparison among kinds of addition. A) Standard without spices; B) rice pudding added on the surface of just-grated cinnamon; C) rice pudding just added of clove; D) rice pudding cooked with clove; E) rice pudding cooked with just-grated cinnamon

Figure 11. Cooked samples of rice pudding with cinnamon (left) and cooked samples just added of cinnamon over the rice pudding after the cooking (right)

With these results, it is possible to argue with the students about concepts like extraction with the boiling water in order to have the antimicrobial activity of the cinnamon. The cloves, without the extraction with the boiling water, presented antimicrobial activity, showing the same results as the sample of rice pudding cooked with cloves.

4. Conclusion

The comparative experiment of rice pudding with and without spices has excellent receptivity with the students of the high school, for its easy execution, and for the visual appeal of the samples deteriorated by the microorganisms. In the visits done at the public schools, the students have been manifesting the intention of repeating the experiments with other spices or seasonings and suggesting the attempt with teas and other

 ISBN 978-989-95095-3-5

ingredients, demonstrating the effectiveness of the experiment in the awakening of the interest for the science and their methods.

5. Acknowledgements

The authors thanks to UENF for Anne's fellowship. We also thank to Antonio Carlos Pavão for his provocative phrase that "Brazil was discovered due to the chemistry of food preservation".

6. References

[1] Mach, Ernst. Popular Scientific Lectures. Open Court Publishing, 4a Edição, 1910.
[2] Paula, Ronaldo César de Oliveira, Master dissertation "O uso de experimentos históricos no ensino de física: um resgate da dimensão histórica da ciência a partir da experimentação". Universidade Federal de Brasília, 2006.
[3] http://www.estadao.com.br/ext/especiais/2007/11/oecd.pdf
[4] http://www.mct.gov.br/index.php/content/view/50875.html
[5] Lopes, Maria Margaret. O Brazil Descobre a Pesquisa Científica: os museus e as ciências naturais do século XIX. São Paulo: HUCITEC, 1997.
[6] Rodari P, Merzagora M. The role of science centres and museums in the dialogue between science and society. Journal of Science Communication, 6 (2), 1-2, 2007.
[7] Gil, F.B., Lourenço, C.M. Que ganhamos hoje em levar os nossos alunos a um museu. Comunicar Ciência. 3: 4-5, 1999.
[8] Hottecke, D. How and what can we learn from replicating historical experiments? A case study. Science and Education, 9: 343-362, 2000.
[9] Vitória Maria Machado Pinto, Master Dissertation. "Módulos interactivos de Química em centros e museus de Ciência", Universidade do Porto, 2007 http://nautilus.fis.uc.pt/cec/teses/vitoria/
[10] Holton G., What Historians of Science and Science Educators Can Do for One Another. Science and Education, 12: 603-616, 2003.
[11] Le Couteur P, Burreson J. Os botões de Napoleão: as 17 moléculas que mudaram a história. Editora Jorge Zahar. Rio de Janeiro: 2006.
[12] http://www.algosobre.com.br/historia/crise-do-modo-de-producao-feudal.html
[13] http://www.galeon.com/projetochronos/chronosmedieval/concilium/pandemia.htm
[14] Ujvari SC. A História e suas epidemias, A convivência do homem com os microorganismos. 2nd edition, Rio de Janeiro, Editora Senac Rio, 2003.
[15] Erdogan Ceylan, M.S., Donghyun Kang, and Daniel Y.C. Fung. Reduction of Escherichia coli O157:H7 in Ground Meat by Selected Spices. Institute of Food Technologists' (IFT's) 1998 Annual Meeting & FOOD EXPO in Atlanta June 21, 1998.
[16] http://pt.wikipedia.org/wiki/Canela
[17] Keogh JB, Clifton PM. Health benefits of herbs and spices: the past, the present, the future. Journal of the Australian medical association, 185(4):S1-S24, 2006.
[18] Kiple KF, Ornelas KC. The Cambridge World History of Food. Cambridge University Press, 1757-1759, 1999.
[19] http://pt.wikipedia.org/wiki/Cravo-da-%C3%ADndia
[20] http://pt.wikipedia.org/wiki/Pimenta

Improving Pre-School Children Initial Ideas about Terrestrial Snails

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Abstract. The focus of this paper is supported by the constructivism and the conceptual change learning theories. It focuses preschool children's initial ideas about snails and their life cycle and how they changed after an instructional session. Data were collected in one classroom of 4 to 5 year old children living in a city. The methodology of this work has three steps. First, children were asked to do a drawing about the life of a snail and were questioned about snails during classroom conversation; their answers, comments and questions were audio recorded and categorized. Secondly, children received a theoretical and practical lesson conducted by older children (8 to 9 years old). It included the contact and observation of living snails and their eggs. Finally, the first approach was repeated. Children's drawings of snails had only two tentacles. The aspects of the snail life cycle represented were related with imagination and their experience. Children's initial ideas about snails showed anthropomorphic but also teleological explanations. During the instructional session younger children asked questions, touched and observed the living snails. After this session, most of the children's drawings represented the four tentacles. The drawings

 ISBN 978-989-95095-3-5

also represented feeding, excretion, reproduction and mucous protection. These and other aspects (habitat, lifetime, function of the body structures) were then included in the answers about what is a snail and how are its life.

Keywords. Pre-School Education, Snails.

Why are Crabs Disappearing from Recife? The Use of a Short Film in a Non-Formal Context in Elementary School Teaching

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Abstract. Mangroves and the city of Recife (Brazil) have an intrinsic relationship, as the ecosystem has social, economic, ecological and cultural importance to the city. Thus, there is the possibility and need for work addressing this environment in different science education settings and in different manners, thereby characterizing the methodological plurality of the field. In this context, the use of short films offers different possibilities and advantages, among which we stress the sensitization of students and the dynamization of the approach to scientific concepts with the inclusion of cinematographic language. Furthermore, the short exhibition time helps minimize the dispersion of the students and enables the later development of specific activities. Thus, the aim of the present study was to analyze the content of discussion panels made up of elementary school children from public schools in the metropolitan region of Recife regarding the reduction in the numbers of crab, which is one of the most characteristic mangrove species, following the screening of the short film "Mangrove Fish". For such, we carried out a 60-minute activity during the 1st Regional Encounter of Biology Teaching with Schools, held in the city of Recife in April 2008. After the screening of the short film produced by Propágulo (UFPE environmental education group), the following question was drafted from a contextualized fact: "The city of Recife has several mangrove areas and many species of crabs have been disappearing. How do you explain this process?" The participants were then organized into teams and cards, coloured pens and crayons were made available for the formation of panels that were to present an answer to the question. Content analysis of the posters, which displayed images of the environment and crabs, along with textual production analysis converged for the following results: pollution from different sources was indicated as the main cause of the disappearance of the crustacean, followed by deforestation and overexploitation. Similarly, alternatives were presented as an explanation for the situation, including the need for species conservation and maintenance and an emphasis on the importance of crab meat as a food source. It should be stressed that we observed difficulties in the interpretation of the question and the establishment of more elaborate answers that included a broader comprehension of all the variables implicit to the question posed. We may infer that there was an initial development of skills and abilities in a conceptual perspective directed toward the need for interpretations of quotidian situations based on scientific foundations, thereby coming closer to the notion of Scientific Literacy.

Keywords. Mangrove, Crab, Short Film, Elementary School Teaching.

Continuous Formation for Teachers of the Initial Series of the Fundamental Teaching. "Projeto Mão na Massa"

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Abstract. The University Science Center Estação Ciência began in July of 2001 a project of continuous formation for teachers of the initial series of the Fundamental Teaching with a proposal based in investigative activities. On those seven years of development of the project the team accomplished in the formations, actions as: discussions on teaching of sciences in the initial series, didactic procedure with the development of investigative activities of sciences; scientific concepts; and the attendance of the implementation of the project in the schools. This work presents analysis of the attendance model and of the results of

 ISBN 978-989-95095-3-5

implementation of the Project Hands On - Scientific Initiation in the Ciclo I, in partnership with the Municipal Education authority of São Paulo, in the schools.

Keywords. Attendance of Teachers' Formation; Teachers' Continuous Formation.

Teachers´ Participation in Guided Visits at Museu de Ciências Naturais PUC Minas

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Abstract. The Museum of Natural Sciences PUC Minas on average receives 60 a thousand visitors per year. 70% of this public come from schools and look for guided visits. The Educative Program organizes these visits in two phases: preparatory and it visits. The present work will go to describe these phases, detailing the Space of the Educator, a work of two hours, carried through to the Mondays, that the dialogue between Museum and School through the lecture accomplishment promotes, visits to the Museum and interactive dynamic that assist professors to transform its visit into a much more beneficial activity.

Keywords. Museum and School, Informal Learning.

Espaços da Ciência of the CECIERJ Foundation

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Abstract. The CECIERJ Foundation develops many different programs and interactive exhibitions aiming to increase the public awareness of science in the Rio de Janeiro State. The “Espaços da Ciência” program promotes the creation of very small science centres in towns in the hinterland of the Rio de Janeiro State in collaboration with local City Halls. This is an innovative project, without parallel in Brazil. The first of these science centres implemented was “Espaço da Ciência de Campos dos Goytacazes”, that stayed opened to the public from 1999 to 2003 and was re-opened in 2006 in the neighbour district of São João da Barra. Besides this, two more Science Centres are currently open in the cities of Três Rios and Paracambi, where Planetariums were also installed in 2002. This program intends to promote the diffusion and popularization of science and technology to the general public, but is primarily aimed to the students and teachers of the regional schools. The Espaços da Ciência present interactive exhibitions with hands-on experiments acquired, designed and built by CECIERJ staff, and shared by partner institutions. These Science Centres also contribute to improve science teaching by offering their facilities to teachers of the local schools, so they can develop research and other pedagogical activities with theirs students. The “Espaços da Ciência” program also intends to promote cultural activities in their science centres, increasing the cultural offers in these towns and fostering thus their integration in the local people’s lives. These Science Centres in the hinterland are important for the local populations that usually don’t have access to social events of scientific and cultural nature.

Keywords. Science Center, Hinterland, Hands-on Experiment.

 ISBN 978-989-95095-3-5

The project "Ciência ao Vivo": itinerant science demonstrations

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Abstract. The project "Ciência ao Vivo" (Alive Science) matches the objectives of complementarity of the program of science of basic education and science literacy of public in general. In relation to formal education, the project searches the rescue of motivating experimental demonstrations in classroom. From the point of view of scientific literacy, the set of experimental kits aims an active acquisition of basic knowledge of science approaching scientific questions to daily practical situations. Joining simplicity to correction, 30 kits were constructed and are being lent to school teachers and exhibited in park and science fairs.

Keywords. Experimental Demonstration Kits, Interactive Science Demonstrations, Itinerant Science Demonstrations, Physics and Mathematics Demonstrations.

1. Introduction

The idea of circulating expositions of sciences is not new. Many initiatives of this sort have already been carried through. Among these, we detach " Experimentoteca" , project developed by the CDCC - Center of Scientific and Cultural Spreading of University of SãoPaulo, in São Carlos, a complete set of kits with experiments linked to the program of Sciences of basic education. Also itinerant exhibitions have already been developed by national institutions of scientific spreading as the MAST, Museum of Astronomy and Similar Sciences, the Espaço Ciência Viva and the Museu Paraense Emilio Goeldi. These institutions have taken experiments, microscopes and telescopes to squares, beaches and slum quarters of Rio De Janeiro, Belém of Pará and neighboring cities so that the population of many of these places had a first contact with science. The project "Alive Science", however, matches the objectives of these initiatives: without neglecting formal education — its presence in the classroom is one of its basic objectives — looks also for accomplishing in science literacy of public in general

2. Theoretical postulations

In relation to formal education, the project "Alive Science" searches the rescue of the experimental demonstrations in classroom, as a motivating element that is capable to unchain social interactions which facilitate and promote the learning of science concepts. Considering the inexistence of experimental equipments in official schools of basic education, the project aims at the creation of an itinerant instructional material, where each package, beyond containing an experimental demonstration which is adequately integrated and ready to be presented, is also an element of support to its presentation. From the point of view of literacy in sciences, the project aims the teaching of basic knowledge of sciences, bringing up to date the scientific questions and approaching them of the daily practical situations, joining simplicity to correction and looking for to complement formal education from a practical, motivating and interactive approach. Continuous changes in scientific knowledge made science literacy of vital importance for citizenship conquest. The domain of a set of basic scientific and technician knowledge is an essential condition to the conscientious participation of people in the contemporary society. In synthesis, understanding the process of teach-learning from a point of view that considers the social and the cultural factors, the project intends to stimulate the questioning, the inquiry and an active acquisition of the scientific knowledge.

3. The project development

The project included the research of industrial drawing and visual communication that could maximize the potentialities of the set of kits, improving the aspects of language clarity, the proper information hierarchizing, as well the independence of ambience of available infrastructure. Playful and motivating aspects related to the materials and graphical and chromatic compositions, that stimulate the active participation in the assembly and development of the experiment, have been qualities analyzed and incorporated to the kits. Sponsored by CNPq (National Council of Research and Development) a set of 30 kits was constructed. They have been being presented in Science Fairs as recently occurred during the 59th. Annual Meeting of the Brazilian Society for Progress of Science (SBPC), in Campinas and lent to school teachers in a way that is very similar to that of a

 ISBN 978-989-95095-3-5

library. From March to June, 46 teachers explored the kits with more than 4 thousand students. Figures 1 is a photograph of kits when presented at 60th. SBPC.

Figure 1. Some kits at the 60th. SBPC

Mechanics, Optics, Thermodynamics, Electromagnetism, Air, Water, Linear Systems, Trigonometric Functions are some of the themes that can be explored in this first set of kits. The research and development included the Faculdade de Engenharia of UNESP and the Instituto de Matemática e Estatísitca and the team of Estação Ciência – USP. Another set of 20 kits is being developed. This set will contain kits of Astronomy and Biology and is being sponsored by the Fundo de Cultura e Extensão of USP.

4. Acknowledgments

The authors would like to thank the support of CNPq and Fundo de Cultura e Extensão-USP to the project “Ciência ao Vivo”.

5. References

[1] Gaspar A. Museus e Centros de Ciências – Conceituação e proposta de um referencial teórico – Tese de Doutoramento – Faculdade de Educação da USP; 1993.

[2] Gaspar A. Experiências de Ciências para o Ensino Fundamental. São Paulo: Editora Ática; 2003.

[3] Tomazello M G C, Schiel D. O Livro da Experimentoteca: Educação para as Ciências da Natureza A través de Práticas Experimentais. Piracicaba: VITAE/UNIMEP/USP; 1998.

[4] Vigotsky L S, Pensamento e Linguagem. São Paulo: Martins Fontes; 1987.

Rescuing Astronomy of the Great Navigations. Teaching Astronomy through Instruments of XVI Century

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Abstract. In this work, wooden replicas of some of the main astronomical instruments used by the great Portuguese navigators of XVI century have been made: an astrolabe, a sextant and a balestilha. Through these instruments, measurements of the position of some astronomical objects had been carried through as a practice of the discipline introduction to Astronomy of Physics course of the PUC Minas. The measure of the height of the sun when crossing the meridian, during one year had been taken and a table of zenithal distances to be used in the calculation of latitude of a given place had been made. The used procedure of the navigators “to weigh the Sun” to determine the latitude of the place was then reproduced, determining the latitude of the comment place. Through the graph of the variation of the height of the sun during the year when crossing the meridian, it had been explained the seasons of the year and the variation of aspects of the sky with the latitude and time of the year. Aspects of the measurement of angular distances between astronomical objects had been made with the sextant and balestilha, emphasizing its use for the navigation through the stars. The main results of this work are: a bigger interaction between disciplines (Astronomy, History of Sciences) bigger interest and better learning on the part of the students, for dealing with concepts

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and concrete applications in a world each day more electronic and virtual.

Keywords. Astronomy, History of Sciences.

E-portfolio – A Modality of Optimising the Evaluation in the Process of Initial and Continuous Training of the Teachers

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Abstract. This paper proposes to formulate a series of considerations which derive from the experience of trainers involved in the process of initial and continuous training of the teachers, a process which witnesses inherent changes demanded, on the one hand, by the development of NTCI and, on the other hand, by the necessity of reporting to the reality of the educational system from the European space.

Keywords: e-portfolio, Initial and Continuous Training.

1. Introduction

In The Report Project on the Improvement of the Quality of Professional Training, presented by the Commission for Culture and Education (Brussels, 26 March 2008), there were weighed in the efforts the teachers have to face, efforts that have become more and more numerous, taking into consideration the fact that the educational environment has become more complex and more heterogeneous, as a consequence of the progress registered by the new informational and communication technologies.[4]

On these conditions, the Commission for Culture and Education of the European Parliament recommends in the same project, the necessity of promoting a continuous and coherent training for the teachers during their entire career. The teachers must have the possibility to improve and actualise their competences and qualifications, as well as their pedagogical knowledge. Only such an approach of the professional training can lead to a correlation between the teachers' level of training and the performance of the educational system. The McKinsey report realised within the PISA Program of OCDE establishes the main determining factor in the viability of education in schools, regarding the students' performance: the teachers' quality. According to this report, the educational systems which reach high results, centre their educational policy on three directions: they attract the right candidates for the jobs of teachers, they help them to become efficient teachers and set into action systems and structures to make sure that each student will benefit from high quality teaching.[5]

2. The aspects of using ICT in the didactical process

In the Romanian educational context, the introduction of Internet in the educational system is the event that precipitates the emergency of a new paradigm in education. The convergence, on the account of the major social changes, of several factors such as: 1. the technological development; 2. The new pedagogical theories, 3. The sharing of responsibility for education with different other institutions – lead to the emphasis of certain features which set the measure of this paradigm: fluidity of the roles, curricula oriented towards the necessities of the trainee (the students, involved in his initial training/teacher involved in his continuous training), distributed resources, virtual facilities, non-synchronised classes.[6]

In the context of the accelerated rhythm of development of the new technologies, in the Report for Evaluating Research – EVAL SEI 2008 one inacceptable aspect in such an advanced stage of the informational educational system can be noticed. In the answers of the teachers who participated in the current statistic study, there can be found in a very small proportion (if not at all) training programs which refer to the pedagogical aspects of using ICT in the didactical process - those courses of

[4] The report project on the improvement of the quality of professional training, Brussels, 2008 a http://www.europarl.europa.eu/activites/expert/eStudies.do?language=Ro, pp.4-5.

[5] The Study, the Content and the quality of training teachers within the EU area Institute of Education, University of London, UK, http://wwwipolnet.ep.parl.union.eu/ipolnet/cms/lomg/eu/pid/456 (Bruxelles, 2008)

[6] Istrate, Olimpius, Distance learning *in* www.elearning.ro.

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"assisted computer training". At the beginning of 2008, we might say we still are in an incipient stage concerning the efficient use by the teachers of the new technologies to teach, learn, evaluate

Regarding the teachers' level of participation to courses of using ICT, one third of the teachers did not attend any course that were related to the new technologies, a surprising fact taking into account the early character of the initiatives, projects and programs referring to the introduction of ICT in the Romanian educational system[7].

Regarding the utility of the existing training programs, related to the actual needs of the class activity, most of the teachers (58%) thought they were adequate for the beginning, but efficient didactical activities with the help of new technologies claim direct experience and practice, 7,4% of the teachers consider that the initial and continuous training programs should be improved.

The introduction of more practical exercises and simulations could be a direction where the teachers' training in using new technologies might be improved (signalled by 10,8 % of the practicians). Furthermore, the organisation of cyclic training activities, staged form simple to complex (16,4%), differentiated on subjects or on levels of difficulty (6,5%), supported by an adequate didactical material (7,7%) is considered by the teachers as an approach that would help a more efficient training, with real benefits for the improvement of the pedagogical practice with an ICT component.

Remarking a significant difference between the number of teachers who declare that they do not know how to use the computer and the number of those who never attended a training course in using ICT, the authors of this study, specialists in educational sciences, consider that it would be necessary "an increased preoccupation for the acknowledgement of the competences in this field obtained through non formal training steps. Such a certification would be even more necessary since it would support a clearer differentiation between the "use of new technologies" and "the use of new technologies for education".

On these conditions, the process of initial, and more important, continuous training, through e-learning system, will know new stages, thus contributing to the development of the modern society that is of the society of knowledge.

The institutions that offer continuous training courses (universities or other institutions involved in the teachers' training process), in the context of organising courses of distance learning/e-learning, must take into account the modalities of projecting a program of this type that should be cantered on learning and on educational performances. The elements that should be taken into consideration in projecting such e-learning courses are: target group, learning content, didactical strategies, ICT tools used (e-mail, web site, videoconferences, educational software, learning sites), resources, objectives of the programs.

On the other hand, there must be assured adequate services of evaluation and self evaluation of the knowledge acquired by the trainees (teachers, in the case of continuous training), by appealing to specific online and/or off line methods.

Beyond a series of principles of the evaluation within the open distance learning, the paper structures a few considerations connected to the relation between the objectives and the evaluation of the objectives; it proposes a series of concrete modalities of organising and realising the evaluation within the open distance learning in the context of initial and continuous learning. We especially propose to bring into discussion a number of modalities of optimising the evaluation, starting from a contrasting analysis between the traditional methods and techniques of evaluation (oral, written and practical evaluation) and the modern ones (portfolio, e-portfolio, project, essay, investigation, inter and self evaluation).

3. e-Portfolio implementations and experiences

Among these, the e-portfolio, as an instrument of evaluation and learning, can be a simple web page, a weblog (http://roinfocds.blogspot.com), wiki (http://tmt-gr3.wik.is) or integrated application which, according to the implementation, it contains proofs of the personal development, a development plan; it allows the management of knowledge, the evaluation of the trainees' abilities.

As a modality of optimising the evaluation within the open distance learning, the e-portfolio assures the achieving of the feed-back, both for the trainer and for the trainee (student or teacher involved in the process of continuous training). On the other hand, by revaluating the e-portfolio opportunities – as a modality of evaluation, the trainer can diminish as much as possible the

[7] Idem, op.cit., pp.25-27

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mistakes which appear sometimes within the evaluation through the traditional methods[8].

Here are several aspects which can lead to subjectivity in evaluation and are no longer justified in the case of the evaluation in absentia-in praesentia, by using e-portfolio:

- The "halo" effect or the error of global association was described for the first time in 1920 by Thorndike and it refers to the appreciation of effective performance by correlating it with the global performance of the trainer;
- The "Pygmalion" effect, Oedipal or of anticipation. The evaluation is influenced by the constant opinion that the teacher has about the student/trainee;
- The contrast effect and related to it, the order effect, which manifests when the teacher tends to evaluate similarly consecutive papers, yet of clear different value;
- Logical error or speculative evaluation. This effect consists of punishing by grades certain mistakes, even if these are not essential elements of the content.

The revaluation of the e-portfolio created by the trainees on an online platform leads to the elimination of these effects and offers both to the teacher and to the student/trainee a coherent image of the didactical course. The trainer can offer an objective value judgement and can follow the progress or the regress of a trainee, especially if he also appealed to an initial evaluation.

We will make an appeal to several obvious examples from the performed evaluation in the context of some courses of initial and continuous training, through which we intend to prove that e-portfolio is a valid (measures what it should measure) and revealing (shows constant results after a repeated application under the same conditions and to the same group of trainees) instrument of evaluation. Obviously, from the perspective of its applicability – another feature which needs to be fulfilled by an efficient instrument of evaluation, there are voices which consider that by using an e-portfolio, the trainer will come across a series of difficulties in interpreting the information offered by this instrument, about the trainee's evolution during the training course.

The evaluation of e-portfolio documents in a structured, systematic and credible way, certain competences established in the evaluation scheme of the portfolio[9] (the scheme that refers to the following criteria: checking list of the portfolio, appreciation of the management of the portfolio, appreciation of the content of the portfolio).

The e-portfolio should offer an efficient feed-back to both the trainee and the teacher. The use of an online MOODLE type platform allows, as it will be demonstrated, a self/inter/evaluation of the e-portfolios created by each of the trainees.
(http://training.ise.ro/course/category.php?id=3).

The Moodle system promotes the "pedagogy of the social constructivism", supported on the following concepts:

1. Constructivism: the new, acquired knowledge is deposited in permanent relation to their cultural and informational background, and not by simple memorization;
2. constructivism: the learning gets to be effective when it shared, discussed, explained to the others;
3. Social Constructivism: disseminating the information is done in a systematic , organized manner, thus leading to the constitution of a small cultural community – the social web;
4. Connected and Separate: tries a thorough look on the motivations which entertain the participating people to the dialogue within the cultural community

Advantages of the Moodle site in the process of continuous training

1. A flexible and ergonomic system of administrating the information;
2. Possibility of on-line editing of the materials in HTML and text format;
3. Easily accessible course support, searched and indexed, which contains further materials than the ones taught during the classical classes and directions to other sources of information;
4. Increases the ability to adapt of the educational process to the demands of a dynamic market, an objective which is

[8]Bogdan Constantin Neculau, The specific of evaluating distance learning, in Distance learning. Guide for Tutors, (coord. Constantin Cucos), Editura Universitatii " Al. I . Cuza" Iasi, 2004, pp88-89.

[9] The evaluation /appreciation scheme of the e-portfolios by the Master Intel Teach trainers, within the course Intel Teach "bases of teaching in the society of knowledge" - SIVECO Romania.

 ISBN 978-989-95095-3-5

attainable by using an equally dynamic environment of learning/communicating - world wide web;
5. Allows the insertion of hyper-connections to Web locations to other materials;
6. Within the section Activities the following types of activities can be added: Examinations, Discussion Forums, Diary, Quizzes, Questionnaires;
7. The activity is not synchronized;
8. The activities can be configured (forum, chat) so that they should give the possibility of a collaboration among all course participants;
9. The supporting activity for the trainees can have for example the form of a tutorial activity where the trainer mediates the relation between the trainee and the material to learn (that is between the trainee and the authors of the course);
10. The technologies are interactive, allowing a total feedback, in real time, and formative or summative, quantitative or qualitative evaluation in a very easy way by even the wisest evaluators.

Limits

1. High costs for the development of the system;
2. the trainees are required to have experience in working on a computer;
3. The trainees must be extremely motivated to attend. The phenomenon of school leaving is much more frequent in distant education by using Moodle than in the traditional frames of education;
4. The relative "dis-humanization" of the courses until the development of the optimal strategy of interaction and of focusing on the student and not on the system.

4. Conclusion

We can notice the fact that the web 2.0 tools (blog, wiki, Moodle platform) that are used within the continuous training courses of e-learning type for the teachers facilitate the obtaining of feed-back for the course tutor and for the trainers too, each of them being able to reach a coherent image of the educational course. The e-portfolios created during the e-learning course, existing on the learning/evaluating platform, offer an opportunity to reflect upon one's own professional practice and to share the achieved experience with other members of the professional community.

The evaluating process will reflect the paradigm change, from the evaluation which is mainly quantitative to a qualitative evaluation; it will be oriented towards an approach from the perspective of critical thinking; it will have a strong metacognitive impact.

5. References

[1] Ambrosi, A., Word Matters, Editura C&F Editions, Caen, 2005.
[2] Brut, Mihaela, E-learning instruments. Computerised guide of the modern teacher. Editura Polirom, Iaşi,; E-learning instruments. Computerised guide of the modern teacher, 2005.
[3] Buckmann, Nicola. Nekeman Paul. Dictionary of distance education terminology; EADTU, 1993.
[4] Cucos, Constantin(coord.), Distance learning. Guide for tutors, Editura Universitatii " Al. I . Cuza" Iasi, 2004.
[5] Distance learning : planning considerations and options. University of Michigan, Information Technology Division, 1995.
[6] Făt, Silvia, Theoretical Fundament in E-Learning, Elearning.România, Bucureşti, 2007.
[7] Istrate, O., Distance Learning. Projecting the materials, Editura Agata, Botoşani, 2000.
[8] Potolea, Dan, Noveanu Eugen (coord.), Olimpius Istrate, Simona Velea, Cornelia Novak, Petre Botnariuc; Computerising the educational system. SEI Program. Report of evaluative research - EVAL SEI 2008 / Bucureşti: Agata, 2008.
[9] Stroe, Antoaneta Daniela, Elearning systems and standards, Editura Edusoft, Bacău, 2005.
[10] www.1educat.ro/elearning
[11] www.elearning.ro.
[12]http://wwwipolnet.ep.parl.union.eu/ipolnet/cms/lomg/eu/pid/456
[13]http://www.europarl.europa.eu/activites/expert/eStudies.do?language=Ro

 ISBN 978-989-95095-3-5

Evaluation of the New Practical Approaches in the Biochemistry Course of the Universidade Federal de Pernambuco, Brazil

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Abstract. Biochemistry is a science field with quick development in the latest years. For this reason, it becomes more complex to keep up to date. Nowadays, the way of teaching is aided by practical approaches that can stimulate students to search for theory and results. At the Federal University of Pernambuco (UFPE) the biochemistry discipline is offer for all graduate courses in biology and health. Each semester, 60 hours of course are offered, with theoretically (30 hours) and practical lectures (30hours). Teacher's assistants (TA) have been largely used to aid teachers during the educational procedures. The practical program was done at least a decade ago without changes. To provide a better development of the students we proposed the introduction of new activities. After theoretically lectures, students were conducted to laboratories. Three new practical lectures were offered: DNA extraction from Human and Plant Cells, Vitamin C Activity as Antioxidant and Informatics as Tool for Learning Biochemistry. Every student received a data sheet containing the program (theory and protocols). At the end of the lesson, a questionnaire sheet with multiple choices was given to evaluate the opinion. The results show that a high percentage of the students accepted new approaches for practical lectures (for DNA and Vitamin C lectures it was 100% and for Informatics lecture it was 93%). As well, the TAs have a good participation and importance during the course. The practical classes contributed to better understanding of the biochemistry theory. However, classes using informatics as tool showed good results as well while difficulties in the laboratory structure and material.

Keywords. Biochemistry, Practical Lectures, Teacher's Assistants.

Problem Solving and Device Construction

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Abstract. *Oficina Desafio*, Challenge Workshop, is a project of UNICAMP Exploratory Science Museum – the Science Center of the State University of Campinas (Brazil). It is an outreach project, based on a fully equipped mobile workshop constructed on a truck, which visits schools and gives the students open solution real problems challenging them to "design, construct and operate a device" capable of solving the challenge. It runs short term activities (4 hours long), called *Small Challenges*, and also a long term annual contest, the *Big Challenge,* when teams of children and teenagers engage in up to for month designing and building their devices. After running for two years and attending about ten thousand young people, analysis of evaluation forms answered by students (more than 800 questionnaires) and journals written by participants in the Big Challenges, we can understand what those activities mean to the participants and what kind of skills and knowledge are actually encouraged and developed. The focus of the presentation will be on team-working competences, learning of basic mechanic and electronic and methodology of project development.

Keywords. Informal Education.

5th International Conference on Hands-on Science
Formal and Informal Science Education
 ISBN 978-989-95095-3-5

Synchronizing Head & Hands together for Excellence: Role of Technology Communication & Technological Temper -An Attitudinal Analysis

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Abstract. More often, we tend to satisfy ourselves by accomplishing around 80% task and feel as if we had contributed enough, but the excellence lies in the remaining 20%. Even out of the 80% accomplished work, only a fraction of it can be attributed to as excellent, as in most cases, we are unable to put our head and hands together in harmony for a particular work. Knowledge and attitude together play a major role in achieving excellence in every walk of life, be it a worker, student, scientist, technician, teacher, housewife, or even an artist or astronaut. Here the hands-on science becomes more significant in all spheres of human endeavours.

We have been talking about science communication, education and scientific temper and very less has been discussed about technology communication and technological temper. Although, in general, when we talk about science, it also inherently incorporates technology. In fact, the most part of our science communication activities involves technology communication, as well. Be it an exhibition, or a hands on activity, such as origami, science toys/ games, teaching/ learning aids, model rocketry, experiments with aerodynamics, water testing or HAM radio, etc.

However, at the dawn of 21st century, when we have arrived at a crucial turning point of sustainable development and multifarious technological advancements and challenges, we cannot proceed randomly and have to step ahead in much professional and systematic manner. Hence, equal focus is required to be given on technology communication and technological temper in a fast advancing world, where technology plays a vital role in not only the life and work of mankind, but also acts as one of the important deciding factors, responsible for the strength and wellbeing of a nation.

One's attitude is a highly complex attribute and varies on a variety of factors, i.e. upbringing, surrounding, parenting, schooling and above all socio-economic and cultural milieu. The present paper examines various attitudinal patterns especially amongst children and tries to find out various factors impeding them with possible ways and means to overcoming these barriers with a dose of technological awareness and technological temperament.

Keywords: Synchronization, Alignment, Fine-tuning, Combining, Harmonizing, Conditioning, Precision.

1. Introduction

When Galileo Galilee discovered that it was the earth, which revolves around the sun and not the sun around the earth, he was simply stating a fact of nature. Science is to understand the laws of nature, or in other words the process of understanding nature is science. So science is not stray from nature, science manifests from nature. Science doesn't create something new; it rather puts forward another application of a natural phenomenon. When man experiments with nature, he could simply be trying with a different magnitude or dimension of nature. In orbiting of a manmade satellite, in experimenting with nuclear structure, in decoding genetic setup, it could never meant going against nature. Science lies buried in nature. However, as a science philosopher observed, "nature can bury science and the world, if these do not go in tandem".

Is it necessary that one has to learn from his own mistakes or commit mistakes to learn? Perhaps no! Wiser one learns from other's mistakes. But he has to keep himself abreast of the latest technologies. The role of communication in science is paramount because science has lot to do with nature and, more precisely with life. Science has a bearing on the way one thinks, lives, conducts and behaves in the society. And thinking scientific is thinking natural. Thinking scientifically is establishing harmony with nature, of which we talk so often. This activity could best be promoted by communicating science in a scientific way. Accuracy, while communicating science needs to be emphasized. Distorted information is no less dangerous than a slow poison.

Technology is an application of science. Technology is believed to have descended in man's world earlier than science. This is an observational obscurity. To the man, technology bears supreme importance. Man's quest for science began from his urge to master technology. This unfolded a chain of technological evolution, as man resorted to druid replication of nature. Many of so called technological feat have been marred by known and unknown hazards on life and surroundings.

 ISBN 978-989-95095-3-5

Man in many terms is a quick learner and he knows that he has but no other alternative.

Though science emerged after technology, it is too obvious to witness that science and technology are strongly interconnected with each other and their progress is interdependent. Science in its early stages was hardly distinguishable from technology. The knowledge of man regarding the use and control of fire, development of tools, primitive agriculture, use of medicinal and herbal plants, etc. during ancient age are the examples of rudiments of technology. In fact, for a long span of time during early stage of evolution of human civilization, it has been observed that technological developments were more frequent; despite there being no scientific concepts. Therefore, several scholars have conceptualized technology as applied science.

The origin of technology can be traced back from the beginning of the human civilization, when the early man had discovered the fire and understood its use and control, and explored natural resources for his benefit. A million years ago, human beings learned how to handle and shape the mud, stone and wood for different uses. Thus development of technology progressed simultaneously with the evolution of human civilization.

However, science as an organized body of thought is generally considered to have begun with the Ionian school of Greek philosophers about 600 BC. Nearly around the same time, Gautam Buddha, in India, gave the cause and effect theory and preached about spirit of enquiry, the basics of scientific thinking. Discoveries or inventions prior to 600 BC were generally referred as examples of technology.

2. Technology Communication

Technology communication is as old as the "technology" and "communication" itself. Although its form was entirely different from the present one. The origin of communication can be traced back to the beginning of human civilization, when the early man might have communicated with each other through body language. The art of communication further developed and got refined as was visible in development of oral communication. Subsequently, man had started making sketches on the walls of the caves, rocks and on other similar objects to express his ideas, observations and imaginations. One can see the beautiful cave sketches at Bheem Betka, Near Bhopal (MP) made by the Stone Age man, depicting various technologies of that time, such as stone axe, etc. Of late, written scripts were developed and man started communicating through written words and sketches on moist soil and mud boards, clay tokens, bark of the trees, wood, stone, metals, like iron, bronze and copper, etc.

The term “technology communication” is a combination of “technology” and “communication”, which is referred to the flow of technological information, thoughts and methods from their origin to the user, through a medium or mediator. In other words, all aspects related to dissemination of technological information and inculcation of a technological temper among people through all possible means, modes, methods, media, techniques, tools and processes can be referred as technology communication.

It is well understood that concerted and widespread efforts in technology communication/popularization can help achieve the goal of overall development of mankind, by making the people technologically aware and inculcating a technological temper among them. It is believed that a scientifically informed, technologically capable and rational society could progress in a much coherent way.

There is, however, an enormous gap between the common masses and scientific and technological information and an acute shortage of personnel suitable for the role of an S&T communicator, who could take up this challenging task of taking S&T to the people.

The human knowledge and intellect is driving quest for science and technology research and development. Given the consequent advancements in various streams of scientific and technological endeavours, we have to consider science communication and technology communication separately. Accordingly, communication of technological information or thoughts through writings, publications, broadcasts, telecasts, lectures, theatre performances, puppet shows, exhibitions Jathas, technological museums and making presentations in seminars, symposia, meetings, etc. is included into the gamut of technology communication.

3. Objectives

Although, the broader objectives of technology communication are hardly different from those of science communication. However, some specific objectives, among others, can be summarized as follows:

1. To communicate and popularize the information about the technology, confronting our day to day life, to the common people.

 ISBN 978-989-95095-3-5

2. To inculcate a technological temper among them.
3. To infuse the spirit of innovation and technological advancement in every sphere of human activity.
4. To make them aware about assimilation and adoption of the latest technology and its confluence with the traditional technology.
5. To develop at least workable understanding of various technologies available around and those we use.
6. To enable people to appreciate the technological changes, that is taking place due to various kinds of research and developments.
7. To bridge the gap between the head and hands and to integrate different attitudes and cultures of white collar and blue collar jobs.
8. To develop and enhance the level of technological literacy among various cross sections of the society.

3. Technological Temper

The state of mind geared up to use of hands in a systematic manner in any technological operation is known as technological temper. In other worlds, the technological temper can be referred to the spirit of using head and hands for accomplishment of any task in a systematic and orderly manner.

Generally, in teamwork, if there is a mistake, we tend to put it on other's head, but in case of a success; we try to take credit of it. If everybody contributes his or her due part in teamwork, such as in an industry, mill or plant, with a high degree of proficiency and accuracy, there may be hardly any chance of a failure. The failure occurs, when any member of a team does not contribute his due part or contributes in an unsystematic manner. This is called the lack of a technological temper. The failure of the launch of GSLV spacecraft is an ideal example of the lack of technological temper, where a small lapse of someone leads to a grand failure.

It may be possible to make it more vivid by citing an interesting example. Generally, it is difficult to find an electronic engineer capable of undertaking even a small repair work of his own transistor set. On the other hand, one can find a number of persons, who have not undergone the regular educational training, but have acquired the knowledge and skill only with the application of technological temper, which is nothing but the common sense. This reflects the application part of a scientific knowledge.

When we go to market, we observe that a particular mechanic or carpenter or any other such professional is excellent in his work and we even recommend his name to others also. What is this! This is recognition of his technological temper in real term. In fact, by way of inculcation of a technological temper, a qualitative and systematic performance is expected from a person, in every walk of human activity that would lead him to perfection and excellence.

More or less, it has become a modern system (!) that various technologies may be available, but of no use. For example, you will find a hand pump, but not working and municipality's tap with leakage of water. Similarly, one can find a public telephone, with no dial tone. This situation needs to be corrected. Here the role of State may be important, but above all, it is the role of our attitude, the technological temperament, which we are talking about. If we are able to develop a technological temper among masses, it can change the situation up to a remarkable extent.

4. Technology Literacy

The technological literacy, understood as an everyday working knowledge of technology, is as necessary as reading and writing (literacy in the commonly understood sense) for a satisfactory way of life in the modern world. Technological literacy is necessary for there to be a capable workforce, for the economic and healthy well-being of the social fabric and every person, and for the exercise of participatory democracy. It also implies the ability to respond to the technological issues that pervade and influence our daily lives. Technological literacy does not mean detailed knowledge of technological jargons, phenomena or deeper aspects, etc., however, it rather points out of the comprehension of what might be called the technological approach, or the systematic and orderly way of doing things and with more accuracy.

In this sense, a technologically literate person should posses a general sense of understanding technological things happening around, such as the boring for tube well, the working of a film projector, etc. There is universal need for technological literacy, since it is the basic requirement for the enhancing and strengthening further technology communication activities around the globe. Although, the magnitude of this need may vary from country to country and region to region, based on exposure of people to various kinds of technologies available around them. For example, a person coming from a remote village may not know about a pager or a

 ISBN 978-989-95095-3-5

digital diary. Similarly, a person from a city may not be aware of the seed driller or potter's wheel.

In our day to day life, we come across various kinds of technologies, products, gadgets, etc. at home, at work place, in a market or all around. But generally, we do not try to understand their mechanism or techniques as how do they work and what kinds of technologies are involved in their working. Accordingly, the technological literacy can be considered as a working knowledge of various kinds of technologies we use and see around us. This would not only develop an understanding about various kinds of technologies, but also develop a sense of confidence. Simply, most of us may not know as how a tube light works or how a cold storage keeps vegetables fresh or even how a fountain pen works. These are the simple examples from our everyday life, where most of us lack the technological literacy.

With a view to identify a certain level of technology literacy, we have to bench mark the desired level of understanding of technologies available around a particular sect of society. This bench marking can be different from area to area and community to community, based on the general level of awareness of people. Accordingly, to reach to a certain level of technology literacy in a given area or community, the efforts of technology communication may be concentrated to fill the void. When a certain level is achieved, then it would almost automatic that societal understanding and inception of technology, changes to those at higher levels. This is the natural way to enhance technology literacy to make any society technologically strong and enlightened.

5. Scope

The scope of technology communication is very wide. It ranges from communication of traditional technologies to the latest ones. The country has a great treasure of traditional technologies, which form the most part of our rural technology base. For example, in Himachal Pradesh, traditional water storage systems are found in remote villages. Underground tanks are constructed in front of the houses and arrangement is made to collect the rainwater and snow falling on the roof of the house, into these tanks via mud pipes. It is called "Khatriyan" in local language. This water is utilized for various domestic purposes, other than drinking, throughout the year. This technology needs to be propagated in other parts of country. Though, Government has now recognized the worth of this potential technology and encouraging harvesting of rainwater from various buildings. Many more such technologies are scattered here and there, especially in far flung areas of the country, needs to be communicated from one place to another, depending upon their suitability. Minor modifications can be suggested as per local requirements.

A number of technological advancements are taking place across the country in various research and development institutions, laboratories under Government and private sector. These technologies are useless, unless they reach to the end user. The technology communication efforts may be geared up for taking such newly emerged technologies to the people. There are a number of farm technologies, rural technologies, construction technologies, etc., which are not only cost effective but also time saving and durable. Information on such developments may flow from their origin to the user by way of different modes and means of communication, such as mass media, technology jatha, technology fair and technology exposition, etc.

One of the major objectives of technology communication is to create an urge for newness. Generally, most people feel comfortable to follow the beaten track. But some of them love to introduce their innovation. In other words, technology communication and technology temper also lead to certain modifications in the existing technologies, besides creating new ones. Therefore, science communication does not only make people aware about a particular technology, but also try to develop a spirit of innovation, motivating them to exercise innovativeness and creativity in every sphere of their life and work and to achieve accomplishment more perfectly and properly.

One of the major activities of technological communication programme can be to identify a technical/technological problem at local level and finding its solution. There may be plenty of technological problems prevailing at local levels. These can be solved with the intervention of technological communication. For example, industrial pollution in Kosi River, near Rampur (UP) poisoned the ground water of about 60 villages. An NCSTC's group of science journalists identified this problem, during an exercise of on the spot reporting. The detailed reports appeared in media and installing treatment plants at the polluting industries solved the problem. That apart, in case, some technological input or innovation is needed to solve a local technological problem, concerning technologists, engineers and experts can provide it and help solve the problem.

 ISBN 978-989-95095-3-5

6. Technology and Media

Mass media plays a pivotal role in bringing technological information and technological aptitude to the common men. There may not be science columns in various newspapers and magazines, but one can find columns in various newspapers and magazines covering latest technologies, products, households, etc., not only in national dailies but also in regional newspapers. Technological columns have become an attractive and vibrant source of general reading. On television, there are many programmes on various technological products, though they are mostly confined to a commercial activity, but still they provide some sense of understanding about the products and technologies. On Internet, a number of products and technologies find prominent places with detailed description and visuals, sometime animated also.

In fact, big players in mass media know the pulse of common man and act very fast, as and when the demand arises. However, in order to harness the potential of mass media for technology communication, there is a great need for providing suitable technological information in the form of articles, features, reports, interviews with technologists/technocrats/industrialists, etc., along with good quality visuals/photographs/illustrations. More precisely, we need a whole host of technological writers/columnists/correspondents/communicator s, who can contribute on various technological developments/issues in mass media, especially in vernaculars to cater to the common people and to fulfil the fast emerging demand of quality stuff on technology.

In our country, various efforts are going on for technology transfer and technology extension. But the target users hardly acquire any understanding of the same. These efforts need to be integrated with technology communication, so that, while using a particular technology, the users can also develop a feel and some degree of understanding of the technology they use or come across.

7. Technology Day

May 11, 1998 was a very special day for Indian technology. We had three great technological events on that day. The first event of the day (12:50 p.m.) was of the successful test flight for final certification of Hansa – 3, the first all composite indigenous aircraft, built by CSIR. The second was (followed a few minutes later) the successful test firing of the Trishul missile. The third and the most momentous were the three successful nuclear tests, known as Pokharan-II. In view of the series of our technological successes, Prime Minister has declared 11th May as the National Technology Day, just as 28th February is celebrated as National Science Day in recognition of discovery of Raman Effect. Consequently, to give more impetus on technology communication and inculcation of a technological temper, we have been celebrating technology day each year on 11th May since then to develop spirit of innovation and encourage innovativeness and creativity in the society.

8. Towards an Innovative Society

Infusion of innovativeness and creativeness may be one of the major tasks before any technology communication effort. Technology communication does not only mean to communicate technological information from laboratories or technological institutions to the people. It can be two ways. In case, some kind of technologies or technological ideas emerges from among the people that can also be carried to the scientists and technologists, so that it can be evaluated in terms of its viability, efficacy, workability and novelty. It can also be reshaped, modified and upgraded, if necessary.

It emerged from the current study that in the age group of 15-25, the creativity of children and youths is very high and they come up with a number of novel ideas. As an average, at any given time, 2-3 such brilliant students do exist in each medium city/town, who are interested in creative endeavours and putting things together in their own novel way. A mechanism can be worked out to harness the potential of such individual innovators. It has also been seen that such persons are least interested in text books or curriculum, but they possess a proven ability of doing technical/technological things. Obviously, they cannot secure good marks in their examination, but at the same time, their technological endeavours can prove them as an asset for the society. Such efforts need to be promoted and supported. The mechanism can be developed so as such technologically motivated persons driven with zeal and gleam in their eyes to doing something new and relevant, reach to the scientific/technological R&D institutions, laboratories, technology centres, etc.

Since the process of technology communication and inculcation of a technological temper stimulate the spirit of innovation among people, they must be made aware about intellectual property rights to protect their innovations and developments. Technological innovations are visible in various farms, rural and

 ISBN 978-989-95095-3-5

domestic technologies across the country. But almost no patent has been taken for such technologies, due to lack of awareness and technicalities involved in patenting process. Common people and even educated people are unable to file a patent with patent office and get patent right in their names for their invention. As a contrast, some people seek patent right, though their innovations may not be patentable. Therefore, the awareness about patentable and non-patentable inventions, preparation of application for a patent, writing/drawing a patent specification, process of getting a patent and maintaining a patent is required to be spread deeper in to the society in the light of WTO and GATT, and this may form a major component of technology communication.

9. Recommendations

Besides routine activities concerning hands-on science, various other activities are envisaged to be organized : i) at school level, involving children, students and teachers, etc., and ii) at community level, involving community people, especially women, weaker sections of the society, etc. Some activities are indicated below:

i) At School Level

1. Identification of local technological problem and/or finding its solution.
2. Identification of the need for some change or modification in the existing tools households and other such gadgets to make them more efficient, useful and safer.
3. Identification of local/regional traditional technologies and collection of information on them.
4. Constituting technology clubs/forums in schools/localities.
5. Organizing discussions on various technological issues, such as CNG Vs. conventional fuels, etc.
6. Designing, developing and making new educational aids.
7. Collecting data on idle/unused technologies around and motivating concerned authorities to putting them to use and in order.
8. Finding the areas where new inventions are needed, developing ideas and converting them into reality by making working model.
9. Some time a new attachment/device can add to the quality and efficiency of a machine or equipment; such small attachments/devices can be thought of and developed.
10. Organizing technology fairs, demonstrations, do it yourself activities, hands on activities, etc. and also creating/developing such new activities.
11. Writing/preparing technical reports for documentation and popular scripts for mass media on the above aspects.

ii) At Community Level

1. Identification of local/regional technological problems/issues and finding their solutions.
2. Involving women, especially from weaker sections in community based programmes, such as technology Panchayat, technology demonstrations, technology appreciation, etc.
3. Arranging question and answer sessions with the community people on various subjects concerning the technologies generally they use, such as, how does a plough work, how does a seed driller sow.
4. Technological fair, industrial fair, technology exhibitions, Jatha can be developed and organized on specific themes.
5. Mass media can be harnessed for technology communication. As such, optimum use of print (newspapers, magazines, etc.); broadcast (radio, television); folk (puppetry, theatre, folk songs, skit, etc.); interactive (lecture, demonstrations, get together, etc); and digital (Internet, CD-ROM, diskettes, etc.) can be undertaken for technology communication, as well.
6. Organizing contests, competitions, quizzes, etc. on various technological subjects.
7. Apart from technology day, some other days related to technology, can be celebrated, such as, disasters prevention day, industrial safety day, etc. Foundation days of various technological institutions, industrial establishments, engineering colleges, polytechnics, etc. can also be celebrated with an involvement of local public.
8. Short term awareness programmes can be organized to especially educate those, who are exposed or likely to be exposed to certain industrial hazard, occupational hazards, etc. People located nearby a hazardous industry/plant must be educated about the possible industrial

 ISBN 978-989-95095-3-5

hazards, so that in case of any fault, they can save their lives and belongings.

10. Conclusion

Indian S&T can play a crucial role in catalyzing and accelerating the economic and social development. The comparative advantage in the globally integrated technology knowledge based world economy today is becoming more relevant to those with an aptitude to absorb, assimilate and adopt the spectacular developments in science and technology, with the traditional knowledge and technology and harness them for national growth and advancement. The best alignment of knowledge and attitude by way of synchronizing head and hands together to harness the benefits of precision technology would be crucial for overall development.

Technology communication is dedicated to technological developments. This is to augment the efforts of the nation to channelize us to a technologically evolved and technologically thoughtful society. It is to work out and share better methodologies and strategies for spreading of technological literacy and technological temper/aptitude across the society.

It is important to inculcate the technological attitude especially amongst children in formative stage with an inherent urge for doing things, whatsoever it may be, in most finished way. It'll allow them to grow with a sharp edge and contribute towards more conducive and rational development.

11. References

[1] Patairiya, Manoj, Technology Communication, NCSTC Communications, May 2001.
[2] ibid, Vigyan Sanchar, Taxsila Publication, New Delhi, 2001.
[3] Kalra, R.M., Popularization of Science in Schools, Vikas Publishing House, Delhi, 2000.
[4] Einstein, A., Ideas and Opinion. Rupa Publications, New Delhi, 1991.
[5] UNESCO Source Book for Out-of-school Science and Technology Education, UNESCO, Paris, 1986.

Learning in Interdisciplinary (non)Formal Contexts – A Means of Developing the Students' Creativity

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Abstract. Our paper presents the way in which such a solution can be performed at high school classes. The paper is articulated around the opportunities of an interdisciplinary project which is going to be developed on an on-line learning site which will facilitate the elaboration of a learning unit.

Keywords. E-portofolio, Formal and non Formal/Informal, Interdisciplinary Project.

1. Introduction

The paper we propose derives from a series of considerations regarding two essential aspects:

1. Realities of Romanian educational system, reflected in a number of statistic studies and research realised by specialists of the Institute of Science and Education Romania and in reports of the European Commission too.

2. Realities of the European educational system (Austrian and Spanish in particular) and European solutions for rendering the didactic act efficient. These solutions, their viability and degree of adaptability – of being performed at the level of the realities from the Romanian high school educational system have been analysed by us within a mobility of Leonardo da Vinci type, of teachers and students.

2. Experimental Learning by using ICT

Specialists in educational politics consider that the realisation of the "postmodern education" cannot exclude a possible conflict between "formal education" (the official one) and the "informal education" (the random one) (Anton Ilinca). Recent studies have reflected the fact that the educational institutions responsible in Romania offer too little attractivity to motivate young people. [1]

In 2006, in Eurostat EU - Adult Education Survey it was mentioned the necessity of transforming a traditional approach into a more

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centred one on an individual perspective, this being one of the challenges of the future. In 2008 the European Commission proposes a program for the 21st century schools [2], insisting on the necessity of more individualised approach of the learning process and a more creative use of evaluation, so that there can be fulfilled, among other objectives of the strategy of Lisbon, those which refer to reduction of early school leaving and improving school attendance.

Regarding the aspect of improving the degree of the students' involvement in their own process of training, we consider that experimental learning, by using ICT in (non)formal interdisciplinary contexts is a European educational solution, viable for the Romanian educational system as well, and it can lead to the increase of students' motivation and the development of their creativity.

The necessity of cultivating the technological humanism which refers to the realisation of equilibrium between the grounding and the rational-technical and scientific formation of the students and the release and cultivation of sensitivity and creativity, determined us to propose three solutions of experimental learning, articulated around two concepts: hands on approach and hands on science.

The paper is articulated around the opportunities of an interdisciplinary project which is going to be developed on an on-line learning site which will facilitate the elaboration of a learning unit. In this virtual space, both students and teachers, will be involved in the collaborative non formal activities which will use, on the one hand, the theory of the multiple intelligence, the approach proposed leading to the formation of key competences for the students and to the development of their creativity too.

On the other hand, the teachers involved in the project, some of them having already been the beneficiaries of the educational program Intel Teach, where they developed their teaching skills, by means of the efficient use of technology, will create contexts of learning so that the computer and the Internet should be used as tools of communication of documenting and development of the students' creativity, who will manifest in a active-participant manner. The opportunities of such an interdisciplinary project, non formal activity conceived as a natural prolongation of an interdisciplinary course taught in class, in an interdisciplinary team, for two years, emphasise the ideas of the specialists according to whom, non formal education must be understood from the perspective necessary to the complementary and cohesive relation formal/non formal/informal and not seen in parallel towards the formal education.

The interdisciplinary project Travellers through cities of Europe (Romanian, ICT, foreign languages, History, Geography, Sciences) was projected as a learning activity and as evaluation as well on the online site, in this format being delivered both the theoretical contents and the products realised by each of the mixed participant teams (students - teachers). The participant teams (Romania, Spain, and Austria) will present their local communities, from the perspective of the concept La Lecture Europeenne de la ville (the European city reading) as Cities of education, Culture and Science (CECS). The projects realised by each team will emphasise the relevant aspects of their cities, from the perspective of history, culture, education, science justifying the belonging to the European Community, not only as a geographical location but as specific ethos, assuring thus the unity in diversity.

The presentations will use multimedia tools. The relevant information and contents for the chosen city's ethos will respect the rules of the journalist genre, such as: written/audio/video reportage, written/audio/video interview, poster, advertising spot, short film, photo reportage/virtual photo gallery of presentation of the important realities for CECS. All these multimedia products will make up the presentation portfolio of the students-teachers team.

3. e-Learning and Web2 Tools in transnational cooperation

The project represents one of the themes that will be approached in the first semester of the school year 2008-2009, in the context of a multinational Comenius project, where Romania (Normal School "Vasile Lupu"- http://elweb2.wordpress.com/pm-romania/)[1] is a partner together with Italy, Portugal, Germany, Sweden, Poland and Bulgaria. The project theme derives from the necessity of developing the students' 21st key competences. "E-learning and Web2 tools as means of enhancing education outcomes and establishing transnational cooperation" (http://elweb2.wordpress.com).

[1] The project team consists of : Sebastian Alexandru - I.C.T. MITeacher (coordinator), Mihaela Ungureanu - teacher of Pedagogy, school head master, Elena Manuca - MITeacher of Romanian, Irina Cosovanu - teacher of French, Roxana Gavrilas - teacher of English.(

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The other themes:

ABOUT FRIENDSHIP, MY
OWN BLOG/PORTFOLIO, ABOUT
MY SCHOOL, INTEGRATION AT
MY SCHOOL, FREE TIME, MY
FAVOURITE FILM, MY
FAVOURITE NOVEL/BOOK, ABOUT
MY TOWN/COUNTRY, TRADITIONS IN
MY TOWN/COUNTRY, FOREIGN CITIZENS
IN MY TOWN/COUNTRY

will allow the communication between the students-teachers teams.

The project proposes to involve in its developing and implementing a team of 6 teachers and a number of 72 pupils (10% of the total number of pupils from school). The mobility will refer to a number of 6 teachers and 18 pupils. The project will allow by our involvement in an active European partnership to realize a comparative analysis of the educational systems from the member countries of the partnership.

The concrete objectives are the following:

- Acquiring knowledge about the educational systems of partner countries
- Improving the quality and the European dimension of continuous training of teachers
- Diminishing the rate of school leaving by stimulating the motivation and the creativity of pupils who come from disadvantaged environment
- Early learning and profound study of foreign languages;

The problems that we will approach are the following:

- Diversification of the curriculum offer of the school within the scope of reducing the rate of school leaving and of increasing the pupils' motivation
- Developing communication competences in mother tongue /studied foreign languages
- Developing the intercultural competence by the realisation of motilities and e-correspondence (e-mail, chat, videoconference, forum)
- Developing the competence of using the ICT by means of e-contents and their inter/transdisciplinary approaches

The ways of approaching /solutioning these problems and, implicitly of achieving the proposed objectives, are as follows:

- Partnerships through which we aim at training competent teachers for a United Europe;
- Training activities for teachers within the scope of using the new informational technologies in education;
- Offering and developing several optional inter/transdisciplinary courses which are to follow the pupils' development of linguistic competences by means of using ICT;
- Offering and developing certain refreshing stages with the teachers from different curriculum areas, aiming at key competences: competence of communication, the competence of using new technologies in education – knowing the e-learning platforms and developing new teaching and learning methods for the pupils capable of performance and, especially, for those with special needs or coming from disadvantaged families;
- Extraschool activities organised within the scope of pupils' knowing of the culture, traditions and customs of other peoples and of developing multilinguism;
- Activities of communitary voluntariate within NGOs/associations with an educational profile.

We propose the following common tasks which should actively involve all the participants to the project:

- Realising a common Internet platform for all the countries involved in the project;
- During the first visit that will take place in one of the project schools, there will be realised an international team/an initiative group to promote the open communication, inter-institutional collaboration and cooperation. Within these teams, there will be established the responsibilities for each participant country. The theme of the meeting is "We, Together, in the Cultural Space of the EU" and has as scope the realisation of a cultural e-portfolio/a virtual mini-encyclopaedia posted on the Internet platform and its multimedia CD - all these being especially created for pupils (a version in the language of the respective country and one in English).
- Realising online seminars by means of the Internet platform where the teachers will debate certain themes from different areas (in the first year of the project there will be discussed themes related to the culture of the countries involved in

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the project)

- Realising and publishing several brochures and multimedia CDs in their mother tongue and a copy in English to be exchanged with the other schools involved in the project about the ethos of each country involved;
- Organising videoconferences between the schools involved in the project where the teachers will debate themes related to the project and will change opinions and ideas about the development of the project.
- Good practice exchange, methods and strategies which envisage integrating ICT in the process of teaching – learning – evaluation.
- Activities of evaluating the project by realising a forum of talks where all the involved partners will fill in a form of the project evaluation.
- Activities of promoting and disseminating the results and the project impact materialised through the presentation of the final product on the project site, on the site of each of the schools involved, media promotion within the frame of international conferences/colloquies.

The most important impact is a radical change of the pupils' attitude towards school, towards its role in educating the young. On the other hand, by means of the intercultural dialogue that it wants to open, this project aims at a more profound awareness of the pupils and of the teachers. Through the proposed activities, there will be developed the team spirit and underlined the civilizing role that the school should have in the society, which ensures the developing of key competences for life. The pupils will develop linguistic competences and competences of using ICT, they will acquire abilities of coordinating and organizing different extra curriculum activities where they will become motivated, creative, will promote their own cultural values and will attribute and refresh the techniques of using ICT within the scope of enlarging the information horizon.

The pupils actively involved in the working teams, coming from under-privileged social environment, will also have an experience that will open new perspectives in developing their career and personality, providing them with competences and abilities necessary to the social insertion as future graduates.

The free time will be used for education in several workshops, voluntariate activities, thus offering the only viable alternative, favourable for learning in a (non)formal environment and of communication in a relaxed and creative atmosphere.

The teachers will be much more involved in the community life, affectively and effectively approaching it by raising the interest in using in education modern methods of informing/NICT, of adapting the learning contents to the pupils' real needs, of disseminating the good practice shared by the partner teachers of the project, of spending extra hours with the pupils outside school.

Within the project that responds to the needs of teachers' and trainers' training, we will have in view the following concrete measures:

- Activities of learning and profound study of foreign languages within the scope of promoting multilinguism in a multicultural Europe by using PROLANG platform;
- Stages of teacher training within the scope of developing abilities of using ICT in the didactical activity and integrating new technologies in the process of teaching, learning, analysis, comparison and exchange of methods and pedagogical good practice;
- Partnerships through which we aim at developing the intercultural competences of the teachers and of the civic spirit;
- Workshops to create e-learning instruments/multimedia encyclopaedias/educational soft within the scope of finding some flexible and balanced ways of their using in didactical context
- Stages of presenting and using the e-learning platforms and of developing new methods and web 2.0 instruments of teaching and learning for the pupils capable of performance as well as for those with special needs or coming from disadvantaged families;
- Educational fairs organized to create and offer new optional (inter/trans/disciplinary) subjects integrated in the educational offer of the school.
- Online Summer School - *ELITSCIENCE*-Challenges within the European Space, proposed by a team of teachers from "Vasile Lupu" Normal School, is articulated around two concepts *hands on approach* and *hands on science,* which organize identically and practically the activities projected in an interdisciplinary manner.

The project will be launched at a national and international level (within the active partnership

 ISBN 978-989-95095-3-5

with the project schools), and then it actually develops online, for three months, when there are a series of individual or group activities, with a diverse topic, of common interest for the young teenagers. The online journalism school will end with a competition on interdisciplinary projects – multimedia applications which will be evaluated by a jury formed from professionals from different areas (science, literature, audio-video-written journalism, photographic art, film direction). All the projects realized during this summer school will be the object of a final product, which will be distributed to the schools involved in this network of active partnership that we will initiate, as an example of educational extra curriculum good practice, valuing the multiple possibilities of NICT in motivating and developing the pupils' learning styles.

- Extra curriculum activities of creating corporatist blogs/e-portfolios through which we aim at e-communicating in the web space.

The teachers' role will be that of facilitators in the activity of the pupils involved in the project, during its entire period, as follows:

- In the implementation stage, by developing the activities proposed (debates, exchange of innovative practice, realizing and bringing up-to-date the project site, organizing the online summer school, corroborating the activities with those of the partners)
- In the evaluation and dissemination stage, by realizing the final product, posting it on the school site and magazine, presenting all the multimedia products on the platform of the E-lit Science online summer school, the press conference, presenting the project within pedagogical meetings, national and international conferences. (ELSE Bucharest, Hands-on-Science, Portugal, etc).

4. Conclusion

The project results and products will be used for the dissemination of the project as well as in the pupils' and teachers' practice by exploiting the key competences – competence of communicating in the mother tongue/foreign languages, competence of using ICT, by continuing the partnerships with the partner institutions, by starting other partnerships at both national and international level.

The direct access to the online site to all e-portfolios created by the participants will facilitate the realisation of an intercultural change, the project being, from this perspective, an efficient and motivating modality for students to use cultural diversity, of strengthening the interest for the process of self-training, by using modern educational methods, ICT, a viable solution for the development of the competences of communication-interrelation, of developing team working spirit, of making the individual responsible within the group, of increasing the degree of empathy teacher – students and, implicitly, a modality of dissemination of the good practice models identified within the project.

5. References

[1] Costea, Octavia, editor*.* Contribuția educației nonformale la dezvoltarea competențelor de comunicareale elevilor*,* Bucuresti*,* Institutul de Stiinte ale Educatiei; vol II*,* 2004.

[2] Improving competences for the 21st century: a program for European cooperation in school subjects; 2008, http://ec.europa.eu/education/news/news492 en.htm

[3] http://roinfocds.blogspot.com, a course performed at the philology classes of the last 2 years of high school, for 2006-2008, by prof. Elena Mănucă, trainer Centre Educatia2000+, prof. Sevastian Alexandru and prof. Roxana Gavrilaş.

 ISBN 978-989-95095-3-5

Learning by Doing. Filling Children with Enthusiasm for Scientific Discovery

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Abstract. Many organizations around the world have programs to improve science education in primary and secondary level schools. TUBA (Turkish Academy of Sciences) members have participated in international seminars on this issue.

Following a meeting with field experts, a summer conference was organized for science teachers in 2004. An innovative pilot study in Turkey was initiated in 2006 under the coordination of TUBA.

The purpose of this paper is to give a short history of the Science Education Project initiated by TUBA and to give examples of unique approaches and teaching methods which encourage students' active participation in learning science, that have been shared during the meetings and workshops coordinated.

Keywords. Science Education Project, Learning by Doing, Educational Website, Development of Scientific Resources.

1. Introduction to Project

In order to determine a strategy for improving primary science education, TUBA's Science Education Commission held a meeting with field experts on 9 May 2004. The following points of view were adopted at this meeting:

- Setting up a portal on science education which will provide easily accessible materials for teachers and will also enable them to share the teaching methods they use
- Organizing a summer school for science teachers to enhance their own development by exposure to new teaching methods
- Promoting the foundation of science centres in Anatolia to awaken the interest of people towards science
- Cooperating with schools to develop alternative means and practices before the university level to help students grow a liking for science by also using technical tools, and to combat the system of education based on memorizing. [1]

Cooperation with different foundations and institutions is envisaged within the framework of this program and certain relationships have already been set up. As a first step, a summer conference was organized for 14 primary school science teachers in Istanbul, between 29 August and 4 September 2004. Following this summer conference for teachers, a pilot study in Turkey was initiated in 2006 under the coordination of Prof. Dr. Yücel Kanpolat in Ankara. A series of conferences, the first of which was held by Prof. Dr. Kanpolat himself, were conducted for the teachers. Prof. Dr. Yves Quere, who is a leading name in the Science Education Movement in France, was invited to Turkey. He delivered presentations in Ankara on 17-18 April, 2007 and in Istanbul on 19-20 April, 2007. In these presentations, Prof. Dr. Yves Quere presented how the 'La main A La Pate' (LAMAP - Learning by Doing) Program was initiated in France, its goals and the responsibilities of the teachers in this program. He shared case stories based on his own experiences. The teachers in the participant schools acquired some first-hand information and hands-on experiences through these presentations. [1,2,3]

Following the conferences, evaluation meetings were organized with the participation of four primary schools. It was agreed that the each participating school would deliver presentations through which they would share examples of their unique approaches related to science education. First presentations were made by four selected primary schools in Ankara in 2007 through which valuable exchanges and new ideas were obtained and which, more recently, led to an evaluation meeting with the same schools. The second round of presentations with the schools occurred in 2008. A regional workshop with the participation of teachers both from primary and government schools, scientists and officials from Turkish Ministry of Education took place in Zonguldak, Turkey between 25 and 29 June, 2008. [1]

2. Inquiry-based science teaching

Learning by doing is based on the personal investigation which helps pupils develop cognitive processes as well as the sense of curiosity and creativity. In front of new and unexpected concrete situations, they are invited to reason, argue and question the nature itself, thus building up a new relationship to the sensitive world and to the "truth". Inquiry-based activities allow them to acquire new communication skills, through open debates in the classrooms, and with the teacher. Instead of the classical schemes of memorization and

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concentration of scientific concepts or formulas, the proposed methodology insists on the appropriation of knowledge through the individual investigation and questioning attitude, leading the children to learn by experimenting in partnership with the teacher.

A progressive and interdisciplinary approach of science is favoured in a close collaboration between pupils and teachers. Instead of accumulating large amounts of knowledge, teachers are encouraged to make the children appropriate the scientific concepts and experimental techniques through their own process of investigation. [2,3]

3. Interdisciplinary projects and activities

A number of scientific projects, unique approaches and teaching methods which encourage students' active participation in learning science have been shared during the meetings and workshops for teachers coordinated by TUBA since 2006. Teachers were invited to present their interdisciplinary activities in an integrated teaching, which allows students to reinforce their knowledge in various fields and practice exciting science at the same time.

Four examples of these activities presented by selected primary schools in Ankara in 2007 which successfully contributed to renovate the manner of teaching science in these schools are stated as follows. [1]

3.1. 'Children as Researchers' Project Presented by: Private Arı Schools

In the 2006-2007 educational term, Arı Primary School was involved in The European Union's Lifelong Learning / Comenius Program. The project represents six different European Regions, Turkey, Sweden, United Kingdom, Norway, Lithuania and Latvia.

3.1.1 Aim of the Project

The aim of the project is to explore, compare and identify the best ways to teach young students in primary schools and preschools the skills they need to become active researchers and how this can be further developed and embedded in their curricula

3.1.2. Integration of the Project into the Curriculum

- Literacy (guided reading, analysis of text and report writing)
- Numeracy (construct graphs, analyse data)
- ICT (MS Power point presentation, MS Excel, general MS Word skills)

3.1.3. Method

In April 2007, an educational program was conducted at Arı Primary School. The teaching program was made up of twelve sessions with eighteen students and ten teachers. For three sessions, the aim and the process of research methods and the skills were discussed with the teachers.

Table 1. The research questions framed by the students

Level (Class)	No of Students	Research Topics
1	4	Why do babies cry?
2	4	Is coke harmful? Why is it sold in schools?
3	2	How should class arrangement be?
4	2	Why do people do shopping?
5	1	Which is more interesting Mathematics or English?
5	1	Do students like using computer?
6	1	Why do people blink their eyes?
7	1	Why do people listen to the music or sing?
7	2	Are you prepared for an earthquake?

Studying processes of eighteen students, from different age levels in the study group, were evaluated within the context of following criteria:

The pilot group of eighteen students was selected from first grade through seventh grade. Initially, students were informed about the steps of research techniques. In groups of two, they framed a research question and prepared their research plans.

The students collected data for their research study through interviews, observations and questionnaires over a period of three weeks. After the data analysis stage, the students wrote their own research reports and disseminated their findings.

Table 2. The Evaluation Criteria

• Students' readiness to begin, continue and conclude studying.
• Being ambitious to study
• Being in need of the guidance from teacher or parents
• Using oral ability, having the ability of self expression
• Participation into the group study
• Having the ability of presentation
• Studying independently

3.1.4. Conclusion

Study results showed that little grades needed more help from their teachers or parents. However, they were so excited and enthusiastic about the Project.

When their ages were getting upper, they had more bias about their school life, and they could be unwilling during the Project from time to time.

All students finished the Project successfully and stated that they would research another topic. This study showed that, teacher's guidance was very important for students and they needed it. We decided to carry out the Project as extracurricular activity as research club.

Figure 1. The students in Arı College collecting data for their research study

3.1.5. Evaluation and discussion

As some of the findings, which were obtained at the end of the project implication period, pointed out students gained:

- critical thinking skills
- study skills: organization, management, analysis, evaluation
- creativity
- communication skills
- heightened ethical awareness
- motivation
- raised self-esteem
- independent learning

Once completed, Children as Researchers Project;

- created a critical mass of research by children and young people
- provided a unique 'insider' child perspective
- informed our understanding of childhood and children's lives.

3.2. 'Experiment and Observation' Presented by Elementary School of Tevfik Fikret

3.2.1. Stating the Problem

At the beginning of the lesson, a problem is introduced to the students. They face with problems for which they have to find a solution through experimentations and debates in a team. For example, the lesson starts with a question like; 'How can you change brightness of a bulb?' The answers are discussed among the students and the teacher. A second key question as 'Can you change brightness of a bulb by keeping all elements of the circuit constant? And how?' Follows the first one.

3.2.2. Seeking Solutions to Real World Problems

The second step is to help the students build a bridge between the problem case and the daily life experiences by raising a question as 'Is it necessary to change brightness of a bulb in daily life?'

Some of the students' answers to this question are as follows:

Ugurcan: "We can save the electricity by adjusting the brightness of a bulb depending on the sunshine."

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Mehmet Ege: "While babies are sleeping, the intense light disturbs them. Thus, we can adjust the brightness of a bulb."

3.2.3. Testing hypothesis

- Small groups are formed in order to test the hypothesis. Each group is given electricity circuit equipments.

- Following instruction is given to the students:
'Examine the circuit equipment and try to change brightness of a bulb by keeping battery and bulb constant'

- Then, 'changing conductive wire in the circuit' is suggested to the students.

- Each group is given:

- two wires at same length and same cross-section, but different type
- two wires at same length and same type, but different cross- section
- two wires at same cross-section and same type, but different length

- Students are asked to take notes of their observations during the experiment.

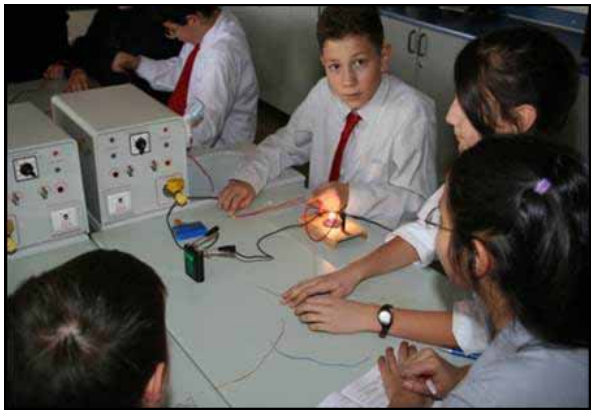

Figure 2. The students in Elementary School of Tevfik Fikret are testing hypothesis

3.2.4. Conclusion

Each student is expected to reach a conclusion of the experiment based on his/her own observations and to share his/her ideas with each other.

3.2.5. Class discussion

Finally, the question of "How can this knowledge affect our daily life?" is asked to the students. An example of the answers is stated as follows:

Ekin: "While I was utilizing devices at home, I noticed the length of wire because resistant was proportional to the length of the wire."

3.3. 'Expansion and Contraction' Presented by: METU Development Foundation School

3.3.1. Science Activities in K-3

METU Foundation School is associated with Middle East Technical University. Science activities are performed in K-3.
These activities are:

- in parallel with other disciplines
- conducted with the collaboration of home teachers.
- integrated with Social Studies Course.
- based on inquiry based learning
- hands-on experiments
- enjoyable for students and provide positive attitude towards science

3.3.2. General Frame of a Sample Activity

Title: Expansion and Contraction

Grade level: 3 rd grade
The program is free and implemented in every two weeks.

Conceptual Strand: Most materials expand (enlarge) when heated, contract (shrink) when cooled.

Guiding Question: 'What causes most materials to expand and contract?'

Objectives: Based on the topic '**expansion** and **contraction**',

- Students carry out;

- investigations using inquiry based learning,
- hands-on laboratory investigations,
- group activities.

- Students are afforded the opportunity to apply knowledge and prerequisite

skills, habits of mind needed for problem solving.

- They develop critical thinking skills.

Performance Indicators:

At Level 3, the student is able to:

- explore thermal expansion and contraction.
- carry out hands-on experiments through the use of everyday tools.
- solve problems related to expansion and contraction in daily life.

3.3.3. Application in the Classroom

At the beginning of the activity, a problem is introduced to the students as the first step. The students respond to the question of 'How can you open the squeezed lid of a jar?' by several answers during the debate. One example of the answers has been noted as follows:

Student: 'We put the jar into the hot water and then into the cold water, the lid of the jar becomes loose and opens as if saying: I cannot stand anymore!.'

3.3.4. Sample Case

Two pictures that illustrate the position of electric wires both in summer and winter in the same area, is shown to the students by their teacher and the question of 'What causes the electric wires sag?' is followed. The students search for the answers and bring their personal experiences into the debate by saying for example;

''The wires are getting closer in winter.'
'As far as my father is concerned, the rails...'

And the discussions are made about the situation.

3.3.5. Experimental Investigation: Expansion and Contraction of Bi-Material Tape

The students build hypotheses which they have to test through new experiments. The experiments are defined by the teacher in order to help the students. They explore their path step by step before reaching the final solution.

An experiment is conducted in the classroom in order for the students to observe the expansion and contraction.

During this experiment;

- Fifteen cm of clear tape is stuck to the dull side of aluminium foil.
- This bi-material strip is held over a candle, keeping it high enough over the flame to avoid frying it.
- The question of 'What happens and why?' is asked to the students.

The students discover the fact that different materials expand by different amounts and at different rates. The bi-material strip bends toward its aluminium side as it heats up; away from its aluminium side as it cools down. On heating, the tape expands faster, bending towards the slightly shorter aluminium. On cooling, the tape contracts faster, bending away from the slightly longer aluminium.

3.3.6. Solving the Problem

At this stage, the question of 'How do you think you can open the lid now?' is asked to the students. Without any scientific background, they have to question, search for the answers, speculate how it may be opened, give arguments to support their speculations, draw conclusions and finally learn the scientific investigation process. By experimenting, they put the jar upside down into a bowl filled with hot water. The lid enlarges and leaves the jar.

Figure 3. The students in METU Foundation School are separating two locked glasses

3.3.7. Applying the Knowledge

Finally, a number of new problems that may have been originated from the students' personal

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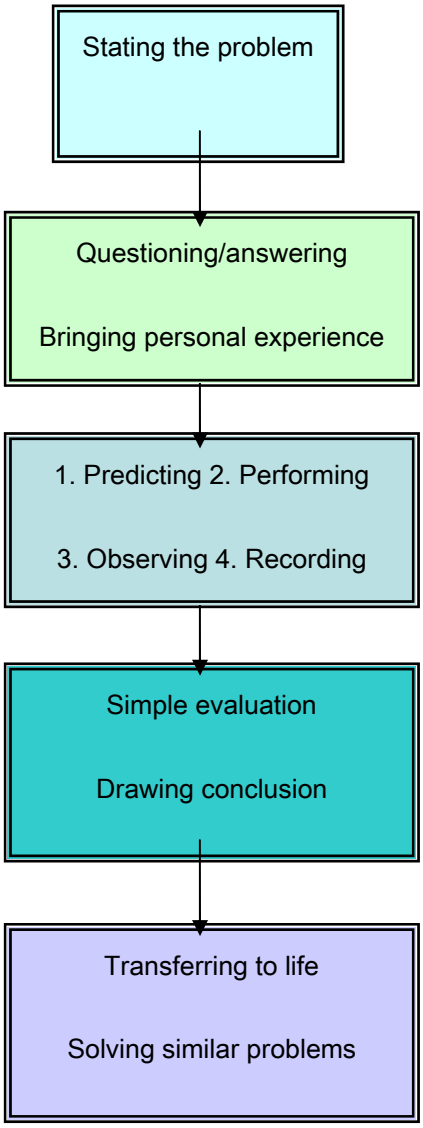
experiences are discussed with the students. They then are asked to search for the solutions through experimental methods. The sample problems and questions are as follows:

Problem 1: The glasses are locked.
Question: How can you separate two locked glasses?

Problem 2: In summer, glasses become loose and drop.
Question: Can you think of any solution for glasses?

3.3.8. Conclusion



In problem solving approach, the teacher takes on a different role as compared to traditional teaching methods. In this approach, the teacher is a guide. The guide maintains to focus on learning and provides appropriate feedback for each student team. Being hands-on and student-centred, problem solving approach is a very effective method for the students to use their critical thinking skills and practice working in teams.

Problem solving approach has a structured format of different stages when compared to inquiry based learning which has an open format that allows students to create their own learning process.

Teaching methods that incorporate problem solving approach and inquiry based learning may be used at schools since both methods have proved that they are promising practices.

3.4. 'Science Camp' Presented by: Ankara University Development Foundation Primary School

3.4.1. Description of the Study

Sixty one students from 7th grade and thirty teachers from Ankara University Development Foundation School took part in Science Camp Project in 2008-2009 educational year. Prior to the camp activities, preparatory meetings were organized by the school twice. The students were divided into groups of ten. Groups were guided by their teacher and took after the name of a famous scientist. The students researched for the biography of the scientist and prepared the posters illustrating his/her work. The camp lasted for one and a half day during the weekend at the school backwoods.

3.4.2. Aim of the Project

The aim of the Science Camp Project is to create a nature based learning environment in which, through outdoor activities, the students:

- explore the dynamics of natural scientific processes
- learn scientific methods by example
- learn actively through increased interest and curiosity
- practice hands-on and minds on activities which encourage them to ask and experiment questions
- develop their skills in student-student and student-teacher social interaction

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3.4.3. Science Activities at the Camp

	Name of the Activity
1	Let's Make Cookies
2	Nature and Science
3	Food Webs
4	The Relationship Between the Beak Shape and the Feeding Type of the Birds
5	Rodents and Insects
6	Physics, Behind the Natural Phenomena All Around Us
7	Archaeology
8	Bees
9	Observing Sky

3.4.4. Competitions and Games at the Camp

	Name of the Activity
1	Science Station
2	Creating a Frog Model
3	A Sandbag of 100 kg
4	Can You Take An Egg Down Without Breaking?
5	'The Best Scientist' Presentation
6	'The Best Plant' Photography Competition
7	'The Best Animal' Photography Competition
8	'The Most Attractive Activity' Photography Competition
9	'The Funniest Memory of the Camp' Photography Competition
10	'The Most Interesting Memory of the Camp' Photography Competition

3.4.5. Artistic Activities at the Camp

	Name of the Activity
1	Art Workshop
2	Tale Webs and Shadow Games
3	Creating a Camp Picture (Painting Activity)

3.4.6. Data Collection and Findings

Immediately prior to and after completing the camp activities, pre and post tests were administrated to the students. The findings were stated as:

	Pre-test(%)	Post-test(%)
Golden Ratio	3	74
Ratio and Proportion	47	67
Geometry	61	75
Rodents	39	92
Biodiversity	33	81
Plant Museums	47	81
Constallations	39	61

Figure 4. Students at Science Camp

3.4.7. Evaluation and Sustainability

In the Science Camp for two years, it was observed that the students started to look at the nature from different edges, to be more curious, to ask more questions, and to be more interested in scientists' life. In order for Science Camp Project to be more sustainable, Science Camp was generalized by Scientific Committee. An update / revise in the camp program, according to students' outcomes changed in per year, was accepted as main principle of sustainability. Extending the length of the camp and disseminating the camp to every topic were viewed as the issues needed to be developed.

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4. Conclusion

Science Education Project: A Nation-Wide Initiative

In the future, TUBA hopes to help teachers by linking scientists, researchers, teaching specialists and teachers dealing with students aged four to eight in Turkish schools through an educational portal (website). This website will be based on the framework of the Science Education Project. From the web site, the teachers will be able to access resources and activities for the classrooms, documentations, ask questions and exchange information with their colleagues and scientists. They will also be linked to the world of research through this site. Development of scientific resources and international projects will be encouraged.

5. References

[1] www.tuba.gov.tr
[2] http://www.lamap.fr
[3] http://www.mapmonde.org

Partitive Mixing of Colours Interactive Device

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Abstract. Rotating a disk with differently coloured sectors is a well-known means of achieving partitive mixing of colours. Most educational devices applying this technique use a single motor that spins only one disk at a time, requiring different disks to be swapped between them. This paper describes an interactive device equipped with five motors, each one holding its own disk. These motors can be switched on individually, allowing more than one disk to rotate at the same time. Some fundamentals on colour mixing are introduced. A few construction details are given, too. The device, built for a science exhibition, has also been used in the classroom.

Keywords. Colour science, Colour Mixing, Additive Mixing, Partitive Mixing, RGB, Newton's Colour Circle, Maxwell Triangle, Maxwell Disks.

1. Introduction

Partitive mixing of colours is a type of additive mixing of colours and can be achieved by a spinning disk with differently coloured sectors. Most educational devices with such rotating disks use a single motor fitted with an adaptor capable of holding only one disk at a time. So, different disks must be swapped between them. This paper describes an interactive device equipped with five motors, each one holding its own disk. These motors can be switched on individually, which allows more than one disk to rotate at the same time.

The device (Figure 1) was built for the Mostra Interactiva de Ciência e Tecnologia[2] (Interactive Exhibition of Science and Technology) – integrating part of the Projecto Ciência na Cidade de Guimarães (Science in Guimarães City Project). Since then, it has been used in science exhibitions and classroom demonstrations in several schools.

Section 2 introduces some fundamentals on colour mixing. Section 3 lists the main materials

[2] Mostra Interactiva de Ciência e Tecnologia, Palácio Vila Flor, Guimarães, Portugal, April 14 – 20, 2008.

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used to build the device. Section 4 gives some details on the construction and operation of the device. Section 5 contains the conclusions of the paper. After the acknowledgements in Section 6, a list of references is given in Section 7.

2. Colour Mixing

It is common knowledge that mixing blue and yellow paints produces green paint. However, mixing proper amounts of blue and yellow lights produces a white light (Figure 2). In fact, there is a fundamental difference between mixing pigments or dyes and mixing lights.

Figure 1. Showing the device in the Mostra Interactiva de Ciência e Tecnologia (Interactive Exhibition of Science and Technology)

Mixtures of pigments or dyes are, usually, complicated processes which results are ruled by their power to subtract certain regions of the spectrum from the incident light [1, 2, 3]. For this reason, the mixing of pigments or dyes is called subtractive colour mixing.

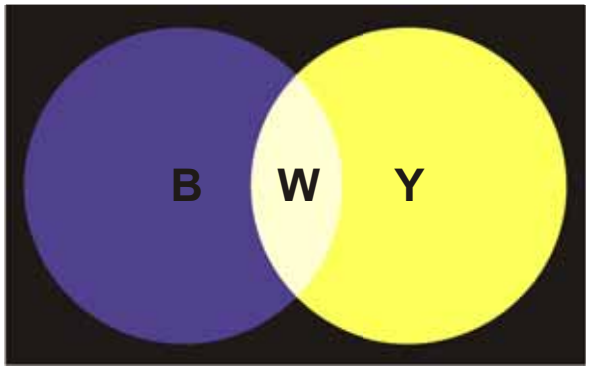
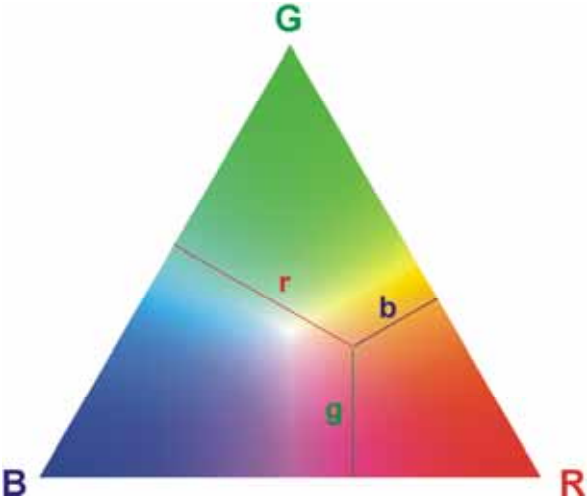


Figure 2. Mixing proper amounts of blue (B) and yellow (Y) lights produces a white (W) light

The wavelengths of two or more coloured lights seen together are added. So, the mixing of coloured lights is called additive colour mixing [1, 2, 3].

Additive mixing of different quantities of red, green and blue colours produces a wide range of colours, which can be displayed inside an RGB Maxwell Triangle (Figure 3).



Line segments r, g and b are perpendicular to GB, BR and RG sides of the equilateral triangle, respectively. The lengths of these line segments represent the quantities of red, green and blue required to produce the colour displayed at the intersection of the segments.

Figure 3. The Maxwell Triangle

Cyan, magenta, yellow and white colours can be produced by the following additive mixtures (Figure 4):

- Mixing balanced green and blue lights produces a cyan light;
- Mixing balanced blue and red lights produces a magenta light;
- Mixing balanced red and green lights produces a yellow light;
- Mixing balanced red, green and blue lights produces a white light.

Red, green and blue are additive primary colours. Each of these colours cannot be produced by any additive mixture of the other two. Cyan, magenta and yellow are secondary colours, produced by mixtures of two primary colours. White is a tertiary colour, since it is produced by a mixture of all three primary colours. The positions of these seven colours on the Maxwell Triangle are shown on Figure 5.

2.1. Partitive mixing with coloured disks

Isaac Newton separated white daylight into a sequence of coloured lights divided into seven colour regions, called Spectrum, and proposed a

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diagram such that a rectangular spectrum is bent into a cylinder and then viewed in cross-section [4]. This diagram [5] is known as Newton's Colour Circle (Figure 6).

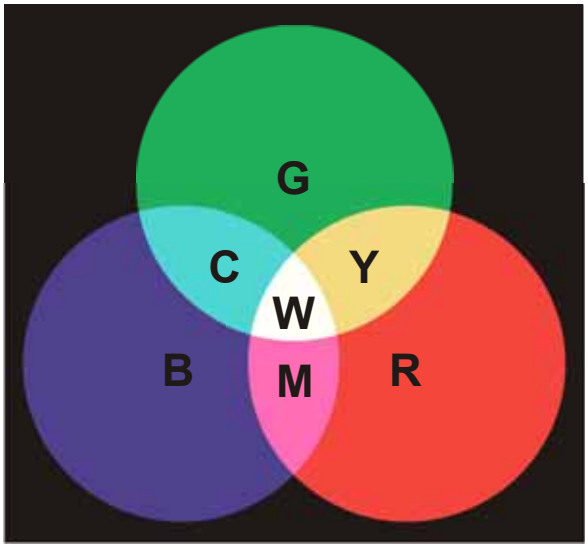

Figure 4. Obtaining cyan (C), magenta (M), yellow (Y) and white (W) lights from mixtures of red (R), green (G) and blue (B) lights

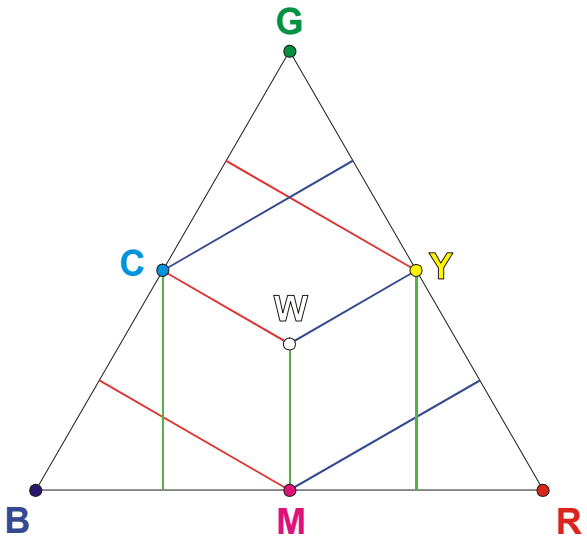

Figure 5. Positions of red (R), green (G), blue (B), cyan (C), magenta (M), yellow (Y) and white (W) colours on the Maxwell Triangle

The proof that all the spectral colours could be recombined to form white light is also due to Newton [4]. One approach to accomplish this recombination consists of rapidly rotating a disk containing sectors with the colours existing on Newton's Colour Circle. The device described in this paper has a disk with 7 colours in 14 sectors. It would also be expectable to obtain white by rotating a disk with balanced red, green and blue sectors (disks with different combinations of red, green and blue sectors are known as Maxwell disks). However, rotating disks can only produce greyish white, as will be explained.

Obtaining a colour by rotating a disk with differently coloured sectors belongs to a type of additive mixing of colours known as partitive mixing. The amount of each colour in the mixture result is proportional to the sum of the areas of the sectors it occupies in the disk [3, 4]. As a result, the brightness of the mixture is lesser than the one obtained with simple additive mixing [6].

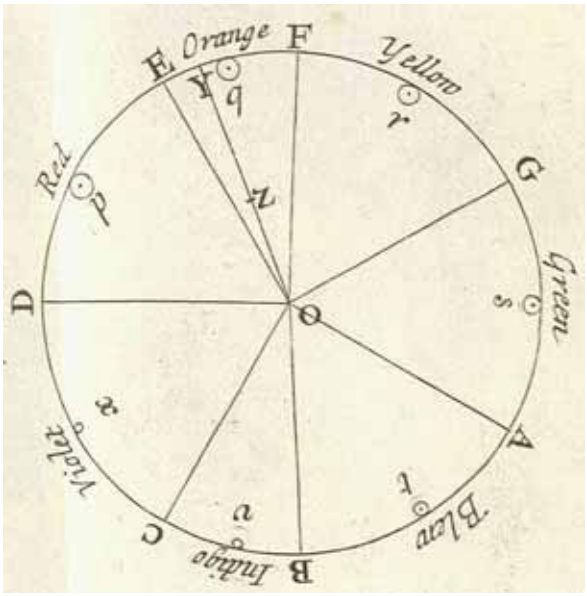

Figure 6. Newton's Colour Circle [5]

In expressions (1), (2), (3) and (4):

- R_{disk}, G_{disk} and B_{disk} are the brightness of red (R), green (G) and blue (B) primaries in the mixtures obtainable using RGB rotating disks with the coloured sectors configurations used in the interactive device (Figure 7);
- R_{disk}, G_{disk} and B_{disk} are the brightness of red (R), green (G) and blue (B) primaries in each disk surface.

$$\text{GB disk}\begin{cases} G_{mixture} = \frac{1}{4}G_{disk} + \frac{1}{4}G_{disk} = \frac{1}{2}G_{disk} \\ B_{mixture} = \frac{1}{4}B_{disk} + \frac{1}{4}B_{disk} = \frac{1}{2}B_{disk} \end{cases} \quad (1)$$

$$\text{RB disk}\begin{cases} R_{mixture} = \frac{1}{4}R_{disk} + \frac{1}{4}R_{disk} = \frac{1}{2}R_{disk} \\ B_{mixture} = \frac{1}{4}B_{disk} + \frac{1}{4}B_{disk} = \frac{1}{2}B_{disk} \end{cases} \quad (2)$$

$$\text{RG disk}\begin{cases} R_{mixture} = \frac{1}{4}R_{disk} + \frac{1}{4}R_{disk} = \frac{1}{2}R_{disk} \\ G_{mixture} = \frac{1}{4}G_{disk} + \frac{1}{4}G_{disk} = \frac{1}{2}G_{disk} \end{cases} \quad (3)$$

$$\text{RGB disk}\begin{cases} R_{mixture} = \frac{1}{3}R_{disk} \\ G_{mixture} = \frac{1}{3}G_{disk} \\ B_{mixture} = \frac{1}{3}B_{disk} \end{cases} \quad (4)$$

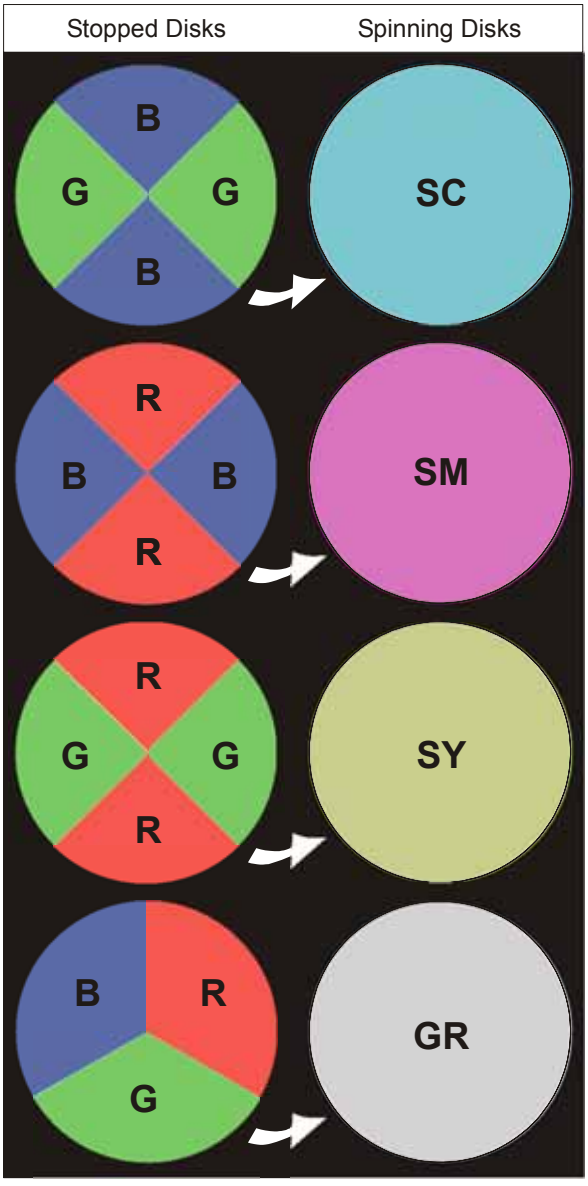

Figure 7. RGB disks coloured sectors configurations and colours obtainable with spinning disks: shady cyan (SC), shady magenta (SM), shady yellow (SY) and grey (GR)

The brightness of the mixture produced by the tricolour RGB disk is only 1/3 of the brightness obtainable with simple additive mixing of its red, green and blue primaries. Moreover, disks use paints and not light sources. Since mixing paints is a "subtraction process due to absorption and scattering, the surface becomes less reflective and can give grayish shades only" [4].

3. Materials used to build the device

The main materials used to build the device were the following:

- 4 metallic disks with RGB sectors (diameter: 10cm) (Figure 8 and Figure 9);
- 1 metallic disk with 7 colours in 14 sectors (diameter: 9,7cm) (Figure 8 and Figure 9);
- 5 inox push buttons (Figure 10);
- 5 permanent magnet 3V DC motors (Figure 11);
- 5 brass adapters (Figure 12);
- 1 Bonfil wooden sketch box with 39cm x 31cm x 7,5cm (Figure 13);
- 1 DC socket (Figure 14);
- 1 HQ non-regulated 500mA power supply (3V output selected), ref. P.SUP.02-HQ;
- 1 plywood board with 28,5cm x 36,8cm x 1cm.

Other materials include black paint, glue and electric wire.

4. Some details on the device construction and operation

Figure 8. The device has five metallic disks with coloured sectors

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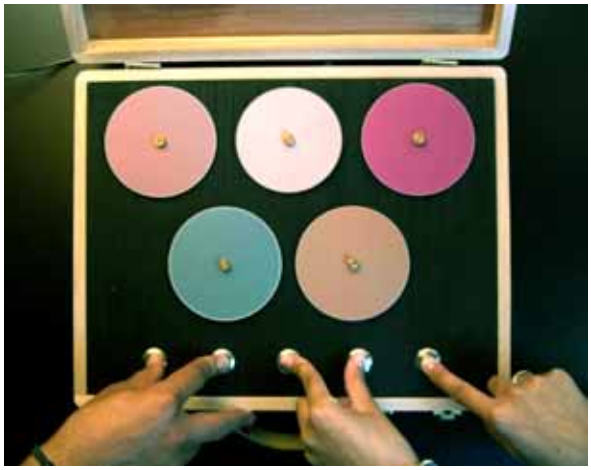

Figure 9. All disks can rotate at the same time

The device has five metallic disks with coloured sectors (Figure 8). These disks were already described in Section 3. They are activated independently from each other and can rotate all at the same time (Figure 9).

Each disk is set to rotate by pressing a specific push button (Figure 10), which switches on the DC motor (Figure 11) attached to the disk. A brass adapter (Figure 12) was used to attach each disk to its motor.

Figure 10. Inox push button

Ten holes were drilled in a plywood board, in order to hold the DC motors and the push buttons. The board was painted in black before the mounting of the motors and the push buttons. Once the motors and the push buttons were in place, the plywood board was accommodated inside a wooden sketch box (Figure 13).

A DC socket placed in the rear of the box (Figure 14) allows an external DC power supply to feed the device.

The schematic of the circuit formed by the power supply, motors and push buttons is shown in Figure 15.

Figure 11. Permanent magnet 3V DC motor

As expected, the colours obtained with rotating disks have low brightness (Figure 9). The two-colour GB, RB and RG disks produce dark cyan, dark magenta and dark yellow. The tricolour RGB disk produces a brownish shade and the 7 colours disk produces a pale grey that is a much better approximation to white.

Figure 12. Brass adapter

Figure 13. Bonfil wooden sketch box

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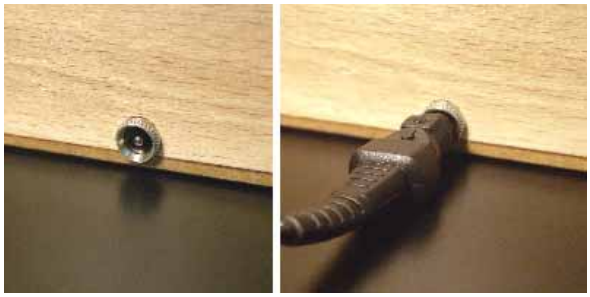

Figure 14. A DC socket placed in the rear of the box allows an external DC power supply to feed the device

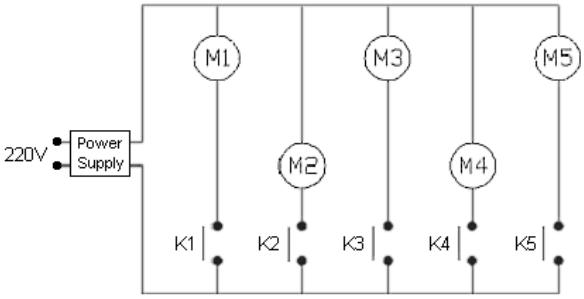

Figure 15. Schematic of the circuit formed by the power supply, motors (M1 – M5) and push buttons (K1 – K5)

5. Conclusions

An interactive device, suitable to demonstrate partitive mixing of colours, has been presented. It uses the following rotating disks:

- Three two-colour, four sectors, RGB disks;
- One tricolour, three sectors, RGB disk;
- One 7 colours, 14 sectors disk.

The device is equipped with five motors that can be switched on individually and each motor holds its own disk. So, more than one disk can rotate at the same time. It is even possible to make all disks rotate at once.

Some fundamentals on colour mixing were introduced. A few construction and operation details were given, too.

The colours obtained with rotating disks have low brightness, which is inherent to this way of accomplishing partitive mixing of colours:

- Two-colour RGB disks produce shady cyan, shady magenta and shady yellow;
- The tricolour RGB disk produces a brownish shade;
- The 7 colours disk produces a pale grey that is a much better approximation to white than the colour produced by the tricolour RGB disk.

The device has been successfully used in science exhibitions and in the classroom.

6. Acknowledgements

The device construction was funded by the Projecto Ciência na Cidade de Guimarães (Science in Guimarães City Project), which was sponsored by the Programa Ciência Viva (Living Science Program). The authors are grateful to Pedro Souto, Filomena Soares, João Sepúlveda and Maria Rodrigues for their support.

7. References

[1] McLaren, K.; The Colour Science of Dyes ad Pigments (2nd ed.); Adam Higler Ltd., 1986.
[2] McDonald, R., Colour Physics for Industry; Society of Dyers and Colourists, 1987.
[3] Lucas, J; Valldeperas, J.; Hawkyard, C.; Van Parys, M.; Viallier, P. and Carneiro; N., Colour Measurement – Fundamentals (Vol. I); Eurotex, 1996.
[4] Choudhury, A., Kumar R., Modern Concepts of color and appearance; Science Publishers, Inc., 2000.
[5] Newton, I., Optics: or, a treatise of the reflexions, refractions, inflexions and colours of light. Also two treatises of the species and magnitude of curvilinear figures, London, Printed for Sam Smith, and Benj. Walford, 1704. http://posner.library.cmu.edu/Posner/books/book.cgi?call=535_N56O_1704
[6] Briggs, D., Partitive Mixing; The Dimensions of Colour (online); 2007. http://huevaluechroma.com/044.php

5th International Conference on Hands-on Science
Formal and Informal Science Education
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Developing a Sense of Connectedness to the Natural World: Latest Impressions from the Unique and Universal Project

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Abstract. The Unique and Universal Project is a global environmental project which uses hands on and minds on science activities to help children aged ten to fourteen explore the interrelationships in nature through the use of scientific processes. The project was initiated by METU Foundation School, Ankara, in 2005 and has been coordinated by this school since then. Three primary schools located in Turkey, the USA and Romania have been involved in the project.

The aim of this paper is to summarize the latest developments in the third year of the Unique and Universal Project and to share examples from the Project to illustrate the impact of the Project on students and the natural environment. The long-term goal of this project is to demonstrate the importance of having students develop a sense of their own connectedness to the natural world so that they will become stewards of the world of which they are a part. By learning in the "outdoor classroom", students develop new ways of gaining knowledge that are currently not being developed in the "indoor classroom".

Keywords. Endangered Species, Threatened Habitats, Connectedness to Natural World, Monitoring Water Quality, Scientific Processes.

1. Introduction to Project

The Unique and Universal Project has two closely related dimensions; studying endangered species and studying their habitats.

Within the frame of the project, a threatened wetland ecosystem in the vicinity of the school and an endangered species living in that area are chosen as the target area and the target species to be studied scientifically by the student teams and their teachers.

At the beginning of the educational year, a plan for the year is constructed with the contributions of project coordinator and students. During regular field trips organized to local wetlands, water quality tests are conducted, findings are recorded, the results of the tests are interpreted, the cause and effect relationships on the ecosystem are interpreted, problems are identified, and possible solutions are brainstormed. Meanwhile, research is carried out and reports are written by the students to learn the characteristics of the chosen species and the threatened area. With this information, the students consider the question of how the studied habitats can be enhanced to improve the survival rates of the selected species and share their thoughts in letters to students in other schools in the Project.

Figure 1. Turkish team planting seeds

It is hoped that students will have a continuing collaboration throughout the year. Through the scientific research carried out by the students they develop an understanding of the cause and effect relationships found in nature and the students learn to interpret these relationships. Students also develop an important sense of caring for and belonging to the natural world which they then want to protect and enhance. In this way, students increase their awareness of and develop positive attitudes towards endangered species and threatened habitats through the project. At the beginning and the end of each term, assessments are given to determine if students are meeting the established project outcomes through their work in the Unique and Universal Project.

1.1. Brief Summary of Selected species and study sites

The selected species and the habitats studied by the student teams from three schools located in Turkey, Romania and the USA are summarized as follows:

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Countries	Endangered Species	Threatened Habitats
Turkey	**1st Year** Centaurrea tchiatcheffii	**1stYear** Mogan Lake
	2nd Year Oxyura leucocephela	**2nd Year** Eymir Lake
	3rd Year Crocus anycrensis	**3rd Year** Yenihisar Pool
Romania	**1st Year** Ardea cinerea	**1stYear** Tur Valley
	2nd Year Rana lessonae	**2nd Year** Odoreu
	3rd Year Iris pseudocorus	**3rd Year** Carei plain
The USA	**1st, 2nd and 3rd Years** Danaus plexippus, its nectar and larval plants	**1st, 2nd and 3rd Years** Chesapeake Bay watershed

Table 1. Summary of studied species and sites in three years

The characteristics of the endangered species are researched, the species are observed on field trips, findings are recorded by the students. Then presentations are prepared and delivered at regular meetings and shared electronically with project partners [1,2,3,4,5,6]. A standard report format for endangered species has been constructed by the project coordinator.

Figure 2. Turkish team examining Crocus anycrensis at field in 2008

As soon as each form is filled in with the characteristics of the species, the form is shared with the other schools. In this way, each school has the same information and can see the progress over the years.

Figure 3. Romanian team at field in 2008

Figure 4. American team developing a "Certified Monarch Waystation" in the school butterfly garden 2008

Figure 5. Ankara Cigdemi (Crocus anycrensis)

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1.2. Short Descriptions of Study Species

Ankara Cigdemi *(Ankara Crocus)* (scientific name; Crocus anycrensis) was chosen as target species by METU College in the third year (2007-2008) of the U&U Project in Turkey.

Ankara Crocus, is a pure golden-orange to sun-yellow species native of Turkey, so often categorized as an "early spring" bloomer. It often blooms either in January or in April.

"The golden crocus reaches up
To catch a sunbeam in her cup."
-Walter Crane
(1845-1915)

Monarch Butterfly *(Danaus Plexippus)* continued to be the target species for Roland Park Country School in the USA. The information below was taken from the research notes of Unique and Universal Club teacher in the USA:

'*The life span of the adult Monarch varies, depending on the season in which it emerged from the pupa and whether or not it belongs to a migratory group of Monarchs.*

Adults that emerged in early summer have the shortest life spans and live for about two to five weeks. Those that emerged in late summer survive over the winter months. The migratory Monarchs, which emerge from the pupa in late summer and then migrate south, live a much longer life, about 8-9 months.

Monarch butterflies are found in a large number of areas throughout the world. In Eastern North American, the Monarch butterflies migrate in September-October to Mexico where they spend the winter in the Sierra Madre Mountains of Central Mexico.

In the winter in Mexico they spend their time protected by the local forests. In spring, summer and fall the adults are feeding from nectar plants in meadows and grasslands in northern North America where the milkweed grows for their larvae.Some of the nectar plants preferred by Monarchs are Queen Anne's Lace, Blue İndigo, Lobelia, Aster, Joe Pye Weed, and Zinnia. Monarchs have become endangered both because of the clearing of forests in their winter habitat in Mexico and because of the destruction of meadows and grasslands in eastern North America where different species of milkweed grow (Asclepias sp.). Areas which were once large grasslands are now urban and suburban areas with many buildings. Milkweed is considered a "weed" by many humans and is not allowed to grow. We decided to build a "Certified Monarch Way Station" so that we could attract Monarchs, encourage the population to grow, and teach each other about their life cycle. We also hope to tag the newly hatched adults before releasing them on their long 4500 km migration to Mexico in September and October.'

Figure 6. Monarch Butterfly (Danaus plexippus)

2. Methodology

2.1 Sample

In the third year of the Unique and Universal Project, 43 students from three different countries participated.

2.1.1. Turkish sample

Thirteen students from 6th, 7th and 8th grades in METU Development Foundation School and their parents participated voluntarily in the project. The study group consisted of twelve, thirteen and fourteen year old boys and girls. Four students had previous experience with the project from the past year. Two eighth graders, acted as the leaders of the team throughout the whole study.

2.1.2. Romanian Sample

Twenty students from 6th grade, who already have experience from the previous year, from School Number 5 in Satu Mare, Romania also took part in the project.

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A SAMPLE of SPECIES REPORT

COMMON NAME
Yellow Flag Iris

SCIENTIFIC NAME
Iris Pseudocorus

DESCRIPTION

It's an herbaceous perennial plant, growing to 1-1.5 m (or a rare 2 m) tall with erect leaves up to 90 cm long and 3 cm broad. The flowers are bright yellow, 7-10 cm across, with the typical iris form. The fruit is a dry capsule 4-7 cm long, containing numerous brown seeds. (See figure 5)

ENVIRONMENT
The Yellow Iris grows in very wet conditions and it is common in wetlands, where it tolerates submersion.

PROBLEMS
It has become endangered because the land where this plant can be found is being used more and more by people. Trade with this plant has also become a problem.

POSSIBLE SOLUTIONS
A solution could be forbidding trade with this plant, establishing protected areas and diminishing the impact of humans upon these areas.

PREPARED BY
School number 5,
Carei, Romania

REFERENCES
www.wikipedia.ro
www.eukarya.ro

2.1.3. American sample

Eight students from 7th grade and two students from 8th grade from Roland Park Country School for girls in the USA participated in the project. All of these students also participated during the second year of the project.

2.2. Project Action Plan

At the beginning of the 2007 - 2008 educational year, Unique and Universal Project Club was set up with the help of the school administration and the coordinator teacher at METU Foundation School. A presentation about the project was delivered at a meeting of the students in the Cultural Centre. Students volunteered for the project. Afterwards, the team proceeded as follows:

(1) constructed an annual activity schedule,
(2) had organizational meetings, every Thursday in the afternoon.
(3) contacted with Biology department of METU University for getting help and visited the laboratories,
(4) tested several water parameters and collected data during field study trips,
(5) invited parents on field trips, students shared their experiences with their parents.
(6) videotaped the field trips and experiments for using them as educational material in the classroom,
(7) observed and researched characteristics of study sites, species, and shared their experiences and findings of the studies with other partner schools via e-mails,
(8) produced power point presentations about Crocus anycrensis and Yenihisar Pool for other students at school.
(9) produced short documentaries about 'Global Warming and It's Alarming Effects on Earth'.
(10) produced short documentaries about 'Wetlands and Their Functions'

2.2.1. 'Looking' and 'Seeing'. Are they different skills?

'Do we actually see everything we look? How well can we observe the details of an object, a person, a place at a given period of time? Can observation skills be developed by studying?'

The questions above and research to learn more about them added a new focus to the U&U project in the third year. A new dimension related to developing observation skills was included into the project action plan in 2007-2008.

Prior to field visits, a preparatory period was devoted to develop students' observation skills. The importance of making careful observations has been discussed with the student team and a game was often played at the beginning of each club session to test their powers of observation. As part of this exercise the teacher might wear something different from normal, such as

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collared socks or an unusual button. Before club, she might have placed a paper towel soaked in vinegar at the back of the room or put up a map or wrote a random word on the board. A questionnaire was then passed out and the students were told that they should not look up from their desks until they finished filling in their questionnaires. Below are some examples of the kind of questions the students were expected to answer:

1. *How many windows are there in this classroom?*
2. *What colour are the teacher's socks?*
3. *How many plants are there in this classroom?*
4. *A map of what part of the world is hanging on the wall?*
5. *What is the smell like in the room today?*
6. *What new word is written on the board?*
7. *How many different sounds can you hear right now?*
8. *What colour eyes does the person have sitting in the seat next to you?*
9. *What material is the teacher's desk made of?*
10. *Name your five senses.*

By repeating this exercise occasionally, the students were impressed by the fact that 'looking' and 'seeing' were actually different skills.

On the day of a field visit, the students did similar exercises just before the field observations and experiments were to be conducted. The students were instructed to perform a '5-minute-notice' when they arrived at field study site. They were asked to write down what they instantly saw, heard, smelled and felt about the wetland during a 5 minute period. Once the period was up, they were asked to describe their observations. [6]

2.2.2. An Artist's Inventory of the Wetland and Wildlife

'Can shapes, colours, sounds be used to describe and illustrate the wetland and wildlife through an artist's eye?
What are the contributions of using the sensations of being outside both to a field work and field worker? What are the benefits of observing with your senses when doing field studies?

These questions opened up a debate between the team students which then lead them to investigate the possible answers. Making an artist's inventory of the wetland was included into U&U agenda in its third year, and this activity became the most significant and motivating part of the project for students in 2007/2008 educational year.

Prior to the main field work, the students were taken to METU Campus where they studied wetland ecosystem. They were asked to bring sketching pads, writing papers, pens, coloured pencils and camera. The group was divided into subgroups and they performed the following:

In terms of *shapes* and *colours:*
They

- described the shape and the colour of the objects
- described and drew the living and non-living components
- answered the question of *'how will the shapes and colours of the area change with the seasons?'*
- picked small features (a plant, an insect, logs etc) of the wetland that appeals to them and drew a picture of it.
-

Figure7. A student drawing a picture of snail in the field

In terms of *sounds:*
They answered the following questions.

- What are the loudest sounds? / The quietest sounds?
- What are the most distant sounds? / The closest sounds?
- What are the most pleasant sounds? / The most unpleasant sounds?
- Can you differentiate between natural and 'human generated' sounds?
- If you did not know where you were, would your sense of hearing help you determine your location?

In terms of *writing:*
They

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- described the different parts of the wetland and recorded where it was wet, muddy, overgrown, scary, pretty.
- described their feelings when they were outside. [6]

2.3. Conducting hands-on experiments as part of field work

Yenihisar Pool (a wetland area) was the main study site for the U&U Project by METU Foundation School in 2007-2008.

Throughout the year, four trips were already organized to the surrounding area:

One trip was a visit to the laboratories of Biology department of METU University and three visits were field trips organized in the vicinity of school.

The first trip was organized on the METU Campus so that students could practice and improve their observation skills. This trip was meant to be a preparatory trip for the later field trips.

Figure 8. Yenihisar Pool, the study area for U&U Project in Turkey 2007-2008

During the second trip, the students visited the laboratories of Biology department of METU University in order to examine *'the key species of still waters'*

The third trip took place in 'Yalıncak Village where the students observed *'Crocus anycrensis' and* recorded the field data about this species.

The final field work was concentrated on water quality testing at Yenihisar Pool in the vicinity of school.

During the field work organized to Yenihisar Pool, the following water quality parameters were observed and measured, and the results of these measurements were interpreted by the project students and their parents: [7,8]

(1)Colour, depth, and temperature (2) Turbidity, (3) pH, (4) Dissolved Oxygen (DO), (5) Nitrate, (6) Ammonia, (7) Phosphate, (8) Iron, (9) Copper, (10) Bacteria.

In the third year of the U&U Project, La Motte test kits and sampling equipment continued to be used during all the testing activities and observations.

The portable field laboratories containing all the equipment and chemicals were provided by La Motte Chemical Company, our laboratory equipment sponsor [8].

The interrelationship between water quality and living species was observed and then interpreted by the students.

Figure 9. Turkish students discussing and recording the data at field

Before and after field trips, the students were given field trip tests in order to get their pre and post knowledge and skills.

During the field visit, the parents of the students joined in the process of taking water samples from Yenihisar Pool, in order to measure the physical and chemical parameters of the water quality. They took photographs of the wetland area and the species.

2.4. Widening the circle of studied species

In the 2007-2008 academic year, a common *'Species Report'* form was created by the project coordinator, and sent to the partner schools (see example shown above). The research data was recorded by each student team and exchanged with the team in partner schools in Turkey, Romania and the USA.

In the third year of U&U project, beside Crocus anycrensis, which was studied by the students during the second field trip organized at Yalıncak Village, two more species were enthusiastically studied by Turkish students.

These species were; Daphnia (Water flea) and

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Anas platyrhynchos (Mallard). Daphnia was researched and examined by the students under a microscope in the laboratories of Limnology department of Biological Sciences at METU University through the guidance of field researchers.

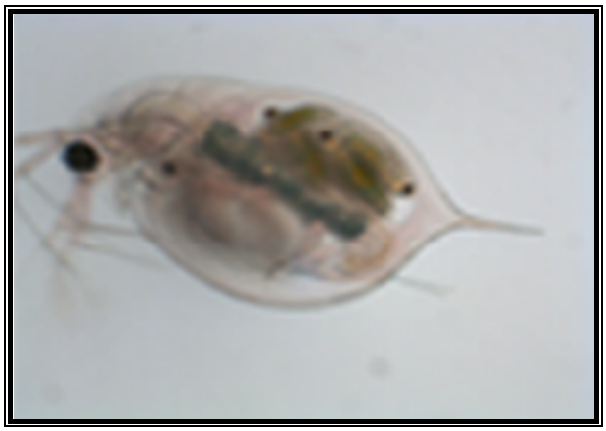

Figure 10. The microscope view of Daphnia, studied by the Turkish students

Figure11. Mallard, photographed by a parent at Yenihisar Pool

After field trips and regular meetings were completed, at the end of the term, knowledge tests, attitude questionnaires and the picture form of the endangered species (which were given at the very beginning of this study), were re-administered to the students. The students were presented with an environmental stewardship certificate by their coordinator teacher as recognition of their efforts during the year.

3. Findings

In this section recent developments in the Project, teacher and students' opinions about the value of the Project are given.

3.1 U&U Project in Media

At the end of 2006-2007 educational year, the implications and findings of U&U Project were presented at the 4th International Conference on Hands-on Science (July, 2007 Azores) [3,4], International Workshop on 'Science Education in Schools' (September, 2007 Bucharest) [5], Annual Conference on Environmental Education organized by the North American Association for Environmental Education (July, 2007 USA) [9], and in *Çoluk Çocuk Dergisi* (June, 2008 Turkey) [10]

Figure 12. 'Exploring the Nature through Science' Çoluk Çocuk Dergisi (June 2008)

The project was described in one of the well known periodicals published for teachers and parents in Turkey. The history of the U&U Project over the first three years and its implications for student learning were discussed in the article. [10]

3.2. Samples of Student presentations

Samples of Turkish students' presentations within the frame of the U&U Project in 2007/2008 educational year include:

A poster titled 'We Are Exploring our Nature Treasures through Science' was created by a team of students [10].

Two short documentary films were produced by Turkish students for other students' usage at schools:

The first documentary was about *'Global Warming and Its Effects on Earth'*

The second film was on *'Wetlands and Their*

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Functions on Earth'.

PPT presentations produced by the student team students about Crocus anycrensis were exchanged with partner schools.

Two presentations were organized by the team students at the end of two terms.

The first presentation was for the 4th and 5th graders at school. It took place at the end of first term. The second presentation was for 6th, 7th and 8th graders and this presentation took place at the end of the second term.

Figure 13. Poster produced by Turkish students 'We Are Exploring Nature Treasures through Science'

3.3. Students' opinions about the third year of the Project

At the end of the educational year, the students in the project were asked to write their opinions about the project implications and their outcomes:

İlke: *"…My outlook on life has changed dramatically since I started the U&U club nearly eight months ago. We have examined the Daphnea through a microscope connected to a computer in Biology Department of METU University. What a beautiful dance show it was! For me, they were the little angels dancing in water!. They are helping the nature by cleansing water through their tiny little movements in it. We have seen beautiful reddish reeds at METU Campus which I had never noticed before. We have picked up some interesting snails, observed them and put them back where they belonged. At times in school, we have sewn, tighten, painted, pasted several objects and created observatory tools. Then we used them in the field. What was so worthwhile was the fact that it was us who made them! We felt like we were real scientists! At the end of the year we organized a big presentation for other students at school and proved to them what a big job we had done for Mother Earth. I like this project so much because of the unique experiences I had in this club.'*

Gul: *"…It is so important that we have not been* researching *the information only through* Internet. *For example, we have studied Crocus anycrensis just by observing it in its natural setting. It was a wonderful feeling to see it so close to us, to examine its different parts for example; petals, leaves, stem.*

Merve: *"…I have chosen this club because I believe that we must be stewards of nature. The Earth has been becoming more and more spoilt by the human impact. There is a lot to work out and give right messages to people''*

Irmak: *"… We have been doing very important work in this club. We have been learning how to work in groups, how to share the workload, the love and care for nature and the most important of all we have been learning what it means to feel responsible for the Earth. I will never forget the day we presented our U&U Project with my friends in the team at the Cultural Centre of our school. I was very excited with the thought of presenting our work to all 6., 7.and 8th graders. We have prepared the stage, drew and painted the huge reeds and some other wetland plants on big cardboards and placed them on the stage. We have painted them with the colours of rainbow. With all these colours, the stage was reflecting our dreamland. We placed our experimental sets on the tables at the stages. I was so surprised when I looked at the stage from a distance. I had never seen such beautiful place before. The stage that we had created was so colourful and gave a great state of happiness to me. I was so proud of myself and my friends in the team. Our friends in cinema and photography club took our live photographs and reflected our sceneries on to the screen while we were demonstrating our water quality tests on the stage. There was an explosion of applause in the centre when we finished our presentation and experiments. Never in my life, will I forget that special day!''*

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Ozan: *"….What I like about this club is doing research on wetlands. I was most affected by the sad situation of wetlands in Turkey as well as in whole world. This is why I produced a short documentary about wetlands and their problems caused by human impacts. Our country, whole world desperately need young stewards like us!"*

Bartu: *"…Our mission is to protect and preserve the Earth. By what we have been doing in this club, we have been guiding and giving useful messages to our friends at school. We have been raising our level of consciousness and awareness to protect the nature. I believe that we have made great contribution in raising our friends' sensitivity and responsibility about nature by our presentation on 25th of March 2008 at Cultural Centre of our school."*

Figure 14. Turkish team student writing his opinions about U&U Project

3.4. Partner teachers' opinions about the third year of the Project

The opinions of the partner teachers of the U&U Project are given below:

Martha Barss *(Project teacher, USA):* Martha Barss is a science teacher in Roland Park Country School for girls in the USA and she has been involved in the project since 2005:

'(1) Students are increasing their knowledge of the natural environment and how humans and all other species are interconnected. Through their studies they are learning how human actions impact the natural species they are studying.

(2) Each year that a school participates in the U&U Project, provides more opportunity for students at the school to gain a sense of caring for the environment of which they are a part. Students who are not participating actively will notice the work of the participating students and gain a sense that "humans can make a difference" by being stewards of their environment.

(3) Through partnerships with families, scientists, funding organizations and nature organizations, a community is growing and students are learning that it takes many people working together to care for our "natural home".

(4) By sharing their discoveries and action projects on the Internet with other U&U project teams, students gain knowledge and understanding about other countries and cultures in the world.'

Ancuta Nechita *(Project Teacher, Romania);* Ancuta Nechita is an English teacher in School Number 5 in Satu Mare, Romania. She has been involved in the project since 2005.

'As every year the students got involved in the activities that were planned, they enjoyed learning new things and doing things "for real". As far as they were concerned, 'practice was far better than sitting inside a classroom and learning things by heart!' This is something that the Romanian teaching system has still to work on now. Putting the students in the situation of thinking by themselves and analyzing each endangered species made them aware of the importance of caring about the environment. The students learn how to protect what they have by seeing what really happens around them. They understand that the environment is something we all have to take care of since the Earth is not ours to keep. We have to make it last for the next generations as well.'

4. Conclusions

In the 2007/2008 educational year at the coordinator's school,

(1) Forty meetings were held with the team within the frame of U&U project.
(2) Four trips were organized throughout the year.
(3) Together with the students, parents became significant partners in the U&U Project.
(4) On the Yenihisar field trip, twelve different water parameters were tested, recorded, and interpreted, and final reports were prepared by the students.
(5) The findings were shared with other schools.
(6) Two short documentary films were prepared by the team students for other students' usage at school.

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(7) PPT presentations produced by the team students about Crocus anycrensis were exchanged among partner schools.
(8) Two presentations were organized by the team students at the end of terms.

The first presentation was for the 4th and 5th graders and it took place at the end of first term. The second presentation was for 6th, 7th and 8th graders at school. And it took place at the end of the year.

As far as the outcomes of the U&U project and the author's observations are concerned, fieldwork in nature opens up new means of communication for children in which they can develop a sense of their own connectedness to the natural world. The more they experience learning in the outdoor classroom, the easier they develop new ways of gaining knowledge that are not being developed in the indoor classroom.

It is the author's hope that the outcomes of the Unique and Universal Project will provide a useful resource to environmental and scientific education communities worldwide. It is also hoped that the students participating in the project gain a sense of belonging to a global community of concerned students as they share their discoveries with their partners in other countries.

5. Acknowledgements

The author is particularly grateful to Professor Dr. Jim Westgate for his kind support through allowing the project coordinator to join his summer wetland institute for teachers in Texas in the summer of 2005. Special thanks to Professor Dr. Ali Yıldırım for his continuous encouragement and motivation. Special thanks to Professor Dr. Meryem Beklioğulları for her support by providing access for our students to Limnology laboratories of METU University. Thanks to the METU Foundation School for its encouragement to carry out the project. Thanks to La Motte Company for their technical support with water monitoring test kits and sampling equipment. To these dedicated partners of the project, we extend heartfelt thanks for their great contributions in our project:

Martha Barss, Science Teacher at Roland Park Country School, Baltimore, MD, the USA, Ancuta Nechita, English Teacher in School Number 5 Satu Mare, Romania and finally special thanks to my dedicated students and their parents as well as those in other schools, who have been volunteers in this project.

6. References

[1] Erentay, N., Erdoğan, M. The Unique and Universal Project: Exploring and Sharing Our Ecosystems through Scientific Processes. Proceedings of the 3rd International Conference on Hands-on Science. Costa MF, Dorrıo BV (Eds.); pp.346-353, 2006.

[2] Erentay, N., Erdoğan, M. Initial Findings of Unique and Universal Project. Proceedings of the 3rd International Conference on Hands-on Science. Costa MF, Dorrıo BV (Eds.); pp.390 -398, 2006.

[3] Erdoğan, M., Erentay, N. Children Struggling for a Sustainable Future: Impressions from Unique and Universal Project Proceedings of the 4th International Conference on Hands-on Science. Costa MF, Dorrıo BV (Eds.); pp.148-157, 2007.

[4] Erdoğan, M., Erentay, N. Children's Perceptions on Endangered Species and Threatened Environment: Results from Unique and Universal Project Proceedings of the 4th International Conference on Hands-on Science. Costa MF, Dorrıo BV (Eds.), pp.141-148, 2007.

[5] Erentay, N., Wetlands in the Classroom: Discovering Outdoor Wet Facts through Controlled Experiments Indoors. International Workshop on Science Education in Schools. 11-14 September, Bucharest, Romania, 2007.

[6] 'A World in Our Backyard' available in web site of www.epa.gov.teachers

[7] Taylor, B. E. (2003). "Wetland and Water Quality." available in web site of www.uga.edu/srel/kidsdoscience/ kidsdosciencewetlands.htm

[8] Campbell G, Wildberger S. The Monitor's Handbook / A Reference Guide for Natural Water Monitoring. La Motte Science Education Products USA,

[9] Erdogan, M., Erentay, N., Barss, M., Nechita, A., & Kostova, Z. (2007, November). An International Project on Endangered Species and Threatened Environments: "*Unique and universal*". (Research Symposium) 34th North American Association for Environmental Education Annual Conference and Research Symposium, Virginia Beach, USA, 13-14, November, 2007.

[10] Erentay N. Doğayı Bilimle Keşfediyoruz [Exploring the Nature through Science] / Çoluk Çocuk Dergisi, 4June 2008.

5th International Conference on Hands-on Science
Formal and Informal Science Education
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Problem-Based Learning in Physics

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Abstract. The New England Board of Higher Education (NEBHE) from Massachusetts, USA invited National Vocational College "Nicolae Titulescu" from Slatina, Romania to participate as an Education Partner in Project PHOTON Problem-Based Learning (PBL) that is funded by the Technological Education program of the National Science Foundation (NSF). Also, from July 27 through August 1st, 2008, I participated in a professional development workshop on PBL method at Boston University (BU) in Boston, Massachusetts. The paper presents our participation in this activity.

Keywords. Experiment, Optics, Physics, Science.

1. Introduction

Problem-Based Learning (PBL) is an instructional method that challenges students to "learn how to learn" by collaboratively solving real world problems. All nations face intensifying global competition and rapidly growing demands for a skilled workforce. The central issue is: are students able to apply what they know?

The PHOTON PBL project, coordinated by New England Board of Higher Education (NEBHE) [1] from Massachusetts funded by the Technological Education program of the National Science Foundation (NSF), USA, proposes to address this challenge by designing, testing and disseminating eight problem-based Challenges.

These Challenges, designed in cooperation with partners in the photonics industry, give our students the opportunity to practice real world problem solving, a critical skill in today's workplace.

2. PHOTON PBL goals and the responsibilities of the education partners

The goals of PHOTON PBL are to:

I. Create eight multimedia problem-based scenarios and instructional resources in photonics technology to complement the highly successful PHOTON curriculum and laboratory materials. The materials will be aligned to academic and industry skill standards.
II. Recruit and train high school and community college photonics technology instructors from 16 institutions to implement, assess and evaluate the problem-based scenarios in classrooms with their students.
III. Conduct quantitative and qualitative research on the efficacy of PBL in engineering technician education.
IV. Outreach and disseminate the field tested problem-based scenarios and research findings to high schools, community colleges and four-year colleges and universities that offer technology programs.

Responsibilities of the education partners are to:

1. Apply in collaboration with a partner education institution. High school applicants should find a community college with who to partner, and community college applicants should seek out a high school partner.
2. Participate in a professional development workshop at the Boston University Photonics Centre from July 27 – August 1, 2008.
3. Field-test two of the PBL Challenges during academic year 2008-2009.
4. Report on their and their students' field-testing experience.

3. PBL levels and methods

Most students are accustomed to traditional lecture-based methods of instruction while PBL represents an exciting alternative to traditional lecture-based photonics education.

PHOTON PBL Challenges are designed to be implemented using three levels of structure ranging from Level 1 (Instructor Led - Highly Structured), to Level 2 (Instructor Guided - Moderately Structured), to Level 3 (Instructor as Consultant - Open-Ended) depending on the technical nature of the problem and the ability level of the students.

Level 1 (Instructor Led – Structured): students are presented with the PBL challenge in its entirety as a multimedia-based case study.

Level 2 (Guided): students have been exposed to the overall problem-solving process through Level 1 and have begun to develop their own problem-solving skills

Level 3 (Open-Ended): students are presented with the most realistic representation

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of the problem statement as it would be encountered in the "real world". [2](Figure 1)

Methods for understanding the problem: Scientific Journal, Sinectics, analogy, Socratic seminar, Pareto analysis. For a solving plan: brainstorming, lists, concepts' map, cause and effect diagram, critical thinking method, Gantt maps.

Methods to accomplish the plan: Johari Window method, Drill Down method, concepts' acquisition, forces field analysis. Test solutions: Venn diagram and Tuning Protocol.

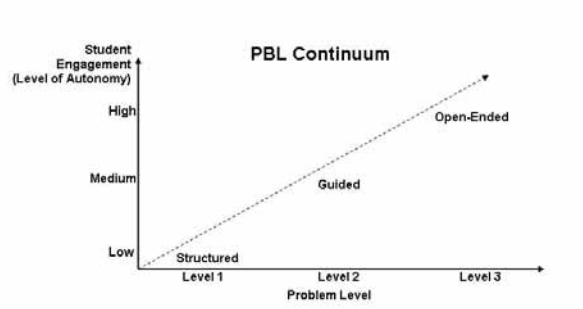

Figure 1. The PBL Continuum (Used with permission)

Student teams work collaboratively in analyzing the problem, generating hypotheses, reflecting on their beliefs about the problem, and generating learning objectives needed to solve the problem. This phase is followed by a period of self-directed learning. During this stage, the instructor serves as a consultant, guiding the student as they seek out required resources and providing additional information as needed. By shifting the responsibility for learning onto students and providing scaffolds for learning, students are more likely to develop the self-directed learning skills needed to successfully engage in lifelong learning. Finally, students reconvene to assess and evaluate their problem solution. [2]

I created a forum for my students in order to discuss with American and Romanian experts at: http://www.hsci.biz/ [3]

4. Field-Testing PBL Challenges in Romania

During school year 2007-2008, I field-tested three Challenges: Photomachining Challenge, IPG Photonics Challenge and the Cal Poly Pomona Challenge.

In Photomachining Challenge, a customer needs 50-micron polyimide-coated copper wire to be stripped and cut to a certain length for use in a medical device. Students must choose a laser and develop an optical system to produce these wires as cheap as possible. [4]

Consequently, I began by introducing the Photomachining Challenge somewhere between a structured and guided exercise. (Figure 2)

Figure 2. Romanian students team working in Photomachining Challenge

I showed them the company overview, the problem statement and the discussion segments of the Challenge. I then split the students into groups and had them list what facts they knew and what they needed to research.

The second Challenge required to device an enclosed system for a safe test for a high power laser in an extended period of time.

Figure 3. The Socratic Seminar

For the IPG Challenge, I organized a Socratic Seminar. I was the seminar leader and I divided the class in two parts. One part formed an "inner" circle (10 students, 17 years old) and participated in the discussion of the problem. The other part formed an "outer" circle (13 students, 17 years old) and observed the seminar. (Figure 3) In fact, the outer circle was a "U" shape. I began the seminar with the distribution of the text to be discussed (IPG statement of the challenge). I asked to all participants with the

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opening question:"What do you think are the key terms in this text?" in order to give to all participants an opportunity to say something.

Once begun, the seminar was driven by questions from me and the participants. First, I asked all participants from the inner circle to do a list with what they know a list with what they don't know and another list with things to do. After that, they read the lists in front the class. They asked things like: "What is a burn-in testing?", "What is coupler?", "How can we measure the power and the wavelength?"

My students remarked that we need sensors for fire, smoke and warm, a computer to supervise the whole test and a system to cool the laser. They all agree that the test must be taken in separate room. Some of them made few drawings of the device. (Figure 4)

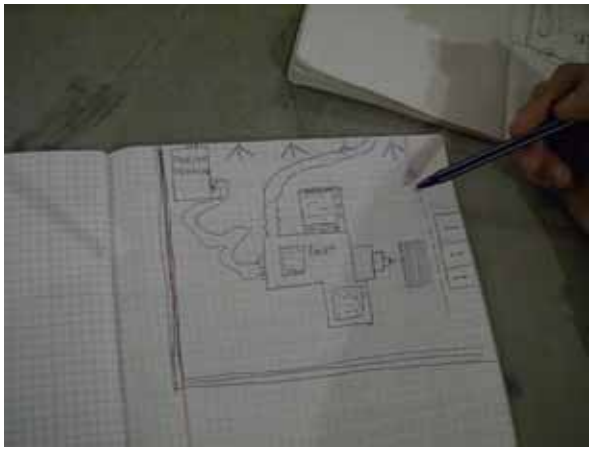

Figure 4. Solution given by students for IPG Challenge

The third challenge field-tested was about students to test the true of a statement on the package for a 26-Watt fluorescent bulb, that claims the bulb's output is the same as a 100-Watt incandescent. As a result of this active learning activity, my students know have a better understanding of each type of lighting.

I worked with 30 students, 17 years old, split in teams of 5-6 pupils who were not familiar with the PBL format.

A very good and innovative tool for my students was a "white (black) board" screen projected a directly onto the classroom's white (black) board. (Figure 5).

I also created a Science Club and an online forum for my students about the PBL Challenges at http://www.hsci.biz[3] and this was a very good opportunity for them to discuss with experts like Mrs. Judy Donnelly and Mr. Ron Schaeffer who were very kind to answer my students questions. I think this increased their enthusiasm and motivation.

Figure 5. Using the Black Board Tool

5. A professional development workshop on PBL method

From July 27 through August 1st, 2008, I participated in a professional development workshop on PBL method at Boston University (BU) in Boston, Massachusetts (Figure 6).

Figure 6. 2008 PBL workshop

25 high school and college teachers from US and Romania learned how to introduce their students to optics and photonics using PBL strategies. The workshop goals were to introduce project participants to four photon PBL challenges, gain feedback from participants, create a community between educational partners who will work together to implement the PBL Challenges in their home institutions and, also, to provide the educators with the tools needed to field-test the challenges. I hope that my participation in this professional development workshop will have an echo on three levels: teachers and pupils, curriculum and educational politics of my school.

My training will increase the quality and attractiveness of my classes by activities whose purpose is to motivate learners by using PBL method and other new acquired original

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techniques and materials. In this way I hope to avoid some students' misconceptions in science and to promote the creative learning. I think I will have a more interactive teaching. My students will work more efficiently and more autonomously and they will understand better difficult Physics concepts. Also, they will be able to understand better physics phenomena from nature and scientific applications in day by day life. After this training activity I will be able to update my optional course "Physics by experiments" and my website http://www.geocities.com/physicsexperiments [5].

I will also share with colleagues my knowledge acquired so that they too can benefit from my experience. On this purpose I will discuss with them on our regular reunions, workshops and conferences, invite them and the principal as well to demonstratives lessons and analyze together CDs and other materials that I got from the training. After my involvement in this activity, my colleagues too will be able to restructure their teaching methods in a way to improve the motivation and quality in learning situations.

The eight problem-based challenges that will be field-tested in our school too, will give our students the opportunity to practice real world problem solving, a critical skill in today's workplace. Consequently, my school will be able to have a realistic point of view of its situation and to use updated strategies and new approaches in order to improve motivation, general climate and quality of education process in our institution and to develop its management and relations with parents and local community. I believe that my involvement in this professional training will be a good opportunity for my school to be exposed to the American Education. As a result there will be a significant change in teachers' way of approaching the educational system and students will be more actively involved in the educational process as well.

6. Conclusions

PBL is a method who gives students tools to cope in uncertain learning situation, where problem parameters are not very well defined – just like in the real world. National Vocational College "Nicolae Titulescu" from Slatina participation as an Education Partner in Project PHOTON Problem-Based Learning (PBL), coordinated by New England Board of Higher Education, USA, is a first time for Romania. I hope that collaboration to continue and to develop by an educational partnership between my school and other schools and institutions from US. I will seek to promote the cooperation and the mobility by encouraging and supporting other teachers to be part in such projects and to apply for such training activities. After this workshop, I will be able to give my expertise, to explain, to advise my colleagues from my school, from my city and from my country.

7. Acknowledgements

I would like to thank Ms. Fenna Hanes - Principal Investigator, Judith Donnelly, Michele Dischino and Mr. Nicholas Massa - Co-Principal Investigators New England Board of Higher Education (NEBHE) [1], USA, the "Hands on Science" [6] network coordinator Manuel Felipe Costa and the "Hands on Science Romania" and Centre for Science Education and Training CSET [7] national coordinator Dr. Dan Sporea for their support and encouragements.

Also, I would like to thank Optical Society of America (OSA) [8], USA for the grant awarded for my participation in the professional development workshop from Boston, Massachusetts, US, July 27th – August 1st, 2008.

8. References

[1] www.nebhe.org
[2] N.M. Massa, R. Audet, J. Donnelly, F. Hanes and M. Kehrhahn, "PHOTON PBL: Problem-Based Learning in Photonics Technology Education", Proceedings of the SPIE Annual Conference, Ottawa, Canada, September; 2007.
[3] http://www.hsci.biz/
[4] J. Donnelly, Problem-Based Learning, OPN Optics & Photonics News; 19(5): 22-23, 2008.
[5] http://www.geocities.com/physicsexperiments
[6] http://www.hsci.info/
[7] www.inflpr.ro
[8] http://www.osa.org/

5th International Conference on Hands-on Science
Formal and Informal Science Education
© 2008 HSci. ISBN 978-989-95095-3-5

Developing Mathematical Talent of Students

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Abstract. Many of my students are interested in Mathematics, but some of them perceive it as a difficult subject. In my opinion, Mathematics is not only an abstract Science, but has implications in everyday life. Mathematics forms and develops logical reasoning, creativity and critical thinking. Each child should have the opportunity to express their talent. Many talented children find it hard to express their needs. A few need a great deal of encouragement and understanding to communicate clearly. The paper presents some methods and educational tools, which will help the educators to identify and motivate talented students in mathematics.

Keywords. Mathematics, Motivation, Talent.

1. Introduction

The decision of the European Union, COM/2001/678 says, «In a society of knowledge, Democracy requires the citizens to have scientific and technological knowledge as part of the basic competence».

The future objective aims of the European Educational Systems, which was agreed on 12 February 2001 from the Education Council in Stockholm, identify Mathematics as one of the major priority subjects. The basic objective is the increase of interest in mathematics from early age and the impulsion of youth to follow careers in these subjects, more specifically in the research in these fields.

2. The Concept of a "Ladder"

A "ladder" is a self-contained mathematical text, focused on a specific topic, which could be used by teachers or by students in their work in and beyond the classroom. In essence the ladder is a sequence of mathematical problems, explanations and questions for self-testing ordered in slowly increasing degree of difficulty. By working on the text the student could elevate his/her mathematical knowledge to essentially higher levels. This is where the name "ladder" comes from: a device for climbing to a higher level, an instrument facilitating the process of overcoming different difficulties. Using the ladder the students (but also their teachers) could enrich, deepen and test their knowledge on a specific mathematical topic. The lower part of the ladder is rooted in the normal curriculum material studied in the class. As "steps" one has the mathematical problems, definitions and explanations, pieces of information and other challenges that the learner has to master in order to acquire the higher level of understanding the material. Depending on their individual abilities the students will advance i.e. "climb" to different heights on the ladder. The degree of advancement will single out higher ability students. Therefore the ladders will help identify talented students too.

If the ladder is well designed and consists of interesting and challenging problems, it will attract and motivate the students to apply more time and energy in studying mathematics.

It is important to design the ladders in such a way that the level of difficulty increases slowly (a small distance between two consecutive steps) and the students are capable of climbing the steps even without the help of the teacher. The definitions and the explanations should help this happen. The presence of questions and problems the solution of which is commented later will allow the student to check whether or not he/she understands what is going on. [1]

3. Identifying mathematical talent

The teacher must to have a major role in identifying mathematical talent through a range of measures that go beyond traditional standardized tests. Measures should include observations, student interviews, open-ended questions, portfolios, and teacher-, parent-, peer- and self-nomination. Recognition should be made of the fact that mathematical talents can be developed; they are not just something with which some students were born.

Also, teachers must to present interesting tasks that engage students and encourage them to develop their mathematical talents, improve opportunities for mathematics learning and a much more challenging, no repetitive, integrated curriculum which is needed to help students develop mathematical talents. Students must be challenged to create questions, to explore, and to develop mathematics that is new to them. They need outlets where they can share their discoveries with others.

Teachers must become facilitators of learning to encourage students to construct new, complex mathematical concepts. Students must be challenged to reach for ever-increasing levels of mathematical understanding.

 ISBN 978-989-95095-3-5

4. Why should we do anything different for mathematically gifted students?

Gifted students differ from their classmates in three key areas that are especially important in mathematics.

Gifted learners differ from classmates through the pace at which they learn the depth of their understanding and the interests that they hold (Maker, 1982). [2]

The sequential nature of math content makes pacing an issue. Deeper levels of understanding and abstraction are possible for most mathematical topics, so differentiation becomes important. If the interest is snuffed out early, the talent may not be developed.

Mathematically gifted students differ from the general group of students studying math in the following abilities: spontaneous formation of problems, flexibility in handling data, mental agility of fluency of ideas, data organization ability, originality of interpretation, ability to transfer ideas, and ability to generalize (Greenes, 1981). [3] Furthermore, there is a myth that gifted students don't need special attention since it is easy for them to learn what they need to know. On the contrary, their needs dictate curriculum that is deeper, broader, and faster than what is delivered to other students.

5. What should be done for the mathematically gifted in the regular classroom?

Historically there has been debate about the role of acceleration versus enrichment as the differentiation mode for mathematics. Most experts recommend a combination. The following are suggestions for differentiating for the mathematically gifted by using (1) assessment, (2) curriculum materials, (2) instructional techniques, and (4) grouping models. These opportunities should be made broadly available to any student with interest in taking advantage of them. What teachers can do?:

* Give pre-assessments so that students who already know the material do not have to repeat it but may be provided with instruction and activities that are meaningful.

* Create assessments that allow for differences in understanding, creativity, and accomplishment; give students a chance to show what they have learned. Ask students to explain their reasoning both orally and in writing.

* Choose textbooks that provide more enriched opportunities.

* Use multiple resources. No single text will adequately meet the needs of these learners.

* Be flexible in expectations about pacing for different students. While some may be mastering basic skills, others may work on more advanced problems.

* Use inquiry-based, discovery learning approaches that emphasize open-ended problems with multiple solutions or multiple paths to solutions. Allow students to design their own ways to find the answers to complex questions. Gifted students may discover more than you thought was possible.

* Use lots of higher-level questions in justification and discussion of problems. Ask "why" and "what if" questions.

* Provide units, activities, or problems that extend beyond the normal curriculum. Offer challenging mathematical recreations such as puzzles and games.

* Differentiate assignments.

* Expect high level products (e.g., writing, proofs, projects, solutions to challenging problems).

* Provide opportunities to participate in contests such as Mathematical Olympiads Give feedback to students on their solutions.

* Provide some activities that can be done independently or in groups based on student choice. Be aware that if gifted students always work independently, they are gaining no more than they could do at home. They also need appropriate instruction, interaction with other gifted students, and regular feedback from the teacher.

* Provide useful concrete experiences. Even though gifted learners may be capable of abstraction and may move from concrete to abstract more rapidly, they still benefit from the use of “hands-on" activities.

6. How can technology support the needs of the gifted?

Technology can provide a tool, an inspiration, or an independent learning environment for any student, but for the gifted it is often a means to reach the appropriate depth and breadth of curriculum and advanced product opportunities. Calculators can be used as an exploration tool to solve complex and interesting problems. Computer programming is a higher level skill that enhances problem solving abilities and promotes careful reasoning and creativity. The use of a database, spreadsheet, graphic calculator, or scientific calculator can facilitate powerful data analysis. The World Wide Web is a vast and exciting source of problems, contests, enrichment, teacher resources, and information about mathematical ideas that are not addressed in textbooks. Technology is an area in which

 ISBN 978-989-95095-3-5

disadvantaged gifted students may be left out because of lack of access or confidence. It is essential that students who do not have access at home get the exposure at school so that they will not fall behind the experiences of other students.

7. What is the responsibility of schools and teachers in developing giftedness in mathematics?

Classroom teachers and school districts share the responsibility of addressing the needs of gifted students. Teachers need training and support in recognizing and addressing the needs of the mathematically gifted. Teachers who teach mathematics to gifted learners need a strong background in mathematics content. If the school has only a few students with special needs and does not have such a teacher, a mentor from outside the school should be located to work with individuals. A coordinated curriculum plan needs to be in place so that the mathematical experiences for students are not duplicated or interrupted from one year to the next.

The school should have an organized support system that includes resource books, technology, and human resources.

Regular mathematics classrooms that offer sufficiently challenging and broad experiences for gifted students have the potential to enrich the learning community as a whole since other students will be interested in attempting, perhaps with help, some of the more challenging tasks. If math classes offer diversity in assignments, products, and pacing and monitor student needs, all students will be able to work at their own challenge level.

8. Acknowledgements

I would like to thank the “Hands on Science” coordinator Manuel Felipe Costa and the national coordinator Dr. Dan Sporea for their support and encouragements.

9. References

[1] www.matheu.org
[2] J. Maker and M.D. Rockville, The Curriculum development for the gifted, Aspen Systems Corporation, Creating, 1982.
[3] C. Greenes, Identifying the gifted student in mathematics, Arithmetic Teacher, 28, 14-18; 1981.

Computer Simulations of Physics Phenomena Using Flash

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Abstract. One of the most powerful tools used in both teaching physics concepts and developing measurement and analysis skills are software simulations. This paper describes several physics simulations designed for the study of the virtual evolution of physics phenomena based on Adobe Flash CS3 computer applications. The simulations help the students understand several important physics phenomena and laws more easily, and improve their abilities of making measurements and processing information. The simulations also provide the students with the opportunity of using the experimental data for performing calculations and plotting. They can be considered checking tools for the results obtained from experimental work.

Keywords. Computer simulations, Flash, Physics Learning, Physics Phenomena.

1. Introduction

In the last decade the great development of the programmable web and new computational technologies has implied the developing of specific platforms like HTML, JavaScript, Flash and Ajax. This had also an important influence on the implementation of the new computational methods in engineering education. The use of computational methods does not require a complete renunciation at the traditional methods, even in the next future a quick and efficient way of improving knowledge would consist in the using at large scale of the Web technology. Recent developments in this area have shown that computer assistance learning process [3], [4], [5], [6], [14], [15], [16], [17] is one of the most promising ways to improve the educational results.

Our experience in the field of physics [7], [8] has demonstrated that processing data using the

 ISBN 978-989-95095-3-5

computational methods is of great help for our students in the learning process. In the last years we have focused our efforts to the acquisition of new computational programs designated to improve the study of physics. In this way, we are able to use a powerful teaching methodology [10] for developing students' abilities [1], [2], [7], [8], [9], [12], [13] to understand the scientific content of our courses, and use the computational programs for simulating physical phenomena. Our main goal is to improve our physics course and laboratory, and this implies providing a framework for the integration of new computational tools, and especially of the computer simulations of physics phenomena. A first step was done by providing our seminars with some "teaching-while-quizzing" tests [10] that were proposed for improving the physics learning and which are already used by our students. Also, this computational method has improved the teaching of physics and developed the students' abilities. The next step consists in the implementation of the computer simulations [11], which will do not replace completely the traditional methods of learning physics, but will allow the good understanding of physics laws and phenomena, and will develop skills of measurement and analysis. Very important is their property of being not affected by the errors generated by the measurement process and the sensibility of apparatus.

At our physics laboratory, the students use the computers as tools for collecting, analyzing, visualizing and modelling real data which are picked up during experiments. For our students, it is very important to get familiar with both the laws of physics and the phenomena in the theoretical lectures and some computer programs that can make the understanding of physics concepts easier. These activities facilitate the development of the students' ability to apply these concepts to physical situations and reason with them. As a result, the students will be able to use these theoretical ideas and the newly acquired skills in practice. For us, it was important to decide which are the laboratory activities that need computer simulation applications, and which of them are the most important.

In this paper we provide a concise description of a set of physics simulations elaborated in Adobe Flash CS3 for the study of Stefan-Boltzmann law of thermal radiation and the determination of Planck's constant using the photoelectric effect. These computer simulations discussed here have been implemented and tested at our physics laboratory, and for their elaboration we used modern software and technologies [18].

2. Computer Simulations for Physics Phenomena

We realized a set of physics interactive simulation computer applications that describes some important phenomena and laws of physics, and which are used in our physics laboratory. We have a suite of 10 simulations of our laboratory works based on various physics phenomena, which cover many of the areas of physics studied in our course of physics. Very important has been to decide what are the physics laboratories that needs a computer simulation application, and among them which are the priorities. We established the most important experiments, and after this elaborated the computer simulations with respect that the experimental results must be the same as the results yielded by the computer simulations. The software can be run during or after the experiment and allowing the students of making a comparative study between experiment and simulation.

The simulations were elaborated in the animation and programming environment Adobe Flash CS3 [18]. This is professional software by means of which applications, animations and web pages may be created and processed. The operations, the functions and the easy handling give to the ones who develop Flash applications the access to many possibilities. This makes Flash to be a good environment in developing applications. Our computer simulation applications were implemented using the data obtained further to physical experiments to simulate as accurately as possible the behaviour/the indications of the lab equipment. There have also been used the physical formulas necessary to obtain the wanted results. By means of experimental data taken from certain sites within a given span of time, an interpolation of 1st degree could be implemented in these applications, so that the user has the possibility to use values from the same span of time that he would have used with the lab equipment. This gives the user the freedom to choose a value, being not constricted to use a limited number of values or even the used experimental values. We notice that these applications have a menu in Romanian and English, which may be used depending on necessity of preference. As examples, we present the applications for the study of Stefan-Boltzmann law of thermal radiation and determination of Planck's constant using the photoelectric effect. Each of these applications allows the students to verify the experimental data and to perform the calculation and carry out the graphs.

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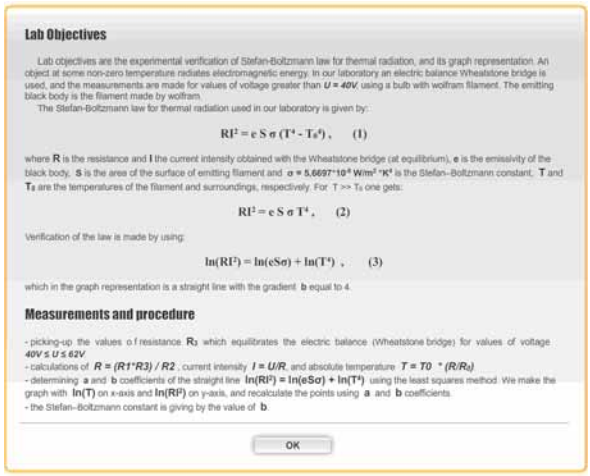

Figure 1. Lab objectives, measurements and procedure for the Stefan-Boltzmann law

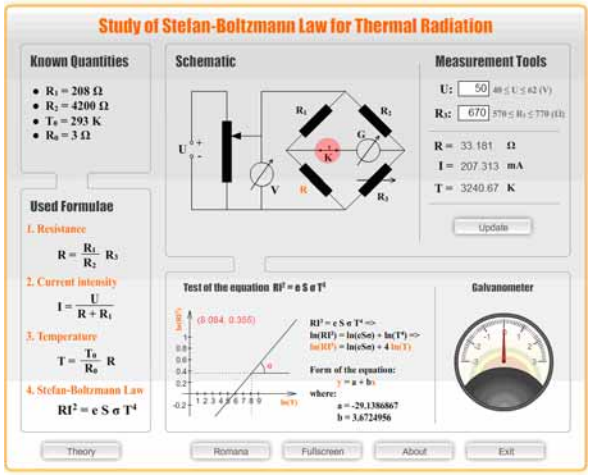

Figure 2. Screen-shot of the application interface

First we describe the application for the Stefan-Boltzmann law of radiation. The screen-shots of the applications interface are presented in Figure 1 and Figure 2. In Figure 1 is given the computer interface image for the lab objectives, the apparatus and equipment, and the measurements and procedure. The aim of the computer simulation is the verification of the Stefan-Boltzmann law of radiation. When opening this application, the students have to press the switch of the circuitry. After that, they have to enter values for the feeding voltage U and the variable resistance R_3, yet these values shall enter the specified range beside the data input area. Otherwise, a warning indicated by a red box flashing next to the wrongly entered value will be provided. After the values that observe the possible value ranges are entered, the button Upgrade will be pressed as it displays the newly obtained values of R, I and T, upgrading at the same time the graphic and the indication of the galvanometer. The user should try to adjust R_3 for a certain value of U, so that the reading of the galvanometer should be 0.

The next example is the one of the computer simulation of the determination of Planck's constant using the photoelectric effect.

For the determination of Planck's constant the Einstein's equation for the photoelectric effect is used. The lab objectives, the apparatus and equipment, and the measurements and procedure are presented below as the computer interface image in Figure 3. The students learn about the theory and experimental method.

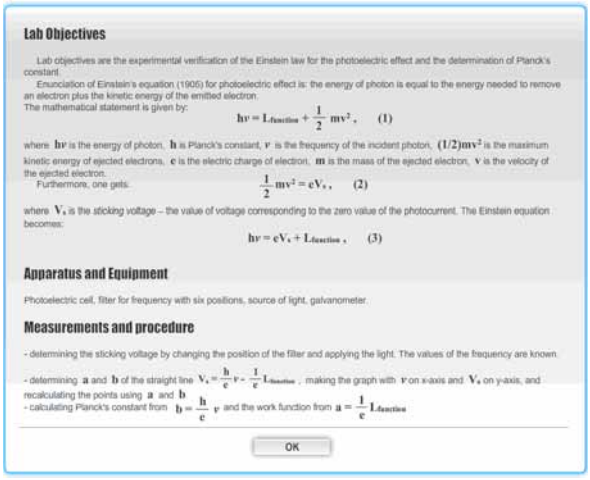

Figure 3. Lab objectives, apparatus and equipment for the photoelectric effect

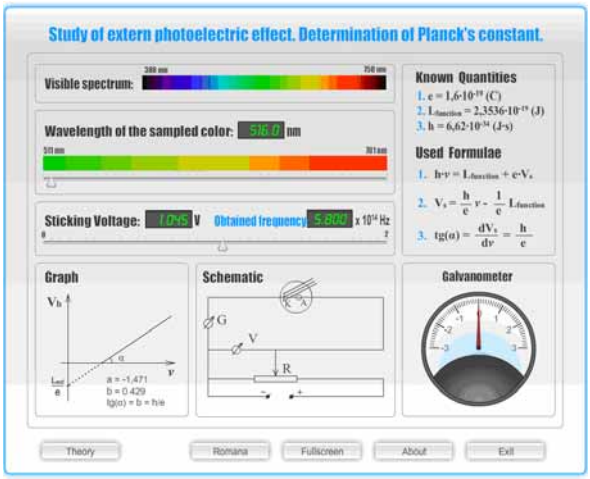

Figure 4. Computer interface image for the photoelectric effect

The second computer interface image for this program is presented in Figure 4. The user should first choose a certain value of the wave length of the colour to be experimented, after which he should adjust the value of the sticking voltage V_s (or another denotation in Romanian is V_b), so that the reading of the galvanometer

 ISBN 978-989-95095-3-5

should be 0. When this requirement is met, the obtained frequency may be extracted.

In our physics laboratory we use a filter with six known frequencies and we pick up the corresponding values for the sticking voltage, and after this we determine Planck's constant using the least square method. The computer simulation gives the possibility to determine by interpolation the corresponding values of the sticking voltage for a large number of values of wavelength.

We present the function my update of the interface in the case of the application for the Stefan-Boltzmann law of radiation (partially in romanian).

```
function my update():void
{
if(k_mc.currentLabel=="inchis")
{
var u:Number = (Number)(u_txt.text);
var r3:Number = (Number)(r3_txt.text);
var r3Ideal:Number = 0;
var i:uint = 0;
var divRez:Number = 0;

var R:Number = 0;
var I:Number = 0;
var T:Number = 0;

if(u>=40 && u<45)
i = 0;
if(u>=45 && u<50)
i = 1;
if(u>=50 && u<55)
i = 2;
if(u>=55 && u<60)
i = 3;
if(u>=60 && u<=62)
i = 4;

divRez = (arrR3[i+1] - arrR3[i]) / (arrU[i+1] - arrU[i]);
r3Ideal = Math.round(divRez * (u-arrU[i])) + arrR3[i];

rotatie = Math.round((r3Ideal - r3) * divRot);
galv_mc.indicator_mc.rotation = rotatie;

const R1:Number = 208;
const R2:Number = 4200;
const T0:Number = 293;
const R0:Number = 3;
const a:Number = -29.1386967;
const b:Number = 3.6724956;

R = (R1/R2) * r3;
I = u/(R+R1);
T = (T0/R0) * R;

r_txt.text = R.toFixed(3);
i_txt.text = (I*1000).toFixed(3);
t_txt.text = T.toFixed(3);

//pentru grafic
lnT = Math.log(T);
lnRI2 = Math.log(R*I*I);

grafic_mc.panta_mc.x = Math.round((90 * lnT)/9);
grafic_mc.panta_mc.y = Math.round(-(75 * lnRI2));
grafic_mc.xy_txt.text = "(" + lnT.toFixed(3) + "; " +
 lnRI2.toFixed(3) + ")";
}}
```

and, also for the determination of Planck's constant using the photoelectric effect

```
function myupdate():void
{
var lu:Number = luSlider_mc.value;
var vb:Number = vbSlider_mc.value;
var vbIdeal:Number = 0;
var frecv:Number = 0;
var i:uint = 0;
var divVb:Number = 0;
var divLU:Number = 0;

//[701, 637, 577.5, 528.5, 520, 511];
if(lu<=701 && lu>637)
i = 0;
if(lu<=637 && lu>577.5)
i = 1;
if(lu<=577.5 && lu>528.5)
i = 2;
if(lu<=528.5 && lu>520)
i = 3;
if(lu<=520 && lu>=511)
i = 4;

divLU = (arrLU[i] - arrLU[i+1]) / (arrVb[i+1] - arrVb[i]);
divVb = (arrVb[i+1] - arrVb[i]) / (arrFrecv[i+1] - arrFrecv[i]);
vbIdeal = Math.abs(lu - arrLU[i])/divLU + arrVb[i];
//trace(vbIdeal);

//divFrecv = (arrFrecv[i+1] - arrFrecv[i]) / (arrVb[i+1] - arrVb[i]);
frecv = Math.abs(vb-vbIdeal)/divVb + arrFrecv[i];
//trace(frecv);
rotatie = Math.round((vbIdeal - vb) * divRot);
//trace(rotatie);
galv_mc.indicator_mc.rotation = rotatie;
```

 ISBN 978-989-95095-3-5

```
frecvVal_txt.text = frecv.toFixed(3);
}
```

It is worth emphasizing that we have noticed an improvement in the understanding of physics phenomena and laws due to the implementation of computer simulations in our physics laboratory.

3. Discussion

In the recent years the development of efficient and accurate tools for physics computer simulations has become of great interest for both students and physicists. In this paper we present two physics simulation computer applications elaborated in Adobe Flash CS3 program that we developed for our physics laboratory. They are used for the study of the Stefan-Boltzmann law of thermal radiation and the determination of Planck's constant using the photoelectric effect. Moreover, they are part of a set of physics simulations elaborated in Adobe Flash CS3, which help our students to achieve a better understanding of physics phenomena and laws.

There are some important arguments that support the necessity of introduction of this way of physics study. First, picking up experimental data is a process that can be perturbed by errors, and this can be avoided by using virtual tools like computer simulations. Moreover, the computer applications also work as checking tools of the results yielded by experimental work. Future computer simulations can be envisioned for improving the learning process. Thus we open a window for the students to the virtual labs and simulations, and they can learn to use a comparative mode of learning and how to experiment and use software applications. The set of physics simulations they use can be further implemented in the distance learning via the Internet (e-learning), which is partially or entirely based on Web and Internet courses and assignments.

Moreover, at our courses, seminaries and laboratories, we are just beginning to develop these kind of new learning activities, as for long time we missed the necessary resources, equipment and technical systems. Our simulation programs themselves are inexpensive aids in the study of physics.

4. Acknowledgements

This work was supported by grant no. 4504/14.09.2007 and no. 11-067/18.09.2007 TELEMON PN II.

9. References

[1] B. Ciobanu and I. Radinschi, One Computational Algorithm for Physics Modelling, In: Proceedings of 5th International Conference on Electromechanical and Power Systems, SIELMEN; 2005 October 6-8, Chisinau, Rep. Moldova, Chisinau, University of Chisinau; 222-225, 2005.

[2] B. Ciobanu and I. Radinschi, Implementation of Physics Teaching in Engineering Education, In P. Svasta, V. Cehan, R.G. Bozomitu, D. Ionescu, editors, Proceedings of International Symposium for Design and Technology of Electronic Packages, SIITME 2006, 2006 September 21-24; Iaşi, România, Iasi, Stef Publishing House; 106-110, 2006.

[3] S. Hennessy, R. Deaney and K. Ruthven, Situated expertise in integrating use of multimedia simulation into secondary science teaching. International Journal of Science Education 28 (7): 701-732, 2006.

[4] A. Jones A and K. Issroff, Learning technologies, Affective and social issues in computer-supported collaborative learning, Computers & Education 44: 395-408, 2004.

[5] G. Murariu and D. Toma, A Note about the Simulation Programs for Heat and Molecular Physics Laboratory, xxx.lanl.gov physics/0505053

[6] G. Murariu, Interactive computer simulations of electrokinetic physics phenomena, xxx.lanl.gov physics/0609215

[7] I. Radinschi and B. Ciobanu, Physics Studies - Computational Methods, a Strong Connection, In: Ionescu C, Paulet F, editors, Proceedings of International Symposium Computational Civil Engineering 2007, CCE 2007; 2007 May 25; Iasi, Romania. Iasi: Publishing House of "Matei-Teiu Botez" Academic Society, Iasi; 200-211, 2007.

[8] I. Radinschi and B. Ciobanu, Improving Engineering Physics Teaching-Learning with Mathematica 5.1, In: Ionescu C, Paulet F, editors, Proceedings of International Symposium Computational Civil Engineering 2007, CCE 2007; 2007 May 25; Iasi, Romania. Iasi: Publishing House of "Matei-Teiu Botez" Academic Society, Iasi; 180-190, 2007.

[9] I. Radinschi , M.D. Frunza and B. Ciobanu, Online Virtual Model for Testing the Knowledge, In: IATED, editors, Proceedings of International Technology, Education and Development Conference INTED 2007, March 7-9; Valencia, Spain, Valencia, IATED; 42-47, 2007.

 ISBN 978-989-95095-3-5

[10]I. Radinschi, L. Scripcariu, B. Ciobanu and M. Frunza, Online Quizzes, an Application of PHP-Triad and MySQL, Romanian Journal of Physics 53(1-2): 391-396, 2008.
[11]I. Radinschi I and C. Damoc, Computer Simulations for Physics Laboratory, In: Ionescu C, editor, Proceedings of International Symposium Computational Civil Engineering 2008, CCE 2008; 2008 May 30, Iasi, Romania, Iasi: Publishing House of "Matei-Teiu Botez" Academic Society, Iasi; 180-190, 2008.
[12]I. Radinschi I, B. Ciobanu B and M.D., Frunza, Physics with Maple 9.5, In: Ionescu C, Paulet F, editors, Proceedings of International Symposium Computational Civil Engineering 2007, CCE 2007; 2007 May 25; Iasi, Romania. Iasi: Publishing House of "Matei-Teiu Botez" Academic Society, Iasi; 190-200, 2007.
[13]I. Radinschi I and B. Ciobanu, Implementation of Computational Methods in Physics Teaching, In: Ionescu C, Paulet F, editors. Proceedings of International Symposium Computational Civil Engineering 2006, CCE 2006; 2007 May 26; Iasi, Romania: Iasi: Publishing House of "Matei-Teiu Botez" Academic Society, Iasi; p. 251-256, 2006.
[14]E.V. Wilson, ExamNet asynchronous learning network: Augmenting face-to-face courses with student-developed exam questions, Computers & Education 42(1): 87-107, 2004.
[15]E.V. Wilson, Student characteristics and computer-mediated communication, Computers & Education 34(2): 67-76, 2000.
[16]www.myphysicslab.com/
[17]http://phet.colorado.edu/
[18]www.adobe.com/products/flash

Perennial Value of Great Physics Laboratory Equipment Collections

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Abstract. The education in Mathematics, Physics and Chemistry has been basic for the training of higher technical staff during all its history in Bucharest, even since "Princely Academy of St. SAVA" (1694) and the first Romanian "Higher Technical School" (1818). At the "St. SAVA College" (1832) one of the four offered curricula was in "Exact Sciences". The first laboratory equipment of Physics and Chemistry was bought in 1833. The first Physics Laboratory was operational in 1850. Since then, the higher technical education in Bucharest was reorganized many times.

In the new campus (1886, POLIZU street) of the "National School of Bridges and Roads", designed by the French architects LECOMTE DE NOUY and Bernard CASSIEN and built between 1884-6, it was reserved a large room (called MUSEUM, close to the main amphitheatre), to the equipment for future teaching demonstrations and student lab work.

A full collection of Physics laboratory equipment was ordered to the internationally renowned "E. DUCRETET" scientific equipment company in Paris (35 rue des Feuillantines). Eugène DUCRETET (1844-1915), in spite of being a self made man, produced new devices for leading physicists of his time, became an active member of the French Physical Society (>30 papers published) and an inventor (especially in radio telecommunications), a gold medallist and finally an organizer of universal exhibitions. This DUCRETET collection, firstly made out of 867 pieces (the catalogue of which having been found), was exhibited at the 1885 International Exhibition of Anvers, where received a Honour Diploma before starting to be used in Bucharest, since 1886. Afterwards, there had yearly been ordered ~ 20 new laboratory items, illustrating newly discovered phenomena (radio, X rays, radioactivity a. s. o.). The King Carol I st honoured Eugène DUCRETET with the title of "officier de l'instruction publique, de la Couronne de Roumanie".

By its size, its complexion, its updating, its quality, the high precision of its components and their reliability (even today working!), this DUCRETET Collection of Physics lab equipment is unique in Romania and probably very rare in the world. It has permanently been a source of

 ISBN 978-989-95095-3-5

progress.

The existence of such a Collection has led to the development, in the Department of Physics, of a workshop, initially for maintenance and repairs but lately for building new didactic and research equipment, sometimes multiplied by specialized companies. Since its beginning, the MUSEUM was the nursery of new experimental courses. It was developed, including exhibits on "POLITEHNICA" achievements and, in 1927, it was reorganized as the "Industrial Museum of the Polytechnic School", disappearing in 1948 during the soviet's imposed reform of education in the country. A part of the Collection has been preserved in the Department of Physics, for experimental demonstrations, until 1960, when a communist reform transformed Physics in a theoretical discipline taught only to seniors. Since then, the destruction of the collection was very fast, it being considered totally depreciated and disappearing from records. Some pieces (spectroscope, lunette) have survived in some labs, even after moving to the new campus (GROZAVESTI, 1970'), being used for research, especially interdisciplinary and training of school teachers, of gifted pupils attending conferences at POLITEHNICA and of Romanian participants in international Olympiads.

The MUSEUM has been re-opened on December 3, 2003. There have been found, exhibited and d and offered to visiting classes, for classical experiments, 14 pieces of the initial DUCRETET collection,, al in all in good state, starting with a genuine metre-etalon and its metrological certificate from Sevres.

Keywords. Formal and Informal Edcuation, Museum.

Suggestions. 1.- **HSCI**, with the contribution of pupils, students, teachers, professors, museums and companies to set up and keep REPERTORIES of museums of science open to live classes and of valuable laboratory collections, particularly of those having received important prizes; 2. – **HSCI** to regularly organize PUPIL COMPETITIONS for finding valuable pieces of Physics laboratory equipment having belonged to old collections.

Permanently Expanding the Use of Standard Laboratory Equipment to New Applications

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Abstract. One important resource to cheaply improve Experimental Physics training, in schools and universities and at the same time, to offer more experimental opportunities to the interested pupils and students, is to use the existing standard teaching laboratory equipment to perform experiments outside the initial scope the equipment has been designed, produced, advertised and sold for.

These new experiments may refer to: larger ranges, a better precision, smaller quantities, more complex investigated objects, new phenomena (eventually interdisciplinary) and higher levels of the processing of experimentally got data.

In the paper, there is described a new application of the standard equipment designed for the measurement, in a Physics didactic laboratory, of the velocity of light in air, equipment produced by many teaching laboratory equipment companies and widely distributed in schools and universities.

The author has used this existing equipment to study the velocities of propagation of light in an optical fiber, particularly to determine the ratio of the refractive indices of core and cladding of the optical fibers, assembled in a light cable.

A possibility to determine the velocity of light would be by measuring: the wavelength in the medium (usually around ~ 0.5 micrometers) - possibly to be done with the existing equipment and the frequency of the light wave, f_0 = ~ $6*10^{14}$ Hz – a too large frequency to be measured in a school laboratory.

Other possibility to determine the velocity of light, is to measure the time of propagation, ***t,*** of a known signal over a measurable distance, ***l***. Because the velocity of light is very high (~ $3*10^8$ m/s) and the cozy operational distance in a teaching laboratory is ~ 1 m, which may be measured with a standard lineal, with a precision of 1 mm, there is to be measured a time of ~ 3.33 ns, too small a time for the precision of the equipment available in Physics didactic laboratories.

The principle of the method used to measure the velocity of light in air, with cheap available equipment, is to periodically modulate, in intensity, a light wave, with a piezoelectric, stabilized in frequency (f_1 = 60 MHz), modulator

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and let the modulated signal to propagate through the studied transparent material (air), supposed to be homogenous. In his way, the phase difference is reduced 10^7 times, but this new difference of phase is, again, too large to be measured with a cheap oscilloscope. The solution is to add to this signal other signal of equal intensity, but with a frequency f_2, differing from the modulating signal f_1 with only ~100 kHz. The resulting mixed signal is monitored with a cheap oscillator, after filtering the higher frequency equal with $f_1 + f_2$.

To measure the differences of time of propagation in the core and in the cladding of optical fibers, independently of the configuration, environment and different connections there is used a differential set-up and a reference signal, synchronized with f_1 and mixed with f_2.

The experiments performed by students, on 4 types of light cables, show that the determination of velocities of light in light cables is possible with simple equipment, with a less than 10% relative error.

Keywords. Formal and Informal Edcuation, Museum.

Suggestion. The author suggests **HSci** to set up a yearly competition for school pupils for introducing new uses of the existing standard laboratory equipment, eventually, on imposed, each year, new topics.

Informal Learning at School. Science Fairs in Basic Schools

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Abstract. The communication herein reports on the second edition of the annual Science Fair at Externato Maria Auxiliadora, in Viana do Castelo, Portugal. It was intended to give continuity to the research project on science fairs of the previous year improving, based on past conclusions, some aspects: the age group of the participants was enlarged to ages 10 to 15, and there was a major effort to engage parents and the whole school community in the process and in the development/construction of the projects to the science fair. Besides that, to the teachers involved in the project, was assigned an increased set of weekly hours to give support to the works realization. The participation of the students was not obligatory and it had no weight in the student's formal evaluation.

The results suggested that the whole school benefited from the enlargement of the age group of the participants in the event, and that the projects made by the younger students were particularly interesting. We concluded again that the Science Fair contributed effectively to an increase of the student's interest on scientific subjects.

Keywords. Basic Schools, Informal Learning, Science Fairs.

1. Introduction

Science Fairs are generally classified as cultural and pedagogical activities that involves all school communities, allowing public presentation of the scientific projects [1] developed by the students, the dialogue, the sharing and discussion of knowledge among students teachers and, hopefully, parents and the community. Work methodologies are developed, research performed, and the creativity of students but also teachers and visitors during the exposition, is explored [2,3]. Science fairs stimulate the construction of the scientific knowledge along the years, the exchange of ideas, work habits and knowledge [4].

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However, the success of this kind of event didn't depend only on the effort of students but it is also necessary that they feel the support given by their teachers and parents. The help given by professionals of the scientific area in study might be very important during the development of the project and the preparation of the presentation [4]. However is important that this kind of support begins at home. Therefore, parents should be notified about the realization of the science fair as early as possible [5] and enrolled actively.

A good organization of the science fair is also necessary to make it a success. Therefore organizers should select the appropriate space for the number of participants and visitants that they expect [6], select dates and opening hours carefully [7] and make available materials and services if necessary [6]. If parents are notified sooner, certainly they don't mind to help in the organization, helping the organizing teachers [5,7] and so leave them with more time to support students with benefits also in terms of security and working rules [4].

2. Development of the project

On previous year project, the first science fair organized at school Externato Maria Auxiliadora was limited to students with ages between 12 and 15 years old (7th to 9th grades) and the scientific areas involved on projects were restricted to Physics and Chemistry. The participants and organizers' lack of experience led to some faults that one tried to remove in this second edition of the science fair.

The fair was advertised sooner by middle October 2007, and the deadline for submission was 29th November. However, it was necessary to give more time in order to support the formation of groups, the choice of themes and the preparation of the projects. Trying to surpass these difficulties, it was established the end of the 2nd term (March) as deadline for the delivery of the projects. The realization of the fair was set for the beginning of the 3rd term (April), since them the students are not overloaded with works and tests, like it happened last year, and were able to give oneself up to the realization of the projects. The two weeks school' break that preceded the fair was very useful to finish the projects and to prepare the presentations. The proposed date for the fair seems to have been a good choice since the student/teacher interaction could be done in a daily base, and the students could practice their presentations and reinforce their scientific knowledge on the subject of their project. The time gap between the choice of the projects and the realization of the fair, also allowed teachers to check if the projects were feasible or not in terms of presentation at the available space, as well as checking the security conditions, making the students aware of the constraints. The gathering of information in this phase was essential for the subsequent distribution of the physical spaces in the fair.

Another factor that contributed to the success of the science fair was the fact that, in the beginning of the year, parents were informed in a general meeting about the realization of this event, and of the importance the activity may have for the students in their learning/"growing" as well as of their active participation in the process. By the end of the 2nd term all parents were informed in writing about the fair date and were invited to attend and participate.

Although this initiative was originated at the school's science departments, the Arts and Technological education department was also actively involved for some support on the construction of the fair mascot (Figure 1) and also helped in some projects.

Another pleasant surprise was the enthusiastic participation of the pre-school students, not only in the visit to the fair, but also in the preparation and presentation of two experiences.

Figure 1. Poster with the mascot of the science fair

3. Results and discussion

101 students (around 67 % of the students of the school) participated in the fair. It is possible to see in Figure 2 that there was a larger participation of the students of the 7th grade and bellow (ages between 10 and 13 years old).

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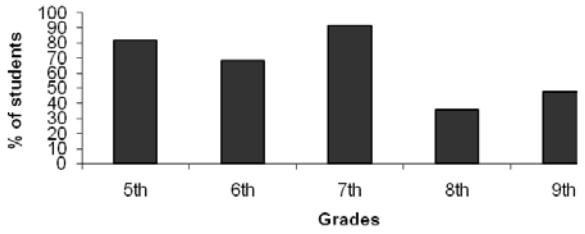

Figure 2. Percentage of students of different grades that participate on the science fair

The enthusiasm and great level of involvement of the new-coming students (last year fair only students from 7th to 9th grades participated) was obvious. It was remarkable the participation of more than 80 % of the students of the 5th year, for whom this activity was completely new and that have a still limited contact with science subjects. We may conclude that it seems to be a good age to initiate them into projects of this extent. The enthusiasm in the participation in the process is very important. However it is of great importance the constant surveillance of the evolution of the students' participation in this type of events across the year (and in the subsequent years), creating work habits in the preparation and development of scientific projects, making sustainable this increased interest in science.

One important aspect that we take into account is the fact that some elder students deliver their projects after the deadline or that disregarded the standards of security imposed. In some cases this lead to the non acceptation of some projects, as a way to emphasize the importance of responsibility, including in what concerns deadlines and security rules. This imposition also led to an improvement of the final products in comparison to last years' fair.

Also important is the continuity of previous year projects, which is recommended in the literature [4]. Two of last year' projects were further developed and presented by the same groups this year. This fact would have interest, if the improvements were not only aesthetic, instead of scientific ones as it should be.

On Figure 3, it is possible to see that the distribution of students by subject was homogeneous. These projects were classified in the respective areas take into account the theoretical basis. Among the 32 projects presented, 12 were approached in the Physics perspective, 12 of the Chemistry and 8 in the broader classification of Natural Sciences. This last area was a novelty regarding the previous year, when there were only projects of the areas of physics and chemistry. It seems that this difference can be related to two quite obvious reasons: the biggest involvement and support given by the teachers of natural sciences discipline, and the participation of students from 5th and 6th grades (authors of 5 from 8 projects on this natural sciences group). It is important to stress that, in spite of the homogeneity described previously, the students treated the subjects under rather varied perspectives, i.e. related to the environment, technology, everyday phenomenon explanation,... It was also interesting to see the variety of resources used to improve the quality of presentations, from common posters and dossiers, to reports and Gowin's V explored in the classrooms.

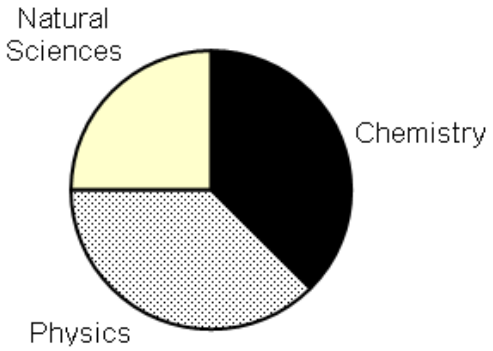

Figure 3. Distribution of the projects between the science fields

In terms of the number of students' which constituted each work group (Figure 4), it was verified that around 47 % of the projects were developed in groups of 4 students. On larger groups was found no major disparity in what concerns students' knowledge, and it can even be considered beneficial in someway since the students could take turns in the presentations, allowing them to visit other stands and see, and discuss, other projects.

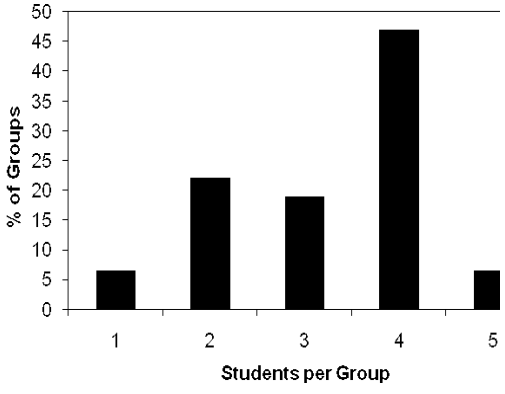

Figure 4. Distribution of students per group

Taking in account the projects development stage, the presentation clearness and the

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creativity, the jury had chosen five winning projects and, by vote, the students have chosen another. It was interesting to notice that the five selected works were developed by groups of students of the 5th, 6th and 7th grades. This demonstrates the high quality of the projects of these students when compared to those elder students.

We considered, and will work accordingly, very important to check if this quality will be kept in the following years.

We can conclude that science fairs are of great interest to schools and their students, since they give the opportunity to students to increase their knowledge in an autonomous way working hands-on. One can finally conclude that the improvement of sciences fairs in schools is dependent on the continuity of the activity, participation and involvement of whole school community, and, probably the most important point, the sharing of knowledge and experiences between teachers.

4. Future work

This project was awed to be of all school community interest. The continuity of the realization of science fairs is a way of curricular enrichment, and a way to increase not only the success in terms of student' learning of scientific subjects but also as the motivation, at larger, for learning. In addition science fairs are a way to enhance students' responsibility and autonomy. In the following academic year the project will be developed within "Area de Projecto" classes (project classes), which will allow teachers to have a larger control of the whole process. It will be done an attempt to articulate the projects with other fields of study in interdisciplinary approaches.

Another aspect to be improved in the following science fair will be a previous definition of the jury which will choose the winners of the initiative.

There is an intention to open the event to elementary school students of the same institution but organizing this "junior" fair in a different room. This initiative will allow studying the degree of involvement of these students, the quality of projects, the time spent and the number of participations, attitudinal and learning gains.

5. References

[1] http://portal.mec.gov.br/seb/index.php?option=content&task=view&id=634&Itemid=650

[2] R. Mancuso, Feiras de Ciências: produção estudantil, avaliação, consequência, Revista digital de Educacion e Nuevas Tecnologias, nº6. April 2000.

[3] T. Abernathy and R. Vineyard, Academic Competitions in science: what are the rewards for students? The Clearing house, Volume 74: 269-276, 2000.

[4] www.feiradeciencias.com.br

[5] W. Sumrall, Nontradicional characteristics of a successful science fair project, Science Scope, 20-25, 2004.

[6] J. Rose, A. Smith, K. Um and M. Demetrikopoulos, Reverse your science fair with educational partnerships, Science Scope, 16-19, 2004.

[7] Science Fair Plus: Reinventing an Old Favorite, K8. NSTA press, 2003.

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Metals Are Reductive but Some Are More than Others

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Abstract. One of the first insights given to the students when they study the reactions of oxidation-reduction is that metals are reductive. Apart from this important aspect of the chemical characteristics of metals, it is important to highlight that some are more reductive than others.

The idea of an electrochemical potential of a chemical, and, in this case a metal, is used as a sign of how difficult it will be for this metal to undergo an oxidation when it is in contact with its peers.

This experiment intends to prove that when two different metals are in contact through an electrolytic conductor, they produce an electro driven force which is attributed to the difference of the electrochemical potential existing among the present species.

Due to this fact, and to prove the existing theories on this issue, and still in order to be able to compare results, an experimental work was carried on. By using some manual dexterity, a very simple-to-use equipment was used and it allowed a successful experiment.

Keywords. Corrosion, Electrochemical, Experiments, Teaching.

1. Introduction

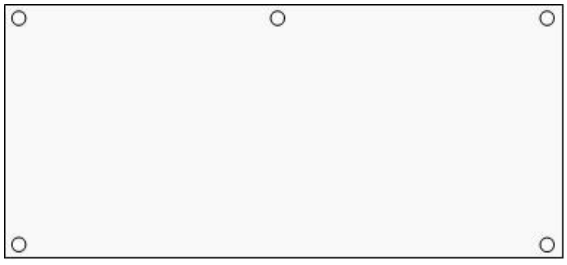

Figure 1. Acrylic board

When consulting the standard reduction potential table, the students observe the existence of values of negative and positive potential which leads them to conclude on the spontaneity of the reactions that occur when different metals get in contact via an electrolyte [1]. In this experiment the students can verify the change of signal when they move the voltmeter forceps that were used to do the readings. This fact allows us to infer in which direction the redox reaction occurs [2].

Also, from this experiment, the need to establish conditions and choose an element to be used as a standard electrode emerged [3].

2. Methodology

We can describe the methodology used based on the tasks that were followed in every step.

- Bibliographic research on the table of the standard potentials of reduction;
- Preparation of materials – mop stripes;
- Preparation of the auxiliary equipment – acrylic boards;
- Preparation of the metals studied;
- Preparation of ionic solutions of the metal elements involved with the concentration 1 $mol.dm^{-3}$;
- Preparation of a saturated solution of potassium nitrate.

These experiments were carried on so as to allow, with the results obtained, the building of the tables presented on item 4 of this work.

Also, a table with the values of pattern potential of reduction for the same chemical species studied was similarly built.

By comparing the experimental results with the pattern values that are internationally acknowledged, the students analyzed the reproducibility of the potential of the metals under study so that they could conclude on the pedagogical/didactical value of the experimental work.

3. The Equipment

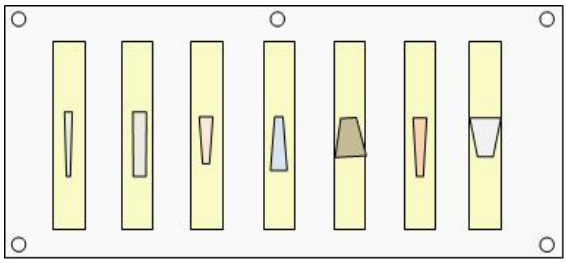

Figure 2. Stripes tissues with metals

Two 330 x 170 x 5-mm acrylic boards (Plexiglas – PMMA) were used. They were holed with a Ø = 5mm screw so that, later, fixing screws can be introduced, according to Figure 1.

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Seven 120 x 20 x 1-mm stripes of absorbing tissue, usually used in mops at home, were cut. Later they were sunk in an electrolyte concentration and seven different pieces of metal are placed on them (each metal with the corresponding ion concentration, 1 $mol.dm^{-3}$ in the stripes), as it is shown in Figure 2.

Note - Without any pedagogical intent, the metals were placed by order of the atomic number. Thus we have the metal and salt used for the electrolyte of its ion:

$_{12}Mg$ – Magnesium / $MgSO_4$
$_{13}Al$ – Aluminium / $Al_2(SO_4)_3$
$_{26}Fe$ – Iron / $FeSO_4$
$_{29}Cu$ – Copper / $CuSO_4$
$_{30}Zn$ – Zinc / $ZnSO_4$
$_{47}Ag$ – Silver / $AgNO_3$
$_{82}Pb$ – Lead / $Pb(NO_3)_2$

After that, a longer mop stripe, 260 x 20 x 1 mm, was cut and sunk in an electrolyte of saturated potassium nitrate [4] and then placed in a way as to connect all the others “as a comb”, as in Figure 3.

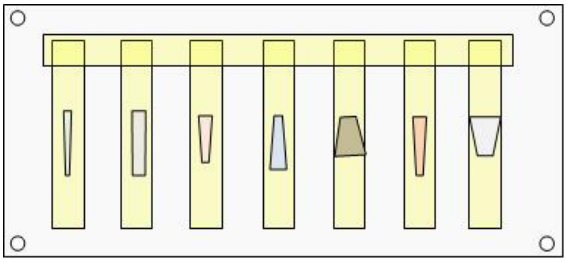

Figure 3. Salt bridge connecting all stripes

Finally, we place a second acrylic board on top of the first one, with 3 mm Ø holes located strategically in the same direction of the metals on the mop stripes to be able to introduce the voltmeter forceps so that the readings of the potential differences can be done, as represented in Figures 4 and 5.

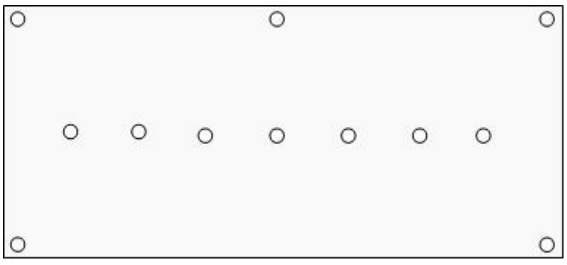

Figure 4. Top acrylic board

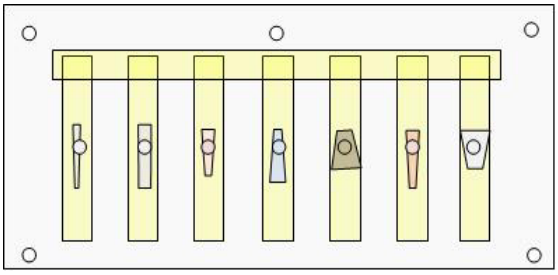

Figure 5. Equipment ready to experiment

Final assembly already fixed and ready for the *ddp* readings. Once the screws/nuts are quite tight adjusting the acrylic boards, the system is ready for the measuring, as shown in Figure 6.

Figure 6. Final equipment

4. Experimental Readings

The values of standard potential [5] for the metals studied are presented in Table 1:

Table 1. Standard Potential Electrodes / E^o, of the metals studied

$M^{n+} + ne \rightarrow M^o$	E^o / *V*
$Mg^{2+}(aq) + 2e \rightarrow Mg^o$	− 2,36 *V*
$Al^{3+}(aq) + 3e \rightarrow Al^o$	− 1,68 *V*
$Zn^{2+}(aq) + 2e \rightarrow Zn^o$	− 0,76 *V*
$Fe^{2+}(aq) + 2e \rightarrow Fe^o$	− 0,44 *V*
$Pb^{2+}(aq) + 2e \rightarrow Pb^o$	− 0,13 *V*
$2H^{+}(aq) + 2e \rightarrow H_2\ (g)$	0,00 *V*
$Cu^{2+}(aq) + 2e \rightarrow Cu^o$	+ 0,34 *V*
$Ag^{+}(aq) + e \rightarrow Ag^o$	+ 0,80 *V*

Representing on a line the theoretical position of the metals studied, we have:

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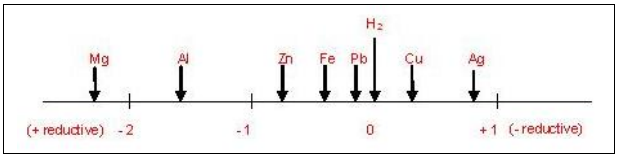


Table 2. Theoretical standard values / *V*

Theoretical	Mg	Al	Fe	Cu	Zn	Ag	Pb
Mg	$Mg^{2+}\|Mg^0$	+0,68	+1,92	+2,70	+1,60	+3,16	+2,23
Al	-0,68	$Al^{3+}\|Al^0$	+1,24	+2,02	+0,92	+2,48	+1,55
Fe	-1,92	-1,24	$Fe^{2+}\|Fe^0$	+0,78	-0,32	+1,24	+0,31
Cu	-2,70	-2,02	-0,78	$Cu^{2+}\|Cu^0$	-1,10	+0,46	-0,47
Zn	-1,60	-0,92	+0,32	+1,10	$Zn^{2+}\|Zn^0$	+1,56	+0,63
Ag	-3,16	-2,48	-1,24	-0,46	-1,56	$Ag^+\|Ag^0$	-0,93
Pb	-2,23	-1,55	-0,31	+0,47	-0,63	+0,93	$Pb^{2+}\|Pb^0$

Figure 7. The equipment and the reading instrument

Considering that the spontaneous reactions, the thermodynamically possible ones, are those that present a difference of positive potential among the pairs of metals studied and which can be represented according to the following chemical equations:

$3Mg\ (s) + 2Al^{3+}\ (aq) \rightarrow 3Mg^{2+}\ (aq) + 2Al\ (s)$
$Mg\ (s) + Zn^{2+}\ (aq) \rightarrow Mg^{2+}\ (aq) + Zn\ (s)$
$Mg\ (s) + Fe^{2+}\ (aq) \rightarrow Mg^{2+}\ (aq) + Fe\ (s)$
$Mg\ (s) + Pb^{2+}\ aq) \rightarrow Mg^{2+}\ (aq) + Pb\ (s)$
$Mg\ (s) + Cu^{2+}\ (aq) \rightarrow Mg^{2+}\ (aq) + Cu\ (s)$
$Mg\ (s) + 2Ag^{+}\ (aq) \rightarrow Mg^{2+}\ (aq) + 2Ag\ (s)$

$2Al\ (s) + 3Zn^{2+}\ (aq) \rightarrow 2Al^{3+}\ (aq) + 3Zn\ (s)$
$2Al\ (s) + 3Fe^{2+}\ (aq) \rightarrow 2Al^{3+}\ (aq) + 3Fe\ (s)$
$2Al\ (s) + 3Pb^{2+}\ (aq) \rightarrow 2Al^{3+}\ (aq) + 3Pb\ (s)$
$2Al\ (s) + 3Cu^{2+}\ (aq) \rightarrow 2Al^{3+}\ (aq) + 3Cu\ (s)$
$Al\ (s) + 3Ag^{+}\ (aq) \rightarrow Al^{3+}\ (aq) + 3Ag\ (s)$

$Zn\ (s) + Fe^{2+}\ (aq) \rightarrow Zn^{2+}\ (aq) + Fe\ (s)$
$Zn\ (s) + Pb^{2+}\ (aq) \rightarrow Zn^{2+}\ (aq) + Pb\ (s)$
$Zn\ (s) + Cu^{2+}\ (aq) \rightarrow Zn^{2+}\ (aq) + Cu\ (s)$
$Zn\ (s) + 2Ag^{+}\ (aq) \rightarrow Zn^{2+}\ (aq) + 2Ag\ (s)$

$Fe\ (s) + Pb^{2+}\ (aq) \rightarrow Fe^{2+}\ (aq) + Pb\ (s)$
$Fe\ (s) + Cu^{2+}\ (aq) \rightarrow Fe^{2+}\ (aq) + Cu\ (s)$
$Fe\ (s) + 2Ag^{+}\ (aq) \rightarrow Fe^{2+}\ (aq) + 2Ag\ (s)$

$Cu\ (s) + 2Ag^{+}\ (aq) \rightarrow Cu^{2+}\ (aq) + 2Ag\ (s)$

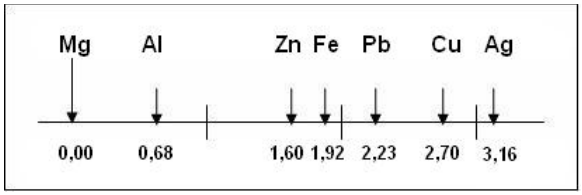
In order to record the average values obtained we carried out several experiments.

In Table 3, we present the experimental results of the driven force between the pairs of metals used in the study.

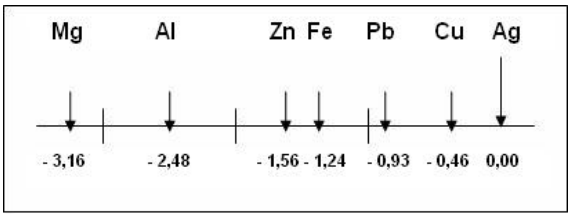
Table 3. Experimental results / *V*

Experimental	Mg	Al	Fe	Cu	Zn	Ag	Pb
Mg	$Mg^{2+}\|Mg^0$	+1,24	+1,35	+1,80	+1,49	+2,19	+1,38
Al	-1,20	$Al^{3+}\|Al^0$	+0,27	+0,59	+0,32	+0,98	+0,13
Fe	-1,25	-0,25	$Fe^{2+}\|Fe^0$	+0,59	-0,21	+0,98	+0,11
Cu	-1,78	-0,51	-0,58	$Cu^{2+}\|Cu^0$	-0,47	+0,39	-0,47
Zn	-1,42	-0,36	+0,13	+0,36	$Zn^{2+}\|Zn^0$	+1,41	+0,21
Ag	-2,16	-0,98	-1,01	-0,39	-1,39	$Ag^+\|Ag^0$	-0,86
Pb	-1,32	-0,15	-0,11	+0,47	-0,17	+0,86	$Pb^{2+}\|Pb^0$

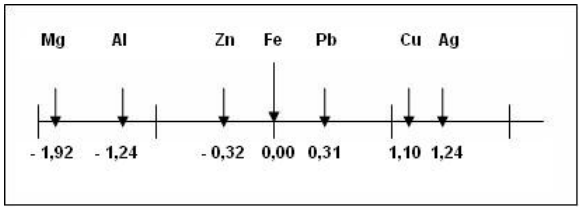
With the experimental results we represent, on a line, as a reference, the more reductive metal. We can see its position compared with the one of its peers.



Similarly, and by using, as a reference, the values obtained for the less reductive metal, we can see the relative position of its peers.



Since iron is quite important in the construction of any structure, which leads to the studies of protection to corrosion, we suggest a representation that highlights its relative position among the several metals studied.



5. Conclusions

This experiment allows the transmission and/or consolidation of electrochemical knowledge [6], namely the notion of potential and the importance of the existence of the standard

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electrode. Being aware that there is a wide range of factors contributing to a sometimes substantial difference between the values obtained in the experiment and the standard values, we must consider this the kind of work that can be carried out in a classroom and stands out as a motivator factor.

To name the reasons that justify the not so good results can lead to a valuable and healthy scientific discussion among the students.

To infer which spontaneous reactions, electrical resistances, ionic interferences and concentrations, work temperature and, naturally, the experimental mistakes is always the appropriate scientific attitude.

6. Acknowledgements

I thank all students that attend the 11th form of the Chemistry, Environment and Quality (QAQ course, in the Colégio Internato dos Carvalhos), who were deeply involved in this experiment. We also thank Edite Pereira da Silva, our English Teacher.

7. References

[1] Peter G. Nelson, *Quantifying Electrical Character*, J.C.E., 74, n 9, p 1085, 2007.
[2] khodakov, Iu. V., Epstein, D.A. and Gloriózov, P.A. Química Inorgânica. Ed. Mir Moscovo. p. 127.
[3] Brett, Ana O. and Christopher M.A. Electroquímica – Princípios, métodos e aplicações. Ed. Almedina. p. 459.
[4] Howell, B. A. Cobb, V. S. and Haaksma R. A. Journal of Chemical Education, A Convenient Salt Bridge for Electrochemical Experiments in the General Chemistry Laboratory. V. 60, n. 4 April 1983.
[5] Tanis, David O. Journal of Chemical Education. Filtrates and Residues. Galvanic Cells and the Standard Reduction Potential Table. V. 67. N. 7 P. 602-603. Jul.1990.
[6] Birss, Viola I.; Truax, D. Rodney. Journal of Chemical Education. An Effective Approach to Teaching Electrochemistry. V. 67. N. 5. P. 403-409. May 1990.

Building a Robot to Use in School – Teachers and Students Learning Together

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Abstract. Robotics is becoming extremely popular amongst the youngsters, because it is fun, you can practice with hands-on and above all you get real results. Since most students have to develop practical works in their schools, robotics works are becoming very popular.

But robotic is a multidisciplinary area of knowledge and therefore the school teachers might not have the know-how in all required fields.

The Robotics Group at University of Minho (Guimarães, Portugal), created a new robotics event called RoboParty© where they actually build robots from scratch (mechanics, electronics, programming, etc.) in 3 days (24 hours a day) supervised continuously by experts on the various fields. At the end, they take the robot home with them and they can continue using and improving it later on.

Keywords. Robotics, Event, Hands-on, Party, Learning.

1. Introduction

It is well known and accepted that in our future there will be mobile autonomous robots, new technological devices and ideas to help society in general, specially servicing robots to help humans in their everyday tasks.

Therefore, many robotics groups have been fostered to develop and improve such technological devices, but to continue that work more and more researchers are needed. Youngsters are very welcome to all these fields of research since their normally bring with them curiosity, new and rebel ideas, and will to work and to prove themselves. There is a trend to foster youngster's curiosity and interest for robotics engineering related areas, motivating them to learn in a structured way and forcing them to a hand-on-science experience.

That requirement of preparing the young generation for the robotics challenges of the future is extremely necessary and it depends very much on their teachers (primary and secondary schools) which should be available to teach them and to learn themselves also. When

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a robotics project is under way, in most cases it is much easier to motivate the students than their teachers. The robots built by the students and a possible participation in a robotics event normally attract the media, being possible to advertise publically their robots, giving some notoriety to the school. These projects also keep the students busy with learning rather than spending time in other less desirable activities.

2. Motivations to organize RoboParty©

The Group of Automation and Robotics [1] from University of Minho (Guimarães, Portugal) [2] has been developing mobile autonomous robots for the last 10 years, and has been participating actively on many national and international robotics competitions with some success, with special attention dedicated to the worldwide robotics challenge RoboCup [3], on the Middle Size League, with a team of 5 robots which can play football autonomously.

Primary and secondary schools from all over the country have been requesting this group to make robotic demonstrations and speeches, and the group use to travel to the schools with robots to fulfil their desire. But the frequency was getting so high that it was decided to organize an event working the other way round. The schools would come to the University of Minho and bring teams of students with one teacher (or person responsible by the team) for three complete days in a unique event, where they would be taught how to build a robot with their own hands, with lectures specially created for their young ages, by experts on robotics. The experience was a success and is here described.

3. RoboParty – a new type of event

The main objective was to teach robotics to youngster from 11 years old, to people who doesn't know anything about robotics, in an entertaining way, very practical with hands-on, in a friendship and helping environment, with lots of fun, breaks for entertaining/sports activities. It is also important to foster their enthusiasm by science and technology studies, and the participants are guided and supervised by experts on robotics.

The participants need to bring with them to the event a sleeping bag per person, a laptop computer for the team, the desire to learn robotics and good state of mind. In the end, they take home a mobile robot built by them, physical souvenirs from the RoboParty, lots of memories and possibly a new future.

Each team has 4 people, one of them an adult (a teacher or a parent). The participants are suggested to share information, ideas and knowledge with other teams, and in fact they help each other very frequently.

4. Event Facilities

The event was held on the University sports pavilion. The space was split into two areas: working area (2/3 of the overall space) with tables for the teams and electrical plugs; and a sleeping/sports area (1/3 of the space) where some entertaining/sports activities were held during the day and a sleeping area during the night, using sleeping bags on sports mattresses.

Figure 1. Sleeping Area

The sports hall has good conditions like central heating/air conditioning, a large number of toilets facilities, room with sports machines, security surveillance cameras, electronic entrance control, parking space, file cabinet with lockers, sound room, and a reception.

Nearby, there is the University canteen where the students had their meals and a huge campus garden where they can relax when they get tired.

A group of over 50 volunteers helped on the organization, all of them last year students of the Industrial Electronics degree.

There is a space where all participants attend the lectures (how to build the robot, how to solder electronic components, history of robotics, robotics competitions, servicing robots, etc.).

Another space was reserved for robots demonstrations (for anyone to show their robots or technological gadgets). Some of the robots on display were built at the University of Minho.

The entertaining/sports activities were very popular, like: indoor Air Modelling, Basketball, Football, Tennis table, Badminton, Wood Ball, Taekwondo, Yoga, Kickboxing, Judo, Karate, *Capoeira*, Stretches, Cardio Session, Triathlon indoor, Golf, Quick Chess, circus activities, Ballroom dance, Archery.

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These activities are available most of the time and each participant can decide the activities he wants to participate. All these activities had professionals to help and teach the students.

5. RoboParty image

In order to make it more attractive, a designer was asked to make the event's image. A mascot was created called Ruminho (Robotics at University of MINHO). This mascot consists of a friendly two wheels robot, with two robotic arms and large eyes. Based on the Ruminho mascot, several entities were created: a T-shirt to offer all participants; a badge (with a transponder inside); trophies for the winners; a certificate for participants given in the end; a Ruminho plush (for sale); and posters to advertise the event (sent to schools weeks before).

Figure 2. RoboParty Image

An appealing world wide web site was created [4] not just to advertise the event but also for other various reason like: to accept team registrations with all the personal details, to give participants all the necessary information to parents and tutors, to explain the rules of the event, the demonstrate with pictures the robotic kit they have to assemble, to publish related news, and above all to show the event live. With these cameras the parents can see their kids on-line on the working area.

Figure 3. RoboParty Poster

Figure 4. RoboParty Web site

6. Event Contents

The event is made up of several parts:

- training and lectures (specifically created for youngsters)
- two invited speakers to talk about robotics (normally robotics expert from a foreign country, so that they can practice their English language).
- actual hands-on robot build up (soldering and mechanics)
- entertaining/sports activities (there is a huge activities list they can choose from). These activities allow them to rest mentally, to try/learn new sports or other activities and to meet new friends.

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Figure 5. Lecture about robot assembling

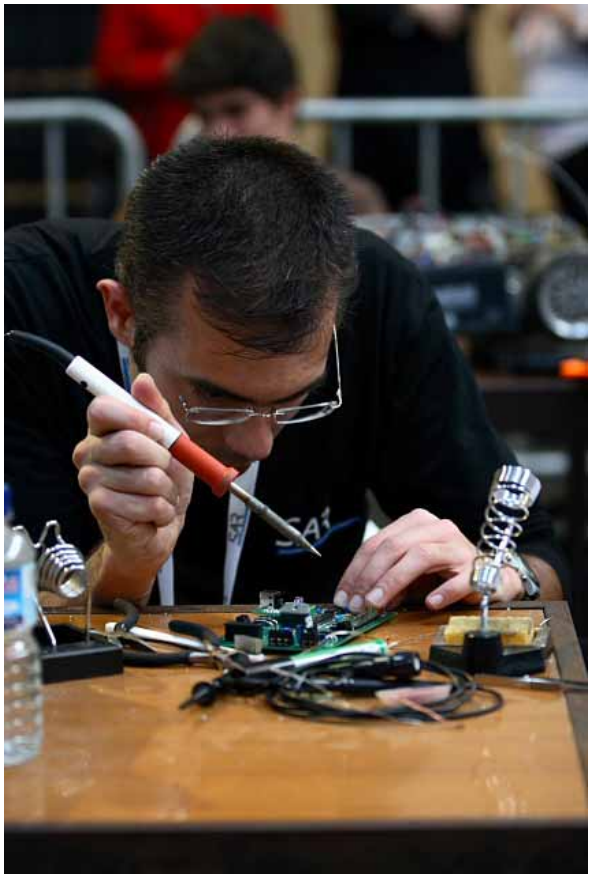

Figure 6. Soldering components

- robot programming (on their laptop)
- optional small competition in the end of the event, to allow teams to show their robots working. It consisted of three leagues: dance (90 seconds on the stage), obstacle avoidance (small track where robots cannot collide with walls) and aesthetic (robots decoration)
- demonstrations area, where other robots are on display, to motivate further developments
- During the event, there is a repairing stand to fix some major break downs made by the teams on the robots, and this stand can fix immediately and/or replace parts. All the robots will leave the event running properly.

Figure 7. Robot programming

Figure 8. Entertaining/sports activities

Figure 9. Optional competition

- There are 50 electronics and programming experienced volunteers to walk around helping and guiding all teams. The volunteer are all University of Minho last year Electronics students.

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7. Participants Kit

When participants arrive, they must bring a sleeping bag each one, plus a laptop computer for the team. Then, their team leader checks them into the event as a team (all under age have to bring a permit from signed by the parents giving them permission to come to the event). They are given badges (with their photograph and a transponder) which gives them permit into the facilities, a RoboParty T-shirt for every one, a city map, a locker to keep their stuff closed, the program of the event, the robotic Kit in a box, a CD with instructions (a video) on how to build the robot, and then they are taken to their table on the working area.

Figure 10. RoboParty Box

The most basic tools to build the robot come in the box, but some others like the soldering gun they must bring from home or buy in the event. The web site contains a description of all necessary tools to build up the robot.

8. Building the robot

A robotic kit was developed on purpose for this event, by SAR - Soluções de Automação e Robótica [5] and University of Minho. This kit was baptized as Bot'n Roll ONE [6].

The robot assembly has three major steps: mechanics build up, electronics soldering and robot programming. All the necessary parts are in the box.

8.1. Mechanics

The participants start assembling the mechanical components which consist of a base where all the components attach to.

They start screwing one motor to an L shape motor holder, and attaching it to the base.

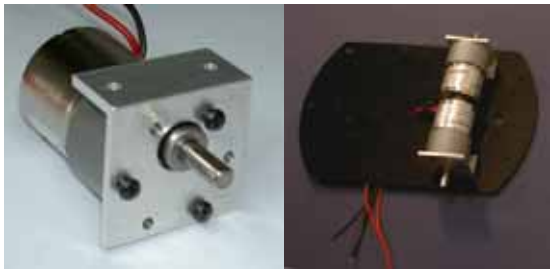

Figure 11. L shape Motor support (left) and robot base with two motors on (right)

Then the wheel is attached to the motor vein. This is repeated to both right and left motors/wheels.

Figure 12. Robot Wheel

The third support of the robot (caster wheel) is also assembled and attached to base and the back side.

Figure 13. Caster wheel

Other components have to be assembled but that task will be carried out after the electronic board has been assembled.

8.2. Soldering electronic board

The second step is then to solder the electronic components on the electronic board. This board was developed on purpose with large electronic components to make it easy for the participants the soldering task.

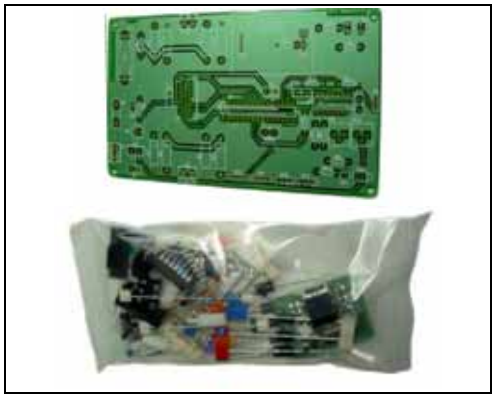

Figure 14. Electronic board (top) and electronic components (bottom)

The components are well and easily identifiable with colours or asymmetries and their location on the board is also easy to find because the board has the names written on it.

Before soldering the components a lecture on "how to solder" is given for those inexperienced. Another lecture is given to explain the participants what is a resistor, a capacitor, a battery, and LED, etc. These very basic instructions make them aware of the functionality of each component. The components soldering proved to be one of the most desired task by the youngsters.

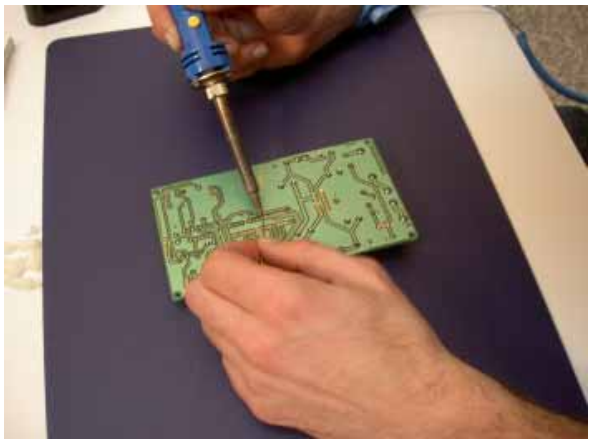

Figure 15. Soldering task

Even though there is a manual to follow, a CD is distributed on the box with videos on how to assemble the electronic board and all the volunteer are around the teams to guided and help the participants.

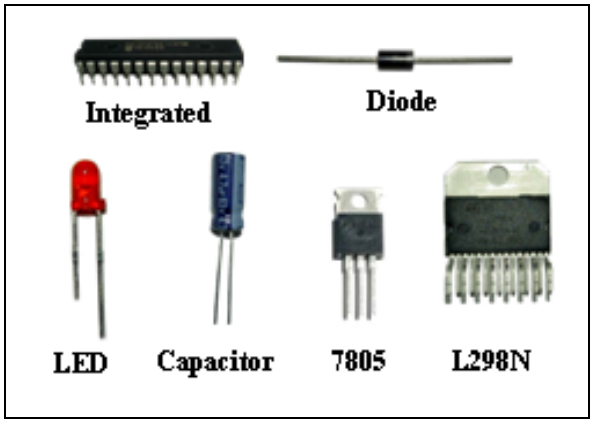

Figure 16. Major components

Once all the components are soldered, the board should look like the following picture.

Figure 17. Board with components soldered

To make it easy for the teams to program the board, a USB-Serial converter is used on the board, but since this uses SMD's (very small components), this is given already assembled as a small secondary board and they just have to plug it on the main board.

Figure 18. USB to serial converter

The board is then tested and placed on the robot (initial base where motor and wheel are attached.) with plastic supports.

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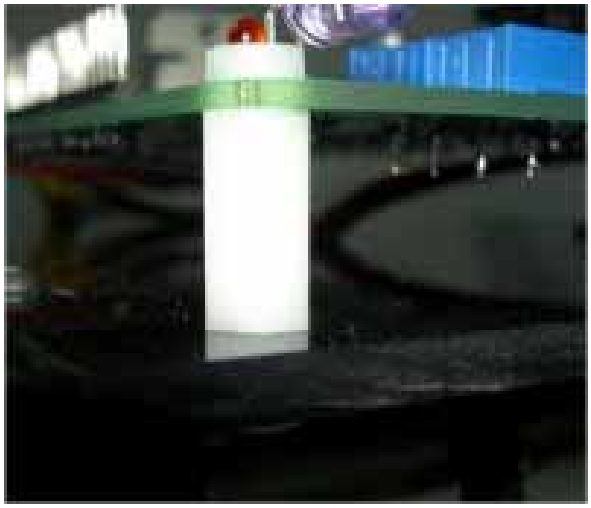

Figure 19. Board supports

The wires are then plugged in. Again, all the wires given have specific colours so that the participants do not mixed them. The main switch is mounted into place and the wires plugged.

Then the battery is placed under the robot and it gets stuck with Velcro, so that they can remove and replace it whenever they need without screws or any other mechanical device.

There are two optional extras for those teams who required it: a line follower and an LCD display. Those come already assembled and they just have to plug them on the robot.

The final aspect of the robot is pictured next.

Figure 20. Fully assembled Bot'n Roll ONE

All the cables, CDs and chargers are supplied in the BOX so that the robot can start working immediately.

8.3. Robot Programming

The third step is the robot programming. The software has to be installed on the laptop computer the teams brought with them, and a manual is given to all participants with instructions on how to install it. The software also comes on the CD within the robot box. A PICAXE is used as the brain of the robot and therefore the software to use is a compiler from the PICAXE itself.

The language is BASIC style and several examples built by the development team are given to the participants so that they get easily familiar with the main instructions. One lecture is given to participants on how to program a robot and teaching the main BASIC instructions.

Taking into account their age and their short programming knowledge, this lecture was specially created with cartons and several examples in order to make it easy to understand. It describes the most basic instructions and real examples are given and followed step by step so that they don't get afraid of learning the rest of the commands. In a few minutes the participants can experience their small projects and see the robot moving.

They get excited because the learning rate is fast. Besides, they are a group of four people and they can share their experiences and suggestions from four people make the learning process much easier and fast.

9. Results achieved

On the first edition (2007), the organization advertised RoboParty only on the city suburbs expecting to receive between 15 and 20 teams (4 participants each), but the registration had to be closed down because over 100 teams were already registered and the space available for the event was not much. They came from all around the country including the Portuguese islands. The space was re-thought of and 100 teams participated, meaning around about 400 participants plus the over 50 volunteers and organizers. Participated teams from primary schools, secondary schools, professional schools and even from universities (although just a few). It is important to point out also teams from robotic clubs and families.

The same happened on the second edition (2008), also with 100 teams (400 participants from all over the country) and the list did not grow due to lack of space.

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Figure 21. RoboParty Working Area

10. Case Study survey

In order to be able to improve the event, a statistical survey study was carried out during the 2008 edition, where over 12% of the participants were enquired with 19 questions. After a careful analysis, the most relevant aspects were taken into account and these are described below:

- Ages - The youngest participant was 9 year old and the oldest was 56 years old. Without considering the adults that accompany the students, the average age was just below 18 years old. An age distribution chart can be seen in the figure below.

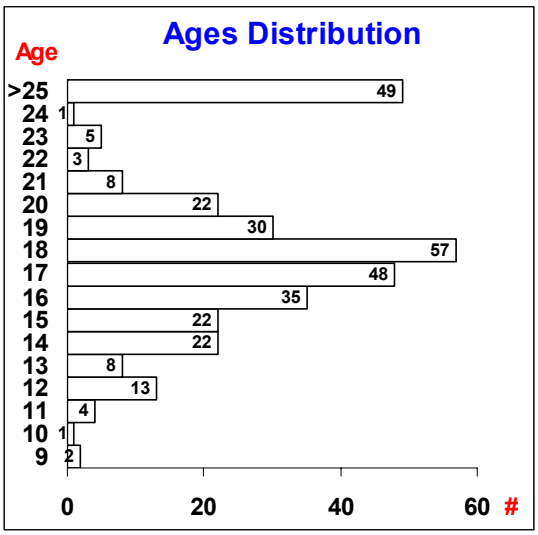

Figure 22. RoboParty participants ages distribution

- The participants come from all over the country, having a major percentage coming from the northern region.
- The degree of satisfaction was: completely satisfied (40%), very satisfied (54,5%), satisfied (5%).
- Regarding the expectations: exceeded expectations (74%), match expectations (23%), below expectations (2%).
- What they enjoyed the most: we point out just a few answers like: “The robot programming”, “The build up from scratch with the help of professional”, “speeches and training”, “the help from volunteers”, “to learn new things”, “the entertaining environment”, “the possibility of build a robot myself”, etc.
- How important has RoboParty been regarding what you know about robotics: extremely important (13%), very important (51%), important (36%), not important at all (0%).
- When the participants were asked if they would like to come and study on this University (Minho), 65% of them answered yes even though that most of them are not from Guimarães.
- Which area attracts the participant the most: Electronics (20%), computer science (58%), mechanics (3%), others (18%).
- When asked if they would continue using and playing with their robot at school or at home, around about 92% answered yes, they would.
- Where would they use their robot: At school (54%), at home (23%), everywhere (11%), no answer (10%).
- Who was the adult who accompanied the team: teacher (54%), parents (4%) and other family or friends (40%).
- Within the team, who actually put more effort on the robot built up: The enquired (15%), the other team mates (11%), all contributed (70%), the responsible adult of the team (5%).

On the enquiry, participants were asked to give some suggestions and those were taken into account and most of them were related with space for the teams, which means that the technical and functional aspects were fine.

11. Conclusions

The outcome of the event is very rewarding. No major disadvantages were found so far apart from a lot of work to organize. The main conclusions are:

- Since this event is dedicated to people who wants to start on the robotics field and they don’t have much knowledge about it, many people wants to participate; teams from schools, teams

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from groups of robotic, and even teams made up of families (parents and kids). In most cases, the adults that come with the teams are teachers of English, Gymnastic, History, and other fields which have nothing to do with robotics.

- Primary and Secondary teachers insist this event should continue in an annual basis, which the organization is considering very seriously. The teachers also see this event as an opportunity to learn a little bit more about robotics and to improve their know-how.
- In the end everyone leaves the event physically tired but with lots of good memories, souvenirs, but especially with a robot built by them selves.
- The participants also had the opportunity to show their robots working properly on the optional com petition on the end of the event, in three different leagues. A large number of public was present to fully and strongly supporting the participants.
- The youngster's motivation to participate on RoboParty is extremely high because they learn at their own rate, they learn many different fields, they learn technology, with easy lessons, without stress, with time to relax, and they have the chance to meet new friends and practice new sports and entertaining activities.
- All robots leave the event working properly, no break downs.
- They can continue using the robot and upgrade it at home or at school, and they can also participate on national and international robotics events.
- Some school teams used this robot to participate on the Portuguese national competition and they got places in the medals and even participated on RoboCup with the kit.

8. Acknowledgements

The author would like to thank the team from SAR – Soluções de Automação e Robótica who put all efforts in developing this project. Without the University of Minho help and especially all the staff from the sports hall, nothing would be possible to organize.

All the organising committee and volunteers deserve the recognition of their work.

A special thank you to Agostinho Gil Lopes, Teresa Moreira and Angela Carvalho whom besides being volunteers they took care of the event survey.

9. References

[1] Group of Automation and Robotics, http://www.robotica.dei.uminho.pt
[2] University of Minho, http://www.uminho.pt
[3] RoboCup Federation, http://www.robocup.org
[4] RoboParty, http://www.roboparty.org
[5] SAR – Soluções de Automação e Robótica, http://www.sarobotica.pt
[6] Robot Bot'n Roll ONE, http://www.botnroll.com

Hands-on and Fieldwork Activities in Biology Teaching: A Proposal for Vocational High School Students

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Abstract. The practice of "hands-on" and scientific activities outside the classroom is fundamental to the understanding of the nature of science. In Brazil fieldwork and "hands-on" activities are still very rare in public education. This paper present a study carried out with 200 students attending Biology classes in their first vocational high school year at Federal Technological Education Centre of São Paulo, (CEFET-São Paulo, Brazil). It aims at describing the efforts to introduce hands-on and fieldwork activities in Biology Curriculum considering the student's profile, the institutional reality and the brazilian government orientations.

Keywords. Lack of Fieldwork, "Hands-on", Biology Teaching, Science Outside the Classroom, Brazilian Education.

1. Introduction

The science teaching should inspire students to continue their studies and prepare them for recognize and assess the impacts of science and technology in their daily lives. It should also

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develop skills to permit them to make decisions based on the knowledge acquired. But the progress of various scientific areas in recent decades has been accompanied by a formal education increasingly focused on memorization of facts, data and scientific concepts. Unfortunately, most of the times, the science classes discourage students from thinking for themselves. On the other hand, experimental classes are often presented as a tedious and repetitive activity.

In Biology teaching, less time is dedicated to experimental or investigative activities than to lecture classes. And, when such activities are offered it usually consist of laboratory-based cellular experiments with practice oriented to microscopic observation. In some ways, these practices serve to illustrate and deepen some issues but end up playing the style "chalkboard and chalk", working more as a complement than as an alternative strategy for learning science [1].

The National Curricular Parameters (PCNs) of the Ministry of Education (MEC) of Brazil indicate the guidelines for the Science teaching in both elementary and high school education. It proposes the production of effective knowledge by encouraging the interdisciplinarity and contextualization of the subjects to be studied [2].

Despite PCNs recognize the importance of learning science and its relations with technology, environment and social issues, they also indicate the great difficulty of implementation and effectiveness of new teaching practices in the classroom in Brazil [2,3]:

"The new theories of education, even where they could be widely discussed among experts educators and researchers, are still far from being an effective presence in much of our basic education. Innovative proposals have brought renewal of contents and methods, but we must recognize that little reach most of the classrooms where, in fact, old practices persist. Changing this state of affairs therefore is not something that can be done only from new theories, but still requiring a new understanding of the same sense of education, the process in which you learn."

The quality of education in science has never before been so discussed and considered in Brazil as it is nowadays. Experts assess that the poor training of teachers coupled with the lack of infrastructure for experimentation and practical classes in schools are the main causes of the poor performance of Brazilian students in the Programme for International Student Assessment (PISA), which has left Brazil in 52th position among 57 countries assessed in 2006. [4].

Some of the MEC efforts are focused directly to basic education, as may be seen in the "Strategy for the Teaching of Science" (originally intended for high school), others are made in order to expand and improve the training of teachers. Meanwhile, it is worth noting that one of the government guidelines is "Encouraging curriculum projects focused on science education and curriculum changes that incorporate practical approaches and investigative of science." [5].

1.2. Institutional background and motivation

The Federal Centre of Technological Education of São Paulo (CEFET São Paulo) is an institution dedicated to professional education in technical and scientific areas. It is situated in the São Paulo city (State of São Paulo), one of the largest cities in Brazil which has outstanding economical projection in Latin America. According to the Brazilian Ministry of Education, CEFET São Paulo is considered one of the most important institution among public and private vocational high schools in Brazil being a reference for technological education. It is maintained by the Brazilian government with open access by admission exam.

CEFET São Paulo offers technical courses for students attending high school as well as undergraduate and graduate courses. The technical high school courses focus on areas such as: mechanics, electronics, computers and automation.

In order to assure a broader education, CEFET São Paulo encourages the interaction between the specific technological areas and basic high school disciplines. This is not an easy task for biology because most of the students don't see any relationship between the course area and the discipline.

In this context, the biology team of teachers decide to adjust biology classes and curriculum to meet the institutional requests.

1.3. Changing Biology Classes

Despite having a large number of students, (200 / high school/year), CEFET São Paulo has only one biology laboratory equipped with microscopes, stoves, reagents, glassware, fixed specimens and anatomy models. About 20 students are able to conduct experiments at the laboratory at a time. Biology classes are usually offered in ninety minutes weekly classes in three years of the vocational high school.

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Some changes in biology classes were proposed by the biology teachers and are summarized below:

1. Adjustment of teachers/students ratio to two teachers per class of 40 students (1:20 teacher/student ratio).
2. Changes in the order of presentation of biology content of vocational high school courses:
    a. First year: Ecology and Diversity (partial)
    b. Second year: Biological diversity (including compared physiology)
    c. Third year: Cytology, Genetics and Evolution
3. Introduction of “hands-on”, fieldwork and investigative activities in biology classes.

This study aims to describe the first efforts to introduce “hands-on” and fieldwork activities in biology curriculum at CEFET São Paulo.

2. Methodology of the study

The research reported in this study is essential qualitative, adopting an interpretative and subjective perspective of educational research [6].

2.1. Participants

This study was carried out with 200 students of 1th grade from vocational high school of CEFET-São Paulo. It also involved teachers from different technical areas.

2.2. Description of the study

The study described in this text involved three different actions: 1. diagnose the scientific literacy of the students of advanced years in CEFET São Paulo; 2. determination of the beginners students profile; and 3. introduction of hands-on and fieldwork activities in Ecology classes. The activities were implemented as curricular component at the beginning of the school year and were related to “abiotic factors”.

The hands-on activities aimed to: (a) develop curiosity of students to environmental issues, (b) develop the capacity of observation, (c) present the basic principles of metrology by simple temperature measurement experiments, (d) encourage the use of mathematical logic and language (E) encourage the application of the use of simple mathematical functions to describe natural phenomena, (h) develop attitudes of working in groups, (i) develop ethical behaviour.

The theme "abiotic factors" is one of the themes presented to students within the subject "Ecology" [7]. The living beings remain complex relations with all the physical environment that surrounds it. The ecosystems depend on the balance between the living and abiotic factors. This balance influence growth, activity and the characteristics of organisms as well as its distribution in different locations. The temperature is one of the main factors that interfere with the maintenance of the organisms in an ecosystem. The “hands-on” fieldwork activity presented here intended to:

1. Assess the temperature in different habitats.
2. Check if the temperature varies according to height.
3. Analyze the importance of abiotic factors in the ecosystem.

Figure 1. Aerial view of the Federal Technological Education Center of Sao Paulo, CEFET-SP. The temperature was measured in three habitats indicated. Dense vegetation (VD), vegetation (VR) and soil without vegetation (SN). The direction North (N) is indicated by the arrow. Image captured the Google Earth software (http://www.earth.google.com)

Each class of students was divided into three teams of six students working in pairs. The temperature of three types of habitats at CEFET São Paulo wooded campus was compared: dense vegetation (VD), low vegetation (VR) and soil without vegetation (SN) (Figure 1). One student from each pair was responsible for measuring the atmospheric temperature and the other was responsible for the annotation of the data obtained. Before starting the work, those in charge of annotations, synchronized their clocks and set the time every time measure should be made (Figure 2).

Five groups of measures were taken for each habitat: the first at ground level and the other respectively to 30 cm, 60 cm, 90 cm and 150 cm from the soil. The thermometers were placed in

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appropriate positions for five minutes after temperature annotation.

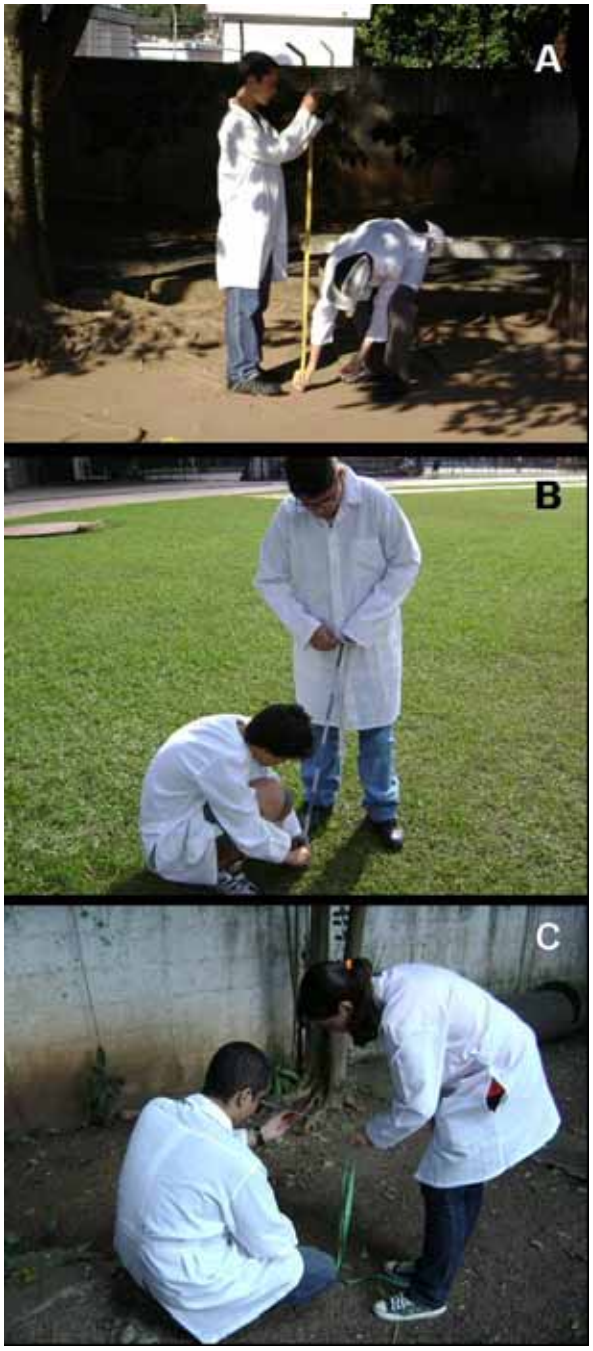

Figure 2. Fieldwork hands-on activity at CEFET São Paulo. A and C: Soil without vegetation (SN); B: Low vegetation (VR)

Data were collected at the end of four days of the fieldwork. Each teacher was responsible for 20 students at a time.

After the collection and analysis of the own data each group was encouraged to share their findings with other students. The students were also asked to prepare a report containing detailed introduction, objectives, materials and methods, results, discussions and references. Data analysis was performed in groups and allowed the use of software to produce charts. Moreover, some questions were available to guide the discussion and preparation of the report (data not shown).

2.3. Data Collection and Analysis

The instruments for data collection were: interviews, questionnaire and direct observations.

In this study, one of the researchers was also the teacher and the other was the coordinator of the activities.

The interviews were focused on teachers from other areas at CEFET São Paulo. It aimed to diagnose the scientific literacy of the students of advanced years in CEFET São Paulo. Data were obtained during the weekly meetings held at the end of 2007.

The students profile involved in this study was obtained through a questionnaire applied at the beginning of the school year. It was elaborated in order to investigate if the students had conducted fieldwork and experimental activities before studying in CEFET São Paulo. It also investigated the frequency of those activities and the students expectations for biology classes in high school.

From the 200 students registered in the course, all of them take part of the “hands-on” activities and 193 answered the questionnaire.

The direct observations allowed an increased approximation of the researcher to the participants and consequently a better evaluation of the meaning that the students give to their experiments and also of the context of the investigation.

3. Results and Discussion

The main issue raised by the teachers during the interviews was the lack of scientific skills observed in students at the end of technical courses. Teachers reported that many students, despite technical subjects, have some kind of difficulty in carrying out inquiry activities and show lack of skills like: building and interpreting graphics and texts, gathering evidence, formulating explanations based on evidence, designing an experiment and drawing conclusions.

In order to understand the students previous experience in accomplishing scientific inquiry activities we decided to apply a questionnaire to the students from the first vocational high school year at CEFET São Paulo.

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The data showed that about 35 per cent of the students did not have any kind of practical classes in elementary school. Most of them considered the lack of infrastructure in their former schools, the lack of interest of teachers and lack of classes intended to this type of activity the major reasons for absence of experimental activities (table 1). On the other hand, the frequency of experimental activities for those students who reported practical classes varied between one per month (29.03%), one per two months (23.38%) and one every six months (16.93%).

The most common practical activity executed previously by the students was passive/observational and only about 10% of students reported active involvement (self planning and execution) in experimental classes.

It also deserves highlight the fact that most students, 83,06%, (even those who had experimental classes) have never conducted activities outside the laboratory. But they all said they would like to take practical classes in both the laboratory and field.

It is noteworthy that the majority of students were expecting that the experimental activities in biology would be offered in the same approach and frequency of that had in basic education.

So, it is not surprise that students demonstrated enthusiasm, curiosity and interest in carrying out "hands-on" activities in the field, and understand the importance of the methodology used to collect accurate data.

Options	Students' opinion (%) N=69
Lack of laboratory and materials	42.03
Lack of interest of teachers	24.63
Lack of interest of students	7.25
Lack of classes intended for this type of activity in school.	26.09

Table 1. Reasons for lack of experimental activities in elementary school

They shared the data and were encouraged to exchange their views and experiences on the implementation of the work. Many of them were enthusiastic about the dynamics of fieldwork activity. Others students were surprised by the possibility of conducting experimental activities outside the laboratory.

Some students reported that the "hands-on" and fieldwork activities facilitated the understanding of some aspects of ecology and sustainable development that was never understood in the classroom. Some students reported that:

"*At school, is only book, chalkboard and chalk. From the way we are learning here, any student can better understand the ecological issues.* "

Students also highlighted the steps of the work that most attracted their attention: the collection of data, descriptions of procedures and discussions of the results. According to them, prior knowledge of ecology became more significant after "hands-on" activities in the field. Other students said that "*the subjects are not normally learned so contextualized*".

Furthermore, some students demonstrated surprise to realize the importance of biology in technical courses, according to their words:

"*I had never thought that ecology and biology was so important for a student of Technical Course".*

It also important to note that the students believe they will put into practice various concepts gained from this experience in the near future.

After the fieldwork activity, students shared the experience highlighting the most important experimental details. They also made comparisons, analyses and reflections on the data collected.

The teacher led the students on the importance of the report as an instrument of objective analysis and presentation of results. Students were instructed to list the issues, problems and solutions raised concerning the activity. Also, all the details concerning the structure of the text of the report were presented in detail. Students were asked to submit their results on tables and, at least, one chart. None specific software was suggested but the most used computer program was Excel 2007 from Microsoft. After that, the charts and statistical analysis were performed using GraphPad Prism version 4.0 program. Some example charts are presented in Figure 3.

The activities carried out in this study sought to engage students actively in the learning process, challenging them to formulate hypotheses, reshape and verbalize their ideas and actions. Classes practices contributed to: (a) identify the variables that interfere with a particular phenomenon, (b) use statistics and probabilities for forecasting phenomena, (c)

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understand the relationships between the characteristics of living creatures and the environment in which they live; (d) develop hypotheses about the phenomena studied and compare them with scientific explanations or data from experiments, (e) understand the role of models in biology and science in general, (f) relate concepts of biology as those of other exact sciences and humanities.

4. Conclusions and future work

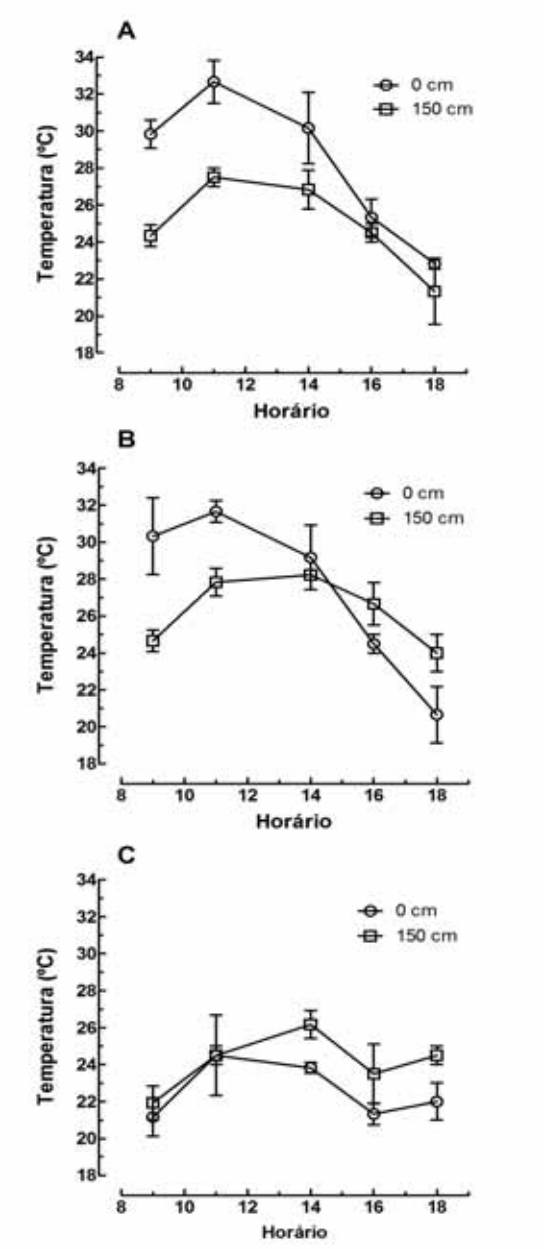

Figure 3. Some examples of charts designed by students

Many are the reasons for not offer "hands-on" and fieldwork activities in Brazil. Some of the difficulties were appointed by science teachers [3,8]: insufficient quantity of classes, students with delayed in the content, excess of students per class, rotation of teachers, lack of time to plan and prepare the classes, lack of good relationship with the school administration, absence of pedagogical coordination, lack of infrastructure.

There is a concern that the amount of "hands-on" and fieldwork activities in high schools are under threat. The practical activities, whether in the laboratory or field, should be designed to stimulate students to participate in the process of learning. In addition, the outdoors activities also address the interdisciplinary, contributing in the expression and communication, research and understanding and sociocultural context.

The work described in this paper is the first attempt to introduce "hands-on" and fieldwork activities in biology classes in CEFET São Paulo. But, despite the initiative presented here, lot of work remains to be done regarding the implementation and evaluation of "hands-on" and fieldwork activities in Biology Curriculum.

It has to be considered that, despite the large number of pupils (200), they are all freshman and only two teachers were directly involved in the implementation of fieldwork. It will be necessary to expand the range of activities and the project itself to the other years of vocational high school in order to validate this approach in biology classes.

It will be also necessary to introduce follow up evaluation tools to see if the knowledge acquired positively impact the performance of students in advanced disciplines in the future. And it will be interesting to communicate the findings to teachers for other scientific basic areas (physics, chemistry and mathematics).

Nevertheless, the results obtained in this work indicate that "hands-on" and fieldwork activities can increase the interest and participation of students from technical courses in biological issues. This may be considering a very important achievement due to the small students interest for biology in technical areas such as mechanics, electronics, computers and automation.

Indeed, the introduction of "hands-on" and fieldwork activities in biology curriculum at CEFET São Paulo may facilitate the development of procedural, communicative and attitudinal competences recommended by Brazilian PCNs.

5. Acknowledgements

The authors would like to thank all students of the first vocational high school year, as well as all biology teachers and courses coordinators from CEFET São Paulo.

 ISBN 978-989-95095-3-5

6. References

[1] Barker S, Slingsby D, Tilling S. Teaching biology outside the classroom: is it heading for extinction? A report on outdoor biology teaching in the 14-19 curriculum. FCS Occasional Publication 72. Field Studies Council, 2002.

[2] Secretaria de Educação Básica. Parâmetros Curriculares Nacionais. Brasília:Ministério da Educação(Brasil). Disponível em :http://portal.mec.gov.br

[3] Augusto TGS, Andrade AM. Dificuldade para a implantação de práticas interdisciplinares em escolas estaduais, apontadas por professores da área de ciências da natureza. Investigações em Ensino de Ciências, 12: 1-17, 2007.

[4] INEP. Programa Internacional de Avaliação de Alunos – PISA. Disponível em: http://www.inep.gov.br/internacional/pisa/Novo/

[5] Secretaria de Educação Estratégias para o Ensino de Ciênicas. Brasília:Ministério da Educação(Brasil). Disponível em : http://portal.mec.gov.br/seb/index.php?option=content&task=view&id=406&Itemid=392

[6] Erickson, F., Qualitative methods in research on teaching. In M.C.Wittroch (Ed.), *Handbook of research on teaching.* New York, NY:Macmillan, 1986.

[7] BSCS. Biologia. Versão Verde. Edart, 1976.

[8] Demo P. Escola pública e escola particular: semelhanças de dois imbróglios educacionais. Ensaio: Avaliação e Políticas Públicas em Educação, 15(55): 181-206, 2007.

Thursday Cultural. All Thursday a Different Programming in the Museum of Natural Sciences PUC Minas

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Abstract. As form to attract the spontaneous public, the Museum of Natural Sciences PUC Minas offers to differentiated activities all the Thursday, of the 19 to the 21 hours. The entrance is gratuitous and the programming sufficiently is varied. The public-target of these events is a spontaneous or doubtful called visitor, that one who does not come in organized groups and not need mediation, nor to mark the visit previously. The Thursday of the month are filled of the following form:

1st Thursday: “A Night in the Museum” - based spectacle in the film of same heading;
2nd Thursday: “Fifth Scientific” - lectures on subjects of border of Sciences;
3rd Thursday: “Art and Music in the Museum” - Shows, workshops of music, show photographic, launching of books and expositions of art;
4th Thursday: “To see Stars” - lecture on astronomy and astroroof with telescopes, in partnership with GAIA - Group of Astronomy and Astrophysics of the PUC Minas.

The events have attracted a varied public, of approximately 50 people for Thursday, made up of college’s student, old people, deficient and families. During the activities, the people have the chance of if revealing, displaying its opinions and clarifying doubts regarding Sciences. The events function as a connector link enters the scientific way, the academic community and the community in general.

Keywords. Formal and Informal Edcuation, Museum.

 ISBN 978-989-95095-3-5

Professor in Activity in Informal Education. The Participation of the Professors in the Visits Monitored to the Museum of Natural Sciences PUC Minas

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Abstact. The Museum of Natural Sciences PUC Minas, opened to the visitation in the year of 2002 receives on average, 60 a thousand visitors per year. 70% of the public are proceeding from schools public or private. Until June of 2008 four thematic scripts were offered for development of the monitored visits, in accordance with the permanent expositions of the Museum. The educators had that set appointments its visits in accordance with the considered scripts, exactly that the subject did not take care of its necessities. To the few it had an evasion of schools and the visit of professors that happened all the Mondays was empty. From the analysis of these events, of suggestions of professors and research carried through next to the monitors and employees of the Museum, it was decided to change this reality. The change process lasted six months and enclosed the training of monitors and levelling of the information of the expositions, the adequacy of the language to the different ages, the creation of playful activities as educative workshops and games and the reorganization of the visits guided of the professors to the Mondays, as it forms to value the dialogue between the school and the Museum. Since the day 1º of June of 2008, the Museum receives, on average, 100 professors for month, in two private Mondays to the construction of the Thematic Visits of the schools, when the professors receive a lecture on the Museum and, together with employees and monitors, they go until the expositions, they debate the subject to be worked in groups of study, select activities playful and they prepare the visit. Currently they are approximately 500 students per day, who come to explore the enormous potential of informal education in Museum PUC Minas.

Keywords. Formal and Informal Edcuation, Museum.

Project Living Museum. Accessibility to Creativity at the Museum PUC Minas

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Abstract. The Project living Museum, approved for the Extension of the PUC in March of 2008, has as objective main the development of educative actions that promote the accessibility in the Museum of Natural Sciences of the PUC. The term accessibility usually is related the deficient public, however the actions of this project are constructed of form to take care of the diverse public that visit the Museum, considering the different phases of the human development. The educative games provide the learning, through the playful one, for children, adolescents and adults. The qualifications of the educators of the Museum assist in the mediation of the expositions, adjusting the language to the different ages. Rejoinders of parts of the quantity are constructed, for touch, of polyurethane and resin, covered for varnish layer. In accordance with the opinion of deficient appearances, the varnish, necessary to the conservation of the parts, reduces the perception of the original texture, but it does not hinder the access to the forms and sizes. Fragments of bones and boxes of niches with skins and penalties of animals of the Cerrado, are touched for perception of the texture. With this material and a slapping eye, a dynamics is carried through that stimulates visual extra sensitivity in people with normal vision. They are members of the Project Alive Museum: an Art Educator, who produces the rejoinders, two pedagogy trainees and two biology trainees, that elaborate educative games, receive groups from visitors and work in the adequacy of the language and formation of the too much educators. In as the semester of 2008 the Project will carry through: Workshop of LIBRAS and reception of deficient for educators; Act of contract of a physical deficient trainee; Implantation of a track in the bush for deficient appearances.

Keywords. Formal and Informal Edcuation, Museum.

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Vacation in the Museum. Educative Leisure in the Vacations of Winter and Summer in the Museum of Natural Sciences PUC Minas

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Abstract. During you wounded them of winter and summer, that the July months of and January in Belo Horizonte, Museum PUC Minas offers playful and educative activities as option of leisure for children and adolescents. During 3 hours the public lives deeply moments of searching zoologists, botanical, archaeologists, through visits to the expositions, workshops of art, presentation of his histories and music, games and development of tracks. The activities are monitored, normally 1 monitor are responsible for up to four children. The called experiences "Searching Infantile" are for ages between 04 and 08 years and "Youthful Researcher", take care of the public of age between nine and eleven years. In the Botanical Researcher the participants count and recount histories, receive information on ecology through games, visit the Garden of Butterflies and participate of a workshop of plantation of changes. The Searching Zoologist, visits all the units of existing animals in the Museum, receiving information on ecology, evolution and anatomy, carries through workshop of plaster rejoinders and walks for the bush with binoculars and magnifying glasses. Archaeologists Infantiles have the chance to carry through hollowing in a sand tank constructed in the Museum, carry through workshops of painting in caves and confection of masks, beyond developing the track and a called game Hunting to the Treasure. During the month of July of 2008, they had participated of the Vacations in the Museum, more than 6000 people. The spreading of the event is made through the site, for sending of emails to the direct mail of the Museum and pamphlet distribution between the communities of neighbours of the Museum, beyond the verbal communication, excellent and efficient vehicle of communication.

Keywords. Formal and Informal Edcuation, Museum.

GAIA Center of Sciences. Itinerant Planetary-Observatory

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Abstract. This is an approved project in the popularization of science and technology 2007 of Fapemig. It is a mobile center of sciences, a planetarium and itinerant observatory. The project has duration of two years and its main objective is to spread a general scientific culture using for this the education of Astronomy. In its first phase, (2008) the itinerant museum has visited schools of Belo Horizonte and its metropolitan region. In the next year, it will include schools of the whole state, including the most devoid regions. This itinerant center has a different approach. It does not teach only Astronomy, but uses Astronomy to create a systemic vision of the Earth, of our place in the Universe, to talk about the climate and climatic alterations, natural and made by the man, to argue about the idea of a living planet that needs care and preservation. Through Astronomy, give lessons of environmental quality, of sustainability, of the necessity of change and care with the planet. This center of sciences aims to form people compromised with the science and the conscience of a new world**.** Science goes to the school, is the motto of the project. This allows working the social exclusion, reaching beyond schools of Belo Horizonte and adjacencies, schools and communities of all the state. In this work we tell the experiences of the first year of the project and delineate activities and challenges for the year of 2009. We believe that the itinerant center will be able to become a reference for the high school and basic level education, taking care of students and teachers. The students have in it an educational complementation. For the teachers, Astronomy recycling courses and specific subjects of sciences will be offered, supplying formation deficiencies and improving the difficulties that appear with didactic books.

Keywords. Astronomy, Itinerant Museums, Environmental Quality, Sustainability, Climate Alterations.

 ISBN 978-989-95095-3-5

Building and Optimization of Solar Stoves and Ovens

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Abstract. The optimized solar stove, besides having a parabolic mirror that concentrates the solar rays into a central grid where the pot must be put, (for this use, it is better that the pot be black in the outside and in the lowest part) it is employed a convergent lens for focusing the sun light rays into a single point, making the temperature to raise, speeding the process of phase change of water to vapour (boiling). By the other hand, the solar ovens employ low cost or recyclable materials. This project does not eliminate the use of conventional stoves and ovens, because it can't be use during rainy days or at night, but will reduce the use of gas and the burning of wood, lowering the emission of carbon monoxide and dioxide. This way, it will help the preservation of environment. Besides, both may be competitive, since the use of low cost materials that can be got by poor people that will be attended by the project. After that, the use could be extended to all the community. Therefore, this work enters in the context of the awareness of the environment giving a simple, practical and cheap solution what it will make possible, later, to the user to promote courses and/or workshops to divulge the process of production and the form of use of the solar stove and the oven, resulting in a source of still unexplored income and with great potential for growth in the market.

Keywords. Solar Energy, Solar Heater of Water, Sustainable Development.

Constructing a Solar Collector of Low Cost: An Opportunity to Teach Physics

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Abstract. In this work we describe the construction of a solar collector with recycled materials and of easy access to the population. This work has as main objective to deal with the physical concepts involved in the construction and use of a solar collector of low cost. We suggest the construction of a solar collector using PET bottles and *tetra pack* boxes as part of a pertaining to school project permeate by the quarrel of the involved physical concepts. The main topics are heat and thermodynamics. We can work of practical form with thermometer, together with the temperature concept, measuring the temperature of the water that enters and leaves the collector and its external surface. To argue as the water it enters cold and it leaves hot, we introduce the heat concept, as a flow of energy of a body with bigger temperature for one with lesser temperature. Topics as thermal capacity and specific heat of a substance are introduced and also arguing the use of the thermal reservoir whose function is to hinder that it has exchange of heat of the water with the way. It is possible to demonstrate the three forms of heat transference using the solar collector, and as the effect greenhouse it is used to advantage. Subjects can be argued as electromagnetic radiation, radiation of a black body, law of Stefan-Boltzmann, among others. We made the survey of the curve-reply of our collector and an estimate of its total efficiency of absorption of solar energy. Development of this project allows a good agreement of the principles of functioning of a solar collector, as well as, its use for the didactic transposition of the physical concepts related, providing a moment opportune to argue the importance of generation e conscientious use of energy.

Keywords. Solar Energy, Solar Heater of Water, Sustainable Development.

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Art and Science in the Park

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Abstract. "Art and Science in the Park" is a project that takes science to the general public that goes to public parks in the city of São Paulo. This is achieved by exposing several groups of interactive experiments on different topics of physics and biology, which encourage the participation of the visitors. Some of the proposed experiments relate vision and hearing physiology to concepts of physics by visual art and sounds produced by musical instruments and ordinary objects, such as metal hangers and glasses. Geometry and abstraction are evocated by "tangram" and topological puzzles. Light and optical phenomena as reflections, polarization and interference are also explored using telescopes, microscopes, different types of mirrors, polarizer and films. A TV set attached to a bicycle demonstrates the conversion of chemical energy to mechanical energy and this to electrical energy. Other experiments show additional concepts of physics and biology. All activities are mediated by monitors, who are undergraduate and postgraduate students of physics and biological sciences. The guiding principle of this project is that it is possible to make science, technology and art accessible to the general public, especially children and adolescents, in the informal environment of a park, via ludic experiments and connections to their daily life. Activities are also performed in some public primary and secondary schools. This project, idealised and executed by researchers of the Institute of Physics of the University of São Paulo, has the collaboration of researchers from the Institute of Biomedical Sciences of USP, support from CNPq and USP, and partnership of Cientec/USP, AAEC and the Prefecture of São Paulo.

Keywords. Science Demonstrations, Physics Education, Scientific Literacy, Hands-on Science.

International Education at Ternopil State Technical University (Ukraine): Gaining Experience

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Abstract. There is little doubt anymore over the need for higher education in any country to introduce an international dimension into curricula content and campus climate. National economies have become increasingly interdependent. This new reality has altered the world students will face following graduation. Knowledge of the international system, intercultural skills, and the flexibility to function in diverse environments is no longer the privilege of just a few international relations majors. These are skills and knowledge essential for every student.

Research on international students' adaptation while studying in a foreign environment has expanded greatly in the last decade concurrently with the growth of the international student population. This trend has a particularly long history in the United States. Our university has recently made its debut in providing international education services. The International Education Center at Ternopil State Technical University (TSTU - Ternopil, Ukraine) was started on November 12, 2007. For 2007-2008 academic year the first group of students from Nigeria and India was enrolled to take an undergraduate course and get a bachelor degree in Computer Sciences or Management. Studies are carried out in English language.

We undertook a survey to examine the students' educational background, motives of coming to Ukraine and the greatest difficulties they face here. The aim of this survey was to discover the degree of students' satisfaction, attitudes about international education, and expectations about the quality of education and participating in social activities while in Ternopil State Technical University. Almost all students learned about the TSTU from an agency. After their arrival, the reality was about the same as their expectations before they have arrived to the TSTU. The survey demonstrated that students rated very high, as excellent or good, the quality of education they are getting, teaching skills and English language skills of the TSTU faculty. Also tutoring from the TSTU faculty and the support from the TSTU administration were rated as

 ISBN 978-989-95095-3-5

excellent or good. However the social life of international students was reported as less successful. Many respondents said about the language barrier and very limited communication with local students. Additionally, they were not aware about local events and were not involved in the social life of the local community. Nevertheless there was strong support among the respondents for continuing their further education at the TSTU or other universities in Ukraine. They also would recommend their friends to come for studies to our university.

The findings from the survey indicate that the TSTU need to think comprehensively and creatively about the international education goals and strategies and pay more attention to social integration of international students.

Keywords. International Education, Students' Adaptation, Satisfaction, Attitudes, Expectations, Intercultural Skills, The Quality of Education.

Experimental Classes in Physics Courses in Higher Education: Managing the Learning Outcomes and Favouring the Students Initiatives

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Abstract. The usual Physics laboratory classes for the Physics and Engineering courses in Higher Education in Portugal used to follow almost the same "classical" model of demonstrations: the students were supposed to follow guidelines with precise instructions for each experiment, the equipment was presented "ready-to-mount", and they should produce a very rigid group report, including items such as a theoretical introduction and a detailed error calculation for each experiment performed.

In my experience as a Physics professor for more than two decades, I had to introduce an experimental curriculum to some specific courses I taught, to change the evaluation scheme for disciplines with a huge number of students, to adapt the program for students that were entering a Physics laboratory for the first time, and more recently to manage experimental classes with a very small number of students: in all these cases, the "classic" model of teaching experimental Physics does not apply, and the teacher must define the skills or learning outcomes for each case, and adapt the possible methods to the number of students, their previous preparation and experience, and even to their expectations and initiative capabilities.

I am presenting two short projects produced by my two co-authors during their laboratory discipline of "Experimental Methods in Physics II", in the second year of their Physics degree, where they have chosen "renewable energy sources" as a leading theme: a mini wind turbine and a small sun concentrator.

Keywords. Hands-on, Physics.

Science in Your Pocket

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Abstract. Science education is necessarily grounded by exploratory laboratory experiments. What if students had a science lab in their pocket their every waking moment? An educator's fondest wish is that students explore beyond the classroom; but for the data driven experimental sciences, scientific exploration requires collecting data which generally requires lab equipment. While the average school lab fits neither a student's budget nor in their pocket, cell phones and gaming systems are a required possession for most. Using such devices, we demonstrate classic physics experiments to show that students have the means to explore science on their own. Further, because the devices fit either in ones pocket or hand, the equipment is both available and mobile, allowing for new types of student experiments. We share the preliminary results of our attempt to create a mobile laboratory from consumer electronic devices commonly possessed by students. We first present a brief overview of the motivation for using cell phone and gaming technology in science experiments, then demonstrate experiments using a cell phone-based sound frequency analyzer and an accelerometer, and close with suggestions for other experiments.

Keywords. Acceleration Measurement, Cell Phone, Mobile Laboratory, Sound Frequency Analyzer, Wiimote.

 ISBN 978-989-95095-3-5

1. Introduction

In the world of students today, cell phones are a necessity; mobility of communication and entertainment devices ordinary. What other possession is student more likely have with them all the time? And who could blame someone caught in a stream of students leaving a class for thinking that checking and answering email, text and phone messages immediately after class was a course requirement? But the ever-present cell phone can be more than just a social networking device; it can also be a tool for science education. The idea of a pocket-sized scientific analyzer is not new, a number of mobile devices have been used in science education for some years (e.g. LabQuest [5]). What is new is that students carry devices that have the capacity to perform some of the same data collection and analysis tasks; often requiring only cell-phone software and a little imagination to be added. In the following, we first present a brief overview of the motivation for using cell phone and gaming technology in science experiments, and then demonstrate two examples of science with devices available to most students: a cell phone sound frequency analyzer and a video game hand wand for acceleration measurement. We close with suggestions for other experiments.

2. Why Cell Phones?

Cell phones have become pocket-sized personal computers, albeit with an expensive calling plan. The most compelling reasons for their use in science education are ubiquity and mobility; cell phones are with almost all students almost all the time. The cell phone is also small, reasonably affordable and ruggedly packaged for carrying; just right for throwing, dropping from a window, or bringing together a bunch, to create your own experiment. The beauty of cell phone science is that it is always there when the chance comes to use it and is small enough to be tossed around or used in some unplanned manner. And, of course, it is the means of choice by which students communicate through text and talk with their peers; perhaps, we hope, sharing the results of their latest experiment. Transforming a cell phone into a scientific instrument can make science more impromptu and familiar, just part of the technology package students carry in their pocket.

Cell phones, in addition to being programmable, also possess measurement devices for sensing external phenomena and for communicating with other devices. All phones possess a microphone for sound, a display and keyboard for user interaction, can determine their geographic location, and many possess cameras and accelerometers; all useful for data collection. Cell phone communication capabilities are also a very important component of data collection. These include human-level messaging by voice or text over the cell phone network, useful to coordinate experiments that require multiple data collection points; Internet connections that can be used to aggregate data at a common collection point; and, local wireless networking that allows using the cell phone to collect data from another device. The last point is likely the most important as it implies that a cell phone can collect data from most any phenomena; in an example given below, the cell phone collects acceleration data from a video game hand wand. With computational, sensing and communication capabilities along with ubiquity and mobility, cell phones present an opportunity for extending science education beyond the space and time constraints of a traditional laboratory.

Developing software for a cell phone or computer is very similar. Common languages include scaled down derivatives of Python, Java and C++ [3]. This is an important point when creating software as you can use familiar languages and development tools, incorporate existing software libraries, and develop and test algorithms on the computer before transferring to the cell phone. To promote phone software development, many manufacturers provide extensive development and test environments at little or no cost. After development, the application can be installed to a phone over a public or local network in a manner similar to computer software.

2.1 The Problem with Cell Phones

Similar to their larger computer relatives, many current phones are programmable, can input sound and visuals, and can connect to other local devices or the Internet. One would then expect software that runs on your phone to run on that of a student. Unfortunately, where personal computers are open systems that share a common hardware and software architecture, some slower or faster but capable of doing basically the same thing, cell phone models are designed as snowflakes, each unique.

For the time being, the cell phone hardware and software are controlled by service plan providers who have a financial interest in and go to considerable lengths to make their models different and often incompatible from everyone else's, even their own. If computers were sold under the service plan providers' model, your computer could only run the programs available through the computer seller. The result, for the

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time being at least, is that cell phone programs running on one model are unlikely to run on another. However, phones that share a common operating or program execution system can often share programs; examples include the Symbian and Microsoft operating systems and the Java programming language. The good news is that the closed system of plan providers is being challenged, particularly projects such as Google's Android [4] which promotes a somewhat more open system model that encourages a software development and distribution model where the owner has more control over what runs on the phone.

2.2 Development Details

The cell phone used in the following the following demonstrations is a Nokia 61, at birth it was considered very capable but now, at two years old, is barely ordinary. The phone runs Symbian OS on an ARM 9 220 MHz processor. For comparison, the latest iPhone has a 600-700 MHz ARM processor running a version of Apple's OS X. The implementation language of the analyzer is Java ME, promising that the analyzer, acceleration and other Java ME applications will run on systems that support Java ME. The applications were developed using a standard text editor to write the Java ME code and a very simple, freely available development environment called the Sprint Wireless Toolkit.

3. Two Examples: Sound Frequency Analysis and Acceleration Measurement

To validate and explore some range of possibilities, we chose to implement two experiments in areas common to most basic physics courses, that of sound frequency analysis and acceleration measurement. The experiments also illustrates the cell phone alone as a scientific instrument and in conjunction with a separate, consumer electronics device often available to students, in this case a video game hand wand.

3.1 Example 1: Sound Frequency Analyzer

Sound frequency analysis is a familiar topic in a basic physics course. Students are often introduced to Fourier analysis through sound experiments in a laboratory setting using a microphone connected to a computer. A sound frequency analyzer operates by capturing some time interval of a digitized sound signal and performing a Fourier time-to-frequency transformation on some portion of that signal to produce a corresponding frequency power spectrum. Some related experiments possible are the frequency analysis of the harmonic and overtone structure of sound sources such as musical instruments and determining the Doppler shift of a moving sound source.

A modern sound frequency analyzer requires the following hardware, all of which are common to cell phones:

1. Sound digitization capable of recording at twice the highest expected frequency.
2. An interface (e.g. buttons) to control the analysis and a display to see the results.
3. A processor to perform the Fourier time-to-frequency transformation algorithm.

Complicated procedures and equipment are a bane to science education. In creating a learning tool for student use, one danger is that the lesson to be learned is overwhelmed by the tool; the hoped for learning insights are lost in the complexity of running the experiment. The sound analyzer uses only a cell phone and its use is less complex than text messaging. The basic start-to-finish procedure for a student, as illustrated in the examples, is simple: download the analyzer software from a Web site, start the analyzer, record a sound, and analyze the sound; only four steps are required to capture and perform a Fourier analysis of a sound. Raw data can be exported for sharing or computer analysis, or, as the figures below demonstrate, the analysis screens can be captured and emailed or uploaded for review. Figs. 1-6 illustrate the use of a sound frequency analyzer as implemented in Java on the Nokia E61 cell phone.

To some, that a cell phone can perform a Fourier transform might be surprising, given that real numbers and mathematical functions are required. That a phone can do so with reasonable quickest is a pleasant bonus. From the above example, determining the frequency of the sound sampled over an approximately 4 second interval at 8000 kHz was performed by a Fast Fourier transform on 32768 samples, took about 10 seconds and produced results with accuracy comparable to that of commercial analysis software running on a PC.

The analyzer is primarily an educational tool for studying sound. As such, a key question to be asked is "does the tool help or hinder learning?" As noted earlier, the tool use should simple, nearly transparent, so that attention can be focused on what is being studied. Further, of course, a measurement tool should be reasonably accurate. An additional challenge for interactive devices when large amounts of data

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must be processed is that it produces results quickly. The above example demonstrates that a cell phone can meet these criteria, providing a viable complement to traditional laboratory experience. Revisiting the points on ubiquity and mobility, sound analysis on a cell phone provides the opportunity for experiments at a different time and place than the traditional laboratory; available whenever or where ever the chance arises.

Figure 1. CellPhone FFT as one of several applications; it was downloaded from the school site using the phone Web browser

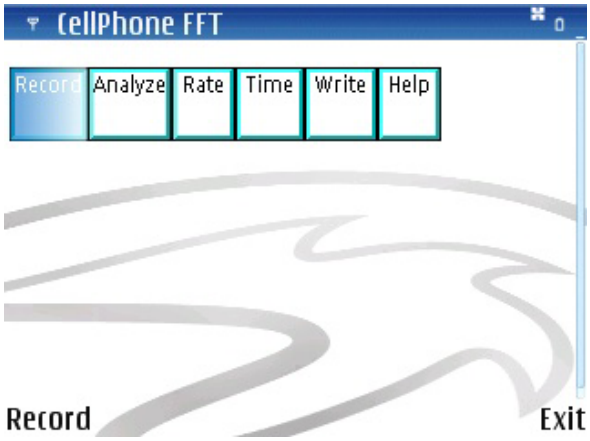

Figure 2. Menu options, Record a sound, Analyze recording, Time and Rate are parameters for data collection, and Write sound data to cell phone file

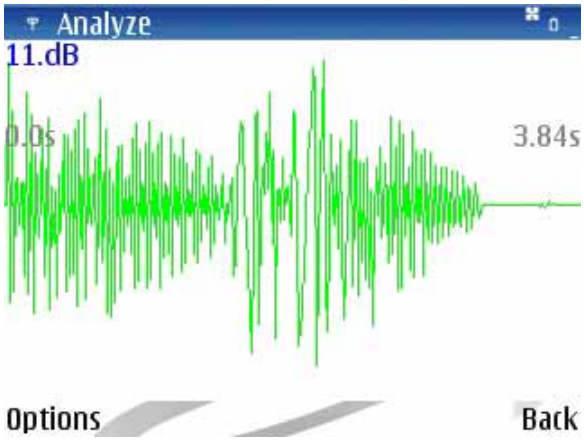

Figure 3. Selecting Analyze initially displays the complete raw signal recorded

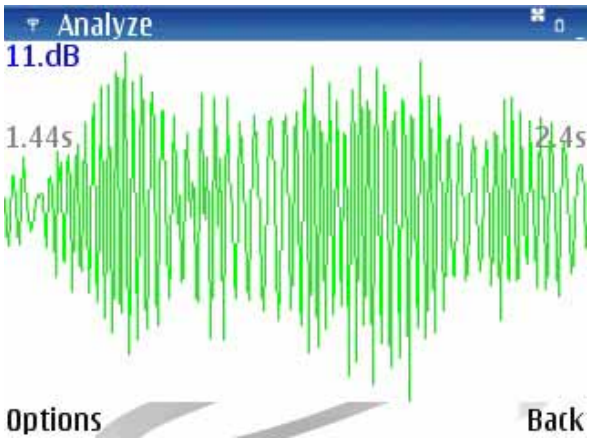

Figure 4. Cell phone directional buttons on allow panning (moving over time) or zooming (increase or decrease time interval displayed) to select a subinterval to view or analyze

Figure 5. Analysis options that can be applied to the signal section selected includes sound Playback and multiple display views of results

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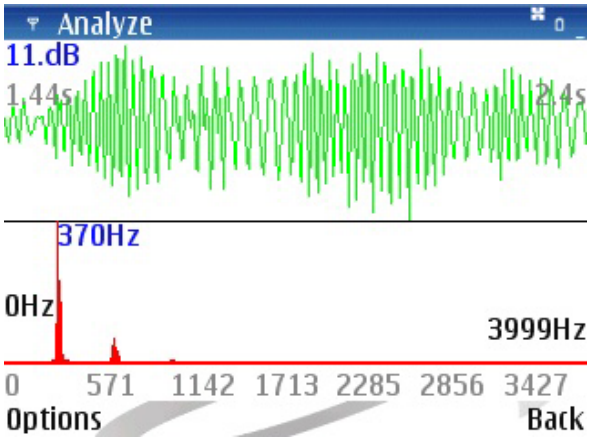

Figure 6. A combined graph of selected raw signal subinterval and Fourier transform

3.2 Example 2: Measuring Acceleration

Experiments involving acceleration are some of the most fundamental and engaging. Along with the cell phone, video games are one of the most available of consumer electronics devices useful for science. Acceleration can be measured by accelerometers with many recent video games and cell phones including accelerometers to determine the device orientation or the directional force to which the device is subjected. The hand-held Wii Remote (aka the Wiimote), for Nintendo's Wii video gaming system, includes a three-axis accelerometer to read a game player's gestures as game input and Bluetooth wireless networking to share the accelerometer measurements with the game console. Fig. 7 illustrates the Wiimote and the 6 directions in which acceleration can be measured.

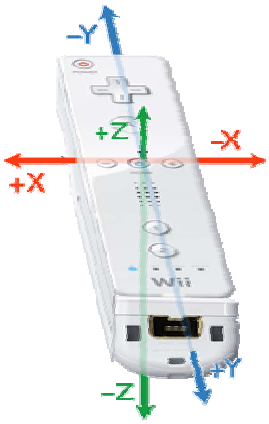

Figure 7. The three axis orientation of a Wiimote accelerometer [6]

A Wiimote and cell phone can form a mobile scientific instrument for measuring about the acceleration experienced on a rollercoaster or in the range of -3g to +3g. The two devices are linked through the Wiimote Bluetooth connection that transmits accelerometer data to the cell phone which records and analyzes the data. This approach, using small, widely available mobile equipment, creates the opportunity to study acceleration in a familiar setting –such riding the elevator or driving a car.

A cell phone and the Wiimote combination can measure acceleration simply and is adaptable to a variety of experiments. The implementation is entirely in cell phone software requiring no hardware modifications or connections. The Wiimote's data is transmitted via Bluetooth local networking so the cell phone and the Wiimote need only be within about 10 meters of each other. The Wiimote accelerometer provides data on the force applied in six directions; at rest, a horizontal Wiimote should report +g in the vertical direction and in free fall, zero g; the accelerometer data is transmitted continuously and read by the cell phone at predefined time intervals.

A common experiment is to measure acceleration and velocity while traveling along a single axis. Using the Wiimote and phone combination, the basic procedure for measuring acceleration is: orient the Wiimote to the direction of travel, calibrate the accelerometer, start data collection, start travel, stop travel, stop data collection, analyze the data. The following instructions provide a student's view of the experimental procedure, given to illustrate the overall simplicity of use. The steps common to all experiments are:

1. Press the 1 and 2 buttons on the Wiimote to initiate a Bluetooth connection.
2. Run WiiConnect [2] program to establish a Bluetooth connection with the Wiimote. Press the Wiimote Home button when connected.
3. Run Acceleration program.

The remaining instructions would be specific to the experiment being performed. For measuring linear acceleration of a vehicle, the instructions are: While stopped, place the Wiimote on a horizontal surface with the +y axis pointing toward the direction of travel and start recording data. From a complete stop, accelerate to a predetermined speed, then stop the car, and stop collecting data. Analyze the acceleration and velocity on the y-axis. Compare different vehicles (e.g. car vs. bicycle). If you have a helmet or hat, try duct taping the Wiimote to it; compare your personal acceleration with that of the vehicles.

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3.3. Measuring the linear acceleration and velocity of a car

Linear acceleration and velocity of a vehicle is a familiar experience from riding in a car, elicits natural curiosity in many drivers but is not easily studied using traditional laboratory equipment; using a cell phone and Wiimote, measurement is relatively simple. For this experiment, the Wiimote was placed on the stopped vehicle's floor oriented in the expected direction of travel and acceleration recording began on the cell phone; the vehicle was then accelerated on a straight road having a few small hills and bumps to an analog speedometer reading of about 40 mph. or 18 m/s. and was then braked to a complete stop.

Figs. 8-14 illustrate the procedure and results of the acceleration experiment. In Fig. 9, velocity is graphed for each of the three axes along with a real-time display to provide a speedometer; the y-axis is the direction of travel. In Fig. 10, acceleration is shown recorded along all three axes with the travel direction on the red or y-axis; the z-axis showing the hills but most obviously the greatest acceleration being the bumps in the road; the x-axis shows relatively small sideways acceleration. Fig. 13 shows the difference in acceleration following changes to higher gears and braking. In Fig. 14, the velocity corresponding to the acceleration over time is shown alone, illustrating the decline in the rate of increase in velocity as the vehicle shifts into higher gears.

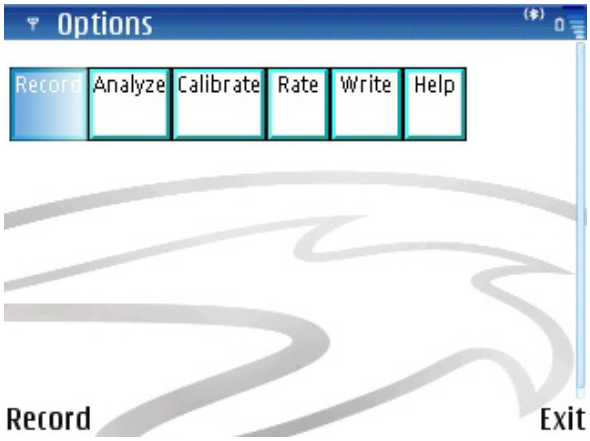

Figure 8. Menu options: Record records acceleration, Analyze acceleration. Calibrate calibrates the Wiimote accelerometers, Rate sets parameters for data collection and Write saves the data to a cell phone file

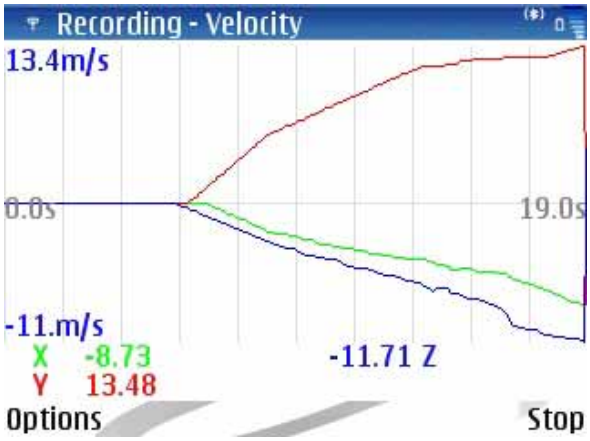

Figure 9. Recording acceleration data while displaying velocity as a speedometer

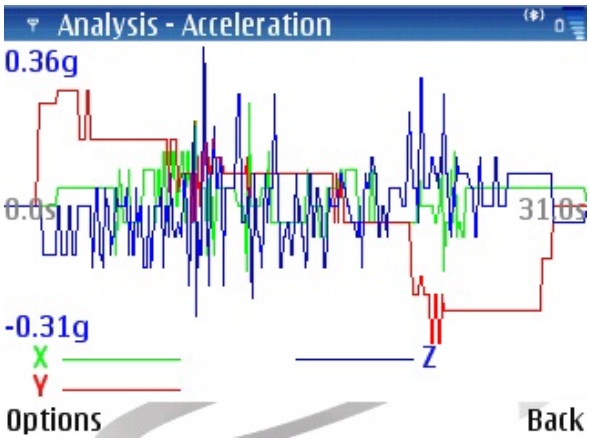

Figure 10. Selecting Analyze initially displays the complete acceleration data for the three axes recorded. Notice the acceleration spikes on the z-axis due to road bumps

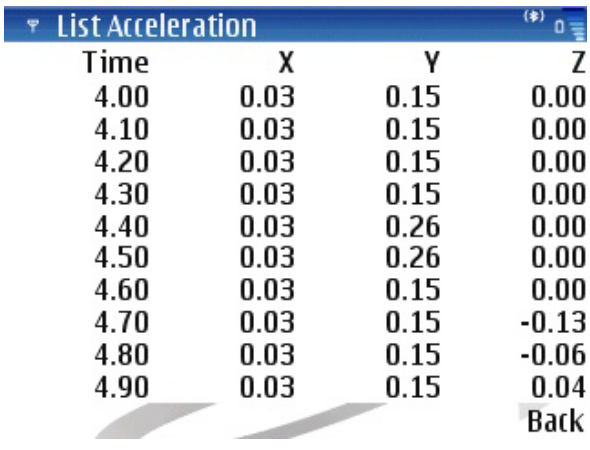

Figure 11. Listing raw acceleration data where Y is the linear acceleration and Z the road bumps

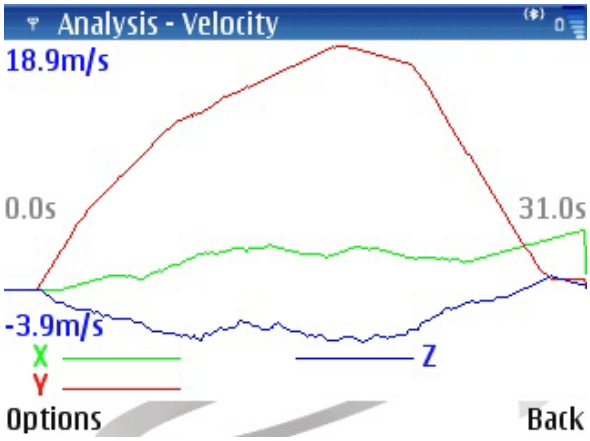

Figure 12. Display of the complete data velocity for the three axes

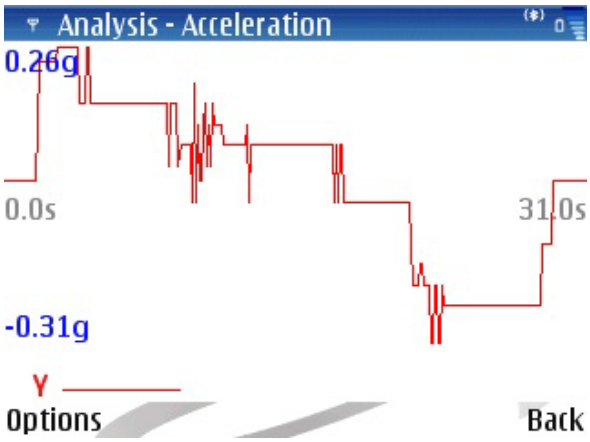

Figure 13. Viewing y-axis shows greatest acceleration in lowest gear with declines following each higher gear change until acceleration is zero and maximum velocity is reached. Negative acceleration is braking

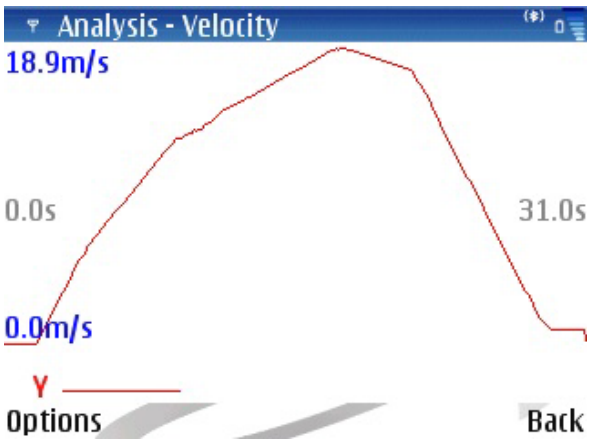

Figure 14. Viewing the y-axis velocity shows the car accelerating to 18.9 m/s, a shift from low to 2nd gear, and braking to a stop

3.4 Other Experiments

Keeping in mind that this purpose of this project was to demonstrate the use of widely available, mobile devices in science education, what other experiments are possible with a cell phone? The answer largely depends upon whether the cell phone is used alone or with other hardware such as a Bluetooth enabled device like the Wiimote. Common hardware of a cell phone can digitally record and play sound at CD quality data rates (44.5KHz), track the phone's orientation with accelerometers, determine global position by GPS, digitally record images, and communicate globally over the Internet or locally with nearby devices using Bluetooth. As pointed out by the Wiimote example, connectivity with other devices is fundamental to expanding the range and type of measurements possible. Other options are to construct measurement devices based on inexpensive Bluetooth-capable consumer electronics, such as headsets, that could be modified to serve as an alternative input device such as a force probe, which measures applied force directly.

Many other experiments are only possible with mobile measurement devices. The following list is not intended to be exhaustive; the expectation is that students will invent experiments that are far more original than those listed below. Note that time did not permit these experiments to be performed using the cell phone and Wiimote combination but are similar to, and should be within the range of those possible for the devices, as the experiments demonstrated above.

- Centripetal Acceleration around a Corner – Take a vehicle to a large, empty parking lot. While stopped, place the Wiimote on a horizontal surface pointing 90 degrees to the direction of travel and start recording data. From a complete stop, make a full-circle left turn at constant rate of speed and then stop. Stop recording data. Compare circular turns of different radii.
- Acceleration in an Elevator - While stopped at the bottom or top floor, place the Wiimote in a corner with the y-axis pointing up and start recording data. Start the elevator and when it stops, stop recording data. Compare upward and downward travel.
- Acceleration of the Vertical Loop on a Roller Coaster - Secure the Wiimote to your lower leg with the y-axis pointing up (long socks might help too) and start recording data. Compare the accelerations at the top, bottom, and sides of the loop.
- Acceleration of a Skydiver [1] – Secure the Wiimote to your lower leg with the y-axis

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pointing up (duct tape might help) and start recording data. Jump out of the airplane, fall, open parachute and land. Stop recording data and analyze the accelerations on each of the three axes throughout the dive.

- Bumpy Road - Measure the force produced by hitting a bump in the road.
- Roller coaster – Place someone at the front middle and back of a roller coaster and compare accelerations. An example of simultaneous multiple data measurements.
- Doppler shift – Determine the sound frequency as a train approaches, reaches and retreats from a vehicle crossing. Calculate the Doppler shift and the corresponding speed of the train.
- Other Acceleration ideas - Record acceleration experienced when dropping the Wiimote, riding on bicycle, car, boat, trampoline, skiing etc.

4. Summary

As has always been the case, science depends upon investigative tools for exploring ideas and quantifying the results. The purpose of this paper has been to demonstrate a small portion of the possibilities for placing investigative tools quite literally in the pockets of students. The ubiquitous cell phone, particularly when combined with commonly available consumer electronics, can complement the traditional science laboratory experience with one that is nearly always available and is highly mobile; adding to the number and range of investigations possible while reducing the constraints of time and space.

Classic sound and acceleration experiments have been presented to demonstrate the feasibility of the cell phone as an investigative tool. Students will certainly create other, more original experiments. While building investigative tools from cell phones and other mobile consumer electronics is not without challenges, the educational rewards are tangible and, given the strong economic forces driving improvement in cell phone and consumer electronics technologies, the power, ease of use, and potential of these devices in science education can only accelerate.

5. References

[1] C. Chudzinski and K. Forinash, Skydiving with the CBL. http://physics.ius.edu/~kyle/K/skydiving/skydskydi.html

[2] A. Erifiu and G. Mario G, Projects: WiiConnect/WiiRider, 2007. http://symbian-resources.com/projects/wiirider.php

[3] F. Fitzek and F. Reichert, editors, Mobile Phone Programming and its Application to Wireless Networking, Springer; 2007.

[4] Google Inc. Android – An Open Handset Alliance Project. http://code.google.com/android

[5] Vernier Software and Technology, Vernier Labquest. http://www.vernier.com/labquest/

[6] WiiLi.org, Wii Linux – Wiimote. http://www.wiili.org/Wiimote

Steel Spheres and Skydiver Terminal Velocity Using Video Analysis Software

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Abstract. Terminal velocity (v_t) of falling objects is one of the contents of the Physics official program in Portuguese high schools. The concept is supported on the analysis of the graphical representation of the y-component of the velocity (v_y) as function of the time, for the motion of a skydiver.

This work describes the use of open source video analysis software in the study of the relationship between the velocity of falling objects and time.

The first motivation of the present work was the acquisition and analysis of experimental data, obtained inside a classroom by students, related with the concept of terminal velocity and the impact of the strategy on its effective learning.

The apparatus used in this work, was a test-tube filled with two viscous fluids: glycerol and engine oil. A 8 mm diameter steel sphere was released inside the tube. The sphere's motion, was recorded by a digital camera (30 frames per second). The motion picture, in avi format, was

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analyzed with Tracker video-analyzer. As in other video analysis software, it is possible to transform the digital images (frame by frame) into position coordinates, velocity or acceleration graphs among others.

With the present work, the first conclusion was that the concept of terminal velocity was understood by the students. In fact, they worked cohesively and effectively, during all the different stages of the experiment. The analyses, the discussion and interpretation of the variation of speed for the motion of a skydiver, after this experiment, allowed a much better understanding of the concept by the students, when compared with a simple analysis of a $v_y = f(t)$ graph of the motion of the skydiver. Tracker gives also the possibility to analyze other concepts such as acceleration, position or energy. The advantage of Tracker it is easy to get, it is an open source, and is workable.

Keywords. Skydiver, Terminal Velocity, Tracker Video Analysis.

Hands-on Interferometry

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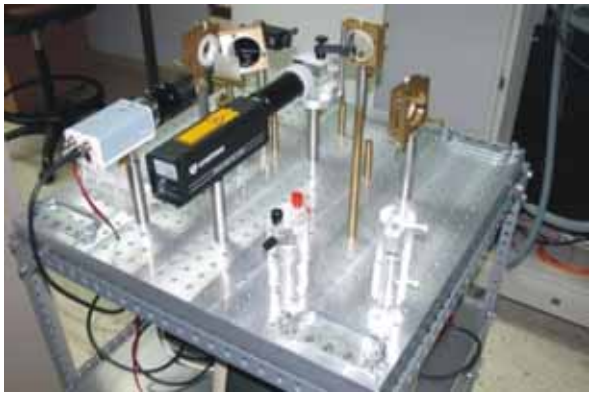
Abstract. When in a certain space region two or more light waves are superimposed, light-light interaction can take place. It can happen that the resulting wave irradiance changes among the different points between certain extreme values. These irradiance variations in the superposition region are considered as the interference phenomena. The points in the superposition region where the optical phase difference takes the same value define a fringe. All these fringes form a fringe pattern that can be visible if the interfering beams are very much alike. The optical arrangement in which two or more beams, derived from the same source but travelling along separate paths are made to interfere is called interferometer, a well-known technological device with important metrological applications on everyday life, as any magnitude able to modify the phase difference of the interfering beams can be measured with an interferometer. So it is possible to measure any quantity related with differences of light path lengths, differences of geometrical path lengths, differences of refractive indexes or wavelength of light when the differences of light path lengths are known. In this work we present the implementation and development of a tailored interferometer for use in classroom. The educational strategy will be presented with focus on materials, equipment, experimental configurations, measurement protocols and problem solving situations. Different experiments developed and results obtained will be analysed and discussed.



Keywords. Hands-on, Optics.

References

[1] E. Alanís, G. Romero, C. Martínez, L. Alvarez and G. Salazar, An Inexpensive Interferometric Setup for Measuring Microscopic Displacements, The Physics Teacher 42, 223-225, 2004

[2] C.A. Sawicki, Easy and Inexpensive Demonstration of Light Interference, The Physics Teacher 39, 16-19, 2001

[3] M. Vollmer and K.P. Möllmann, Michelson Interferometer for Your Kitchen Table, The Physics Teacher, 46, 114-117, 2008

[4] B.V. Dorrío and A. Rúa, Actividades manipulativas para el aprendizaje de la Física, Revista Iberoamericana de Educación, 42/7, 1-15, 2007

[5] B.V. Dorrío, 101 Hands-on electromagnetic induction activities, Development, Diversity and Inclusion in Science Education, M.F.M. Costa, B.V. Dorrío and R. Reis (Eds.), Ponta Delgada: Universidade das Açores, 201-202, 2007

5th International Conference on Hands-on Science
Formal and Informal Science Education
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Abstract. A few months ago, the Theoretical High School Grigore Moisil from Bucharest won a Grant Competition for scholar development, with the goal to pilot a Microsoft Learning Gateway application for educational use, in order to facilitate the communication between all the educational actors: students, teachers, managers, parents, local community.

In order to valorise the possession of the portal, we, the teachers of Natural Science, are intending to realize an e -portfolio named Natural Science between real and virtual. It will contain all kind of experiments and projects made by the students and the Science Teachers and it will be hosted on the portal of our school. It can be accessed at: http://portal.moisil.ro, username: vizitator, password: vizitator.

Now, the portfolio contains the electronic paper named Natural Science between real and virtual- data acquisition, processing and presentation, by Mihaela Garabet and Ion Neacşu, elaborated in partnership with Center for Science Education and Training, Microsoft Partners in Learning, National Instruments and Vernier International.

One section of the portfolio, named Against Global Warming, was presented at the Innovative Teachers Forum, held in Zagreb, on 6-8 Mars, 2008.

Our main goal is to promote experimental teaching of Science as a way of improving in-school scientific education and Science literacy in our society.

That's why we are developing and using hands-on experiments in our classrooms so that students "do" science rather than merely being "exposed" to it. We have also prepared a set of data acquisition experiments that could be performed from distance by logging on our computers and work in our lab.

Keywords. e-Learning, e-Portfolio, Data Acquisition Experiments.

1. Introduction

A few months ago, the Theoretical High School Grigore Moisil from Bucharest won a Grant Competition for scholar development, with the goal to pilot a Microsoft Learning Gateway application for educational use, in order to facilitate the communication between all the educational actors: students, teachers, managers, parents, local community.

It can be accessed at: http://portal.moisil.ro, username: *vizitator*, password: *vizitator*. In the Figure 1, you can see the homepage of the portal.

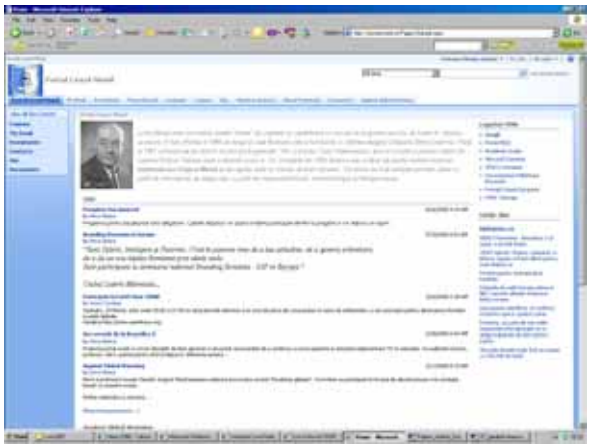

Figure 1. portal.moisil.ro – home page

Microsoft Learning Gateway (MLG) is a powerful, extensible suite of features designed to help schools meet their priorities and to give students personalized learning portals that bring together everything they need to support their classes. Password-protected access can be extended to parents, providing up-to-the-minute information on students' attendance, grades, assignments, timetables, and upcoming events. Administrators are provided with a secure, personalized interface from which they can improve planning and follow-through and make effective decisions. You can explore the tabs from Figure 2 and you will see the content of the portal.

Figure 2. The sections of the portal

As a 'Virtual Learning Environment' (VLE), Learning Gateway simply breaks down barriers of location and time to offer pupils and staff the ability to communicate and interact as if they were sharing the same space. Indeed web-based communication and collaboration via email, messaging, chat rooms, bulletin boards, videoconferencing, web pages, presentations, written documents, notes, is at the core of Learning Gateway. But the next step is to have access to and share online workspaces, where coursework, homework, reference materials and the like can be uploaded. No longer can the dog

eat the recalcitrant child's homework! There are ample opportunities for supporting pupils, with online discussions, tutorials, background materials, revision resources and two-way interactions.

The Table 1 shows the major benefits for teachers, learners and parents.

Teachers	Learners	Parents
Plan lessons Tests and marking Allocate home work to learners Class registration Add content Communicate Access from anywhere	Collaborate with other learners Tests online Research resources Personalize pages Keep up to date Access from anywhere	More involved Follow children's developme nt Aware of school news and events Access from anywhere

Table 1. MLG benefits

We will try to illustrate all of these features using the description of the Science e-portfolio.

2. Natural Science between real and virtual

In order to valorise the possession of the portal, we, the teachers of Natural Science, are intending to realize an ***e-portfolio*** named **Natural Science between real and virtual**. It will contain all kind of experiments and projects made by the students and the Science Teachers and it will be hosted on the portal of our school.

For the beginning, let's see the tutorial named **Natural Science between real and virtual-data acquisition, processing and presentation**, by Mihaela Garabet and Ion Neacşu, elaborated in partnership with Centre for Science Education and Training, Microsoft Partners in Learning, National Instruments and Vernier International. The tutorial has as a the major goal to bring our students closer to the real world, to give them a chance to apply their theoretical knowledge in practice in an integrated manner and from a different point of view comparing to the outcomes of the curricular standards.

On the other way we find it is a good way to develop the general competences prefigured in the Romanian curricular standards like: understanding and explain natural phenomenon and technological processes in everyday life, the applying of scientific investigation in Physics, Chemistry, Biology and the environmental protection. So, click on tab Hands on Science, then click on the link *Hands on Science – Real si virtual in Stiinte Naturale* and you can explore the themes we are proposing: movements, sounds, light, electric circuits, Global Warming, everyday life solutions, human cardiovascular system, plants, etc (Figure 3). All of them are treated with data acquisition experiments which are described in the tutorial and all the registered signals are given in xls format for free. Any visitor can download and use them for processing.

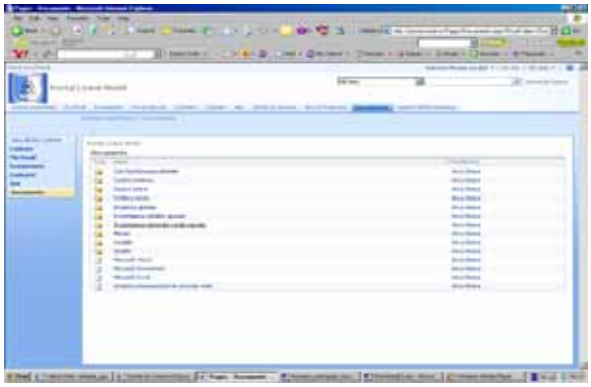

Figure 3. The tutorial's content

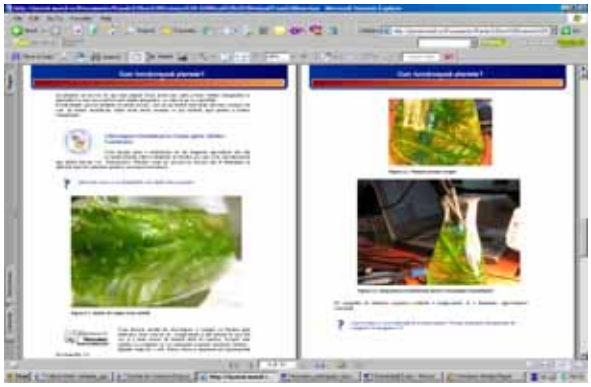

Figure 4. Aspects from the tutorial

3. Students projects

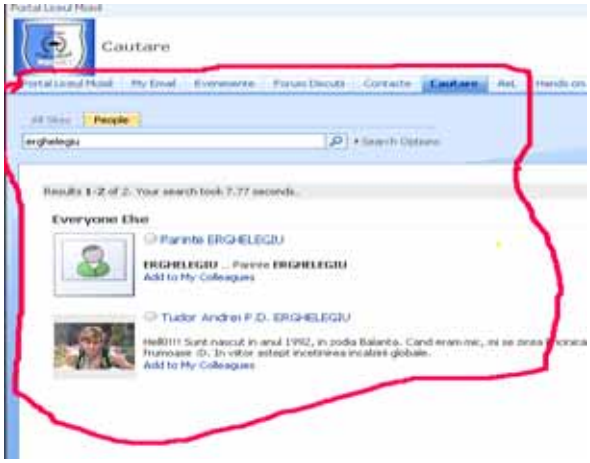

Figure 5. Searching by the name of the student

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The students' projects are uploaded on their personal sites. I am the teacher, at my home, and I want to check Andrei Erghelegiu's work... So I will access the portal using my username and my password and I will search by the student name, using the tab Cautare, like in the Figure 5. The results are two: the parent Erghelegiu and the student personal sites.

I will click the student site for checking his works!

I will find what you can see in the Figure 6!

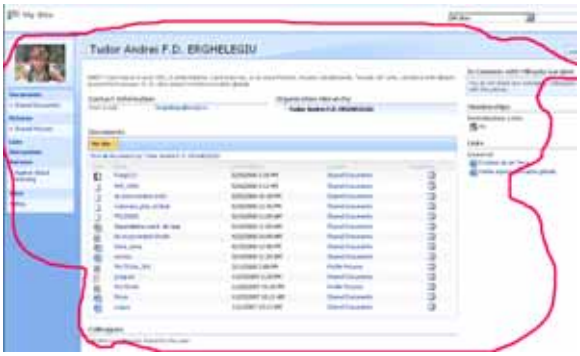

Figure 6

And an example of a result of a project developed by a student from 9A: the study of car moving down an inclined, using a camera for register the movement frame by frame and Microsoft Excel for making the graph you can see in the Figure 7.

Figure 7. Example of Physics Homework

Another collaborative Science project started in 2006 because the students from 10th have discovered that the Earth has a great problem: the phenomenon called Global Warming. It happened during a documentary project proposed by the Physics Teacher Mihaela Garabet: the students had to illustrate the phase transitions in a PowerPoint presentation. After that, the students, helped by the teacher and the technician engineer, Ion Neacsu are projecting and developing experiments to investigate the way we contribute to the Earth warming. The Centre for Science Education and Training gave them last generation instruments for data acquisition. They have tested the role of carbon dioxide in Earth's atmosphere warming, the role of the oceans in carbon dioxide consumption, the role of the plants and trees in maintaining the atmosphere equilibrium. After a brainstorming they formulated some ideas for reducing Global Warming. The students want to sensitize the people to fight with Global warming, so in June 2007 they organized a poster exposition named Message for Terra. A team of 3 students created Message to ourselves which is an electronic self statement about what to do in order to slower the Global Warming and to protect the environment. This statement was posted, in 2007 on the school web page and everybody was asked to sign the self agree for respecting it forever! This section of the portfolio, named *Against Global Warming*, was presented at the **Innovative Teachers Forum**, held in Zagreb, on 6-8 Mars, 2008.

You can find more about it by searching the tab *Against Global Warming*!

We hope our students will learn a lot in this project because the manner of developing the activities is very different from the classic lessons of Science, now they can integrate their knowledge and they can act like the adults in the real life.

Figure 8. experimental set-up

4. The online data acquisition experimental platform

Now we are intending to integrate an online experimental platform on the Moisil portal. We have some experience in conducting data acquisition experiments and more important, we

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have the necessary equipment and we can share it via Internet with different users. They will have to receive a user name and a password which grant them limited access to make real experiment from distance. The online laboratory will be set up to perform science experiments covering a vast array of fields including Physics, Chemistry, Biology, Earth Sciences, Mechanics and Electricity. Students using the LabVIEW software will be able to operate real equipment throughout the experiment directly via the Internet.

We have also prepared a set of data acquisition experiments that could be performed from distance by logging on our computers and work in our lab.

When I am writing this paper the platform is not integrated ready yet on the portal by I will try to describe the way I can do a simple experiment from distance. I am at home and the experiment of raising the Current- voltage characteristic of a light bulb will take place on the table of our lab, but will be conducted by me, from the distance. The experimental set-up is shown in the Figure 8: the bulb, the current probe and the conductors for registering the bulb's applied voltage from the AO of the data acquisition board. The last one is connected to the computer and works together with LabVIEW 7. In this experiment the user will manually modify (from the distance), the apply voltage to the bulb and register the current and the voltage on different channels (Analog Input) of the data acquisition board. The user can plot the graph I=I(U) directly in the VI (Virtual Instrument) he is using or he can save the registered data in an xls datasheet.

Figure 9. The results of the distance experiment

I am at home. I will authentify myself to grant access on PC21 Physics Moisil Laboratory, where I can only use the VI for the study of the electric bulb. In the Figure 9 you can see the results for the bulb characteristic I=I(U) and an web-cam image of the experimental set-up.

In the future, a student from anywhere (in Romania) could be able to do the same. And many other experiments we are hoping now!

5. References

[1] http://www.microsoft.com/education/LearningGateway.mspx
[2] http://education.inflpr.ro
[3] http://www.ni.com
[4] http://www.vernier.com

Coal Mines and Natural Surroundings, Can They Be Integrated? An Educational Standpoint

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Abstract. The needs for energy have become an important question in our economical system and in our daily life, mostly in the last years. Since the industrial revolution coal has been vastly used in steam engines and actually in the production of electric power. Our school is located in a high mountain area in Asturias (north of Spain) where the main economical source is the exploitation of coal mines, even in open air mines and underground galleries.

We are in a small village (around 1000 habitants) at high altitude (1060 m). An important part of our municipality is integrated in a natural park (Fuentes del Narcea, Degaña e Ibias), and the traditional life consist in agriculture and forestry related activities.

In this paper, we describe the work made by our students analyzing, in this environment, how the wildlife is being affected by the extraction, transformation and transportation of coal to the nearest thermoelectric plants.

Keywords. Environment, Constructivism, Science, Education.

1. Introduction

During the development of the first human societies, from the first stages, the harmony between man and nature has become a basic need to keep in mind and take into account in all artificial activities.

Nevertheless, the aspiration of comfort and a quick and sometimes an uncontrolled growth and

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development of our economical system in different fields such as agriculture, mining, materials production and transformation, power generation, etc, has give as a result a broad damage of our natural environment.

After some time (years, decades, even a century…) our society realized that this way was not completely right in the direction to achieve a good quality of life.

Then, the concept of sustainable development has emerged as a principle to follow in all the economical and social activities for the future.

School is a suitable scene to develop activities and encourage attitudes in this direction. In this way, a multinational group of secondary school pupils, aged 14-16, from different schools, most of them from European countries, and also Turkey and Canada, conscious of the relevance of their activities for the future, they have been developing, during the last schoolyear, some indoor and outdoor activities studying different environmental fields to promote positive attitudes on the protection of the environment

Since the first edition, started in 2004, the Youth Eco-Parliament (YEP) project is an international educative program that involves each 2 years a great number of schools from the above mentioned countries. The aim of this big plan is to raise awareness of sustainable development.

In this paper we describe the different activities carried out by the students of the CPEB de Cerredo, a public secondary school, located in the region of Asturies, in the north of Spain.

Cerredo is a village of the municipality of Degaña, located at an altitude of 1060 meters over the sea level, where the main economical source nowadays is the extraction of coal even in open-air and underground galleries. The traditional activities of mountain agriculture and forestry have only importance as a complementary activity for some families.

2. Aims

The main objectives of the Youth Eco-Parliament are to encourage students to observe, analyze and find out solutions for local environmental problems, as well as to broad their thinking and feeling to a global level within the framework of planning and conferring with classmates and others in the international writing group.

The participation in this project gives the opportunity to the students to make contacts and share experiences, feelings and knowledge with other colleagues from different countries and cultures. This collaboration opens their minds to others ways of thinking and contributes to emphasize the concept of European citizenship.

Another important objective is to promote educational and outdoor activities that are especially attractive for teenagers and increases their interest towards the different matters such as natural sciences, technology and English.

The communications and information transfers between the different students, school, coordinators and national and international moderator's results in a key role of the information and communication technologies in this project.

In our case, and due to the special characteristics of our municipality and the surrounding areas, we decided to present our project based on the study of the different types of pollution: air, water, soil as well as noise pollution. We analyzed the main sources and the consequences on the environment and the health of people living in this region.

3. Background

Supported by the organization Pro Europe (Packaging recovering organization Europe) in partnership with Ecole et Nature (a network of organizations and individuals who work in the field of environmental education), the Youth Ecoparliament (YEP) is an international educational platform.

Figure 1. General meeting of the 1st youth eco-parliament in Berlin 2004

In 2004 this project was launched, involving some 3000 European students that have elaborate a European White Paper for the Environment divided into five thematic units: energy, water, food, waste and air.

This document, containing resolutions and proposals for action; was given to the President of the European Parliament Josep Borrell, the President of the Environmental Commission Karl

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Heinz and to the European Commissioner Stavros Dimas.

Figure 2. First edition of this project

Figure 3: Project meeting of the second edition in 2006

The second edition, in 2006 takes the form of Open Letter for the Environment, as a document based on assessments and observation and practices on local environmental issues and addressed to influent groups in our society. The addressees of the open letters were: producers and industries, non-governmental organizations, journalists, researchers and scientists, public authorities, educators and also international institutions.

The third edition, in 2007-08, consists in the elaboration of the YEP Report for the environment which is directed at UNESCO representatives within the framework of the Decade of Education for Sustainable Development 2005-2014 (DESD).

It will feed both the second Biennial and the half-way Report of the Decade to be published in September 2009.

In this edition, in 2008, the collective writing of this Report, invited 3500 young people, aged 15 to 17, accompanied by national moderators, to pick out, analyse and highlight environmental education actions with a view to sustainable development.

4. Structure of the YEP Report

Apart from the general objectives of the overall project involving all the countries, the 67 Spanish schools involved were coordinated in order to elaborate a particular report. This document, written in Spanish language, constitutes an edited book incorporating a compilation of brief outlines summarizing the main topics, the concrete objectives and a short description of each local project developed particularly by each school.

Each group of students, coordinated by one or more teachers, presents, in this document, the positive and negative elements of the work organized, as well as the main achievements and difficulties encountered during the progress of the different tasks and stages, the main outcomes and effects on themselves and on the educational community and other agents involved.

Figure 4. Contribution to the Spanish report (part A)

The final product of the multilateral cooperation is a complete compilation of the conclusions, proposals and feelings emerged during the different activities and experiences developed. This report contains the reflections that came up from our study of 115 youth projects across 10 countries of Europe and Canada. The environmental, social, cultural and economical implications are huge and reach many aspects concerning the life of the world's population. This educational effort will encourage changes in behaviours that will create (undertaking local actions projects) a more sustainable future in terms of environmental integrity, economical viability, and a fair society for present and future generations.

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Figure 5. Contribution to the Spanish report (part B)

The Report is organised in 5 chapters:

1. Our Vision: « a positive vision to get started » In this chapter, we intend to demonstrate that motivation is personal before becoming collective. Being in nature as well as meeting others is motivating. We think that it is important to be part of a worldwide network of young people, to share our visions, our values and to start acting however small the action.
2. “Scientific Approach » Our belief is that a change in the habits is enhanced with true scientific knowledge. Realising that actual scientific language is too complex for us to understand we wish to make sure our results will be understood by everyone.
3. “Start acting now! » Our objectives are to motivate others and not wait that something will happen... Step one: I can do something. Everyone asks himself « What can I do from now on! » (use bicycles, go by foot, ...). Step two: Think about friends who are motivated enough to think about local actions and do something with them. Step three: Look for “people with power" » (partners: mayor, directors of companies, journalists); use networking...
4. “Public awareness » This chapter aims at showing and analysing different tools that can be used to raise awareness. We had to look at what made us aware and collect the many ideas from all the countries. The main idea is that we should not give lessons to people but we should keep active and try to inform the largest public.
5. “Learning to transform » This chapter is about education from young age to older generations. Learning does not only happen at school and it not only implies lectures but also other teaching methods (dialogue, teamwork, practical training...)

Networking is key element in the YEP (exchange of information among schools, persons, with companies, members of parliament, NGOs...). This chapter aims at giving tips on different methods you might use and adapt while taking actions.

5. Activities developed

5.1. Context and situation

Our school, the CPEB (Public centre of basic education) of Cerredo is located in a high mountain area in Asturias, in the north of Spain. Cerredo is a small village (around 1000 habitants) at high altitude (1060 m).

Figure 6. Geographical location of Cerredo

This centre has singular characteristics due to the adverse geographical conditions: poor communications with neighbouring towns and important cities and also severe climatic conditions due to low temperatures the presence of significant amounts of ice and snow, mainly in winter. Our school covers all the levels of compulsory education in the Spanish education system, since we have pupils from 3 to 16-17 years old.

An important part of our municipality is integrated in a natural park (Fuentes del Narcea, Degaña e Ibias), and the traditional life consists in agriculture and forestry. Since the middle of the last century, the main economical source is the exploitation of coal mines, even in open air mines and underground galleries. This coal is entirely employed in the production of electrical energy in two thermoelectric power plants situated at 30 and 50 kilometres far from the location of the extraction areas.

In this environment, we have analyzed how the wildlife is being affected by the extraction, transformation and transportation of coal to the thermoelectric plants.

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Figure 7. General view of the small village of Cerredo

5.2. The natural park of Fuentes del Narcea, Degaña e Ibias

Declared Natural Park in 2002, is situated in the southwest of the region of Asturias, in the occidental part of the Cantabric Mountains, with an altitude between 400 m and 2000 m over the sea level and an area of 47.589 ha. The name of the park is given by the main rivers Narcea and Ibias.

Inside this area there is a region of 60 km^2 of special protection: the integral natural reserve of Muniellos; the access is restricted to a maximum of 20 persons per day with authorization, which constitutes an effective way to safeguard and improve the environmental values.

This park is particularly rich in flora and fauna characteristic of European high mountains. Between the vegetal species are especially important the oak (quercus robur and quercus petraea) and beech (fagus sylvatica) forests and there is also chestnut trees (castanea sativa) and birches (betula celtiberica) as well as other small species, mainly different ferns, moss (muscus) and lichens.

Figure 8. Glacial lake

We have organized several visits to our environment, where our students were guided in order to see, identify and collect the different species or parts of trees and plants.

Figure 9. Students are identifying different plants and trees in the forest

The wildlife species more important in this park are the bear (ursus arctos arctos), with an estimated population of around 40 members but with clear signs of resurgence in the last years, and the tetrao urogallus, more important due to the special situation of this species in Europe than to the number of members. Regarding this aspect are more important the wolf (canis lupus), the fox (vulpes vulpes) the wild boar (sus scrofa) and the deer (capreolus capreolus) between the mammalians and the goshawk (Accipiter gentilis) and the sparrow-hawk (Accipiter nisus) in the group of the birds.

As it can be understood, it is not easy to find and observe such species directly in their natural environment and this even more difficult with a group of students. Nevertheless, an interpretation centre has been visited and we could examine some bibliographical and audiovisual materials related to the wildlife.

5.3. The coal extraction and handling

Cerredo belongs to the south-Cantabric coal basin, one of the most important coal areas in Spain. Anthracite and soft coal are the more abundant types of coal extracted.

The coal is extracted following two different methods:

- In open air mines using heavy machinery, mainly in the highest parts of the mountains.
- In underground galleries, with different levels and interconnected indoors.

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Figure 10. Open-air coal mines

The second method is obviously more complicated from the technological perspective and economically more expensive. Nevertheless, the effects on the environment are more significant in the open-air techniques due to the powder emission to the atmosphere, the noises provoked by the movement of the machinery and the detonations, and the destruction of the natural environment and the visual impact.

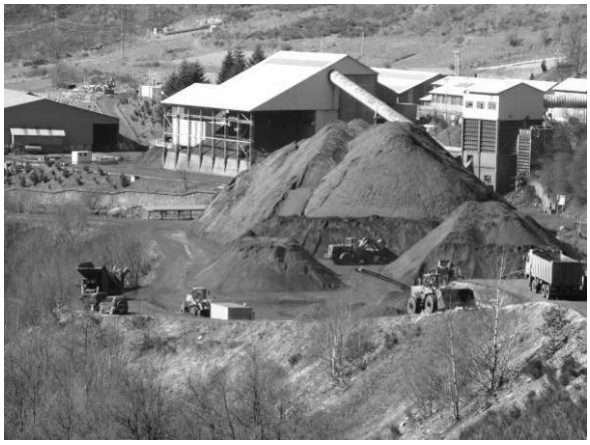

Figure 11. Coal handling

This methods of coal extraction have been evaluated by our students by means of visits to the mines (except the underground galleries because it is forbidden for people aged less than 18 due to security reasons) and interviews and talks with the responsible for the environmental management of the company and the engineer.

Once extracted, the coal is processed in industrial plants usually placed close to mines, with the purpose of separate the unwanted and useless parts of rocks and soil from the coal used as combustible in the thermoelectric power plants.

Figure 12. Students are analyzing the wreckage of the coal mines

This washing process generates a large amount of dirty water that needs to be treated before dumped directly to the river. Nevertheless the rain usually drags important amounts of coal and rests of soil to the watercourses.

After the washing procedure, the coal should be milled and converted in small pieces before be sent to the destination. This milling process constitutes another important element of air pollution and also noise pollution that affects directly to the population of the village, since the treatment plants are placed very close to the houses.

5.3. Organization of the work

The project was launched in November of 2007 when the CPEB de Cerredo was selected to participate, together with other European schools.

The students of the upper course of this school (fourth level of secondary compulsory education) were selected by the leading teachers to be in charge of this project and all the tasks related. They were guided and organized by the teachers of natural sciences and biology. The national moderators of the project helped also them concerning some procedures and the dates and deadlines to manage the different activities.

The title of our project is: “Coal mines and natural surroundings, can they be integrated?”

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and, during the school year, the following activities have been developed:

- An initial search for information in different sources (mainly webs, books and the monthly magazine of the local coal extraction company) about two key topics: the characteristics of the natural park and the procedures directed to the coal extraction and handling.
- Exploration on the environment and research and study directly on the same themes: in the neighbouring nature and in the mines and coal handling industrial plants.
- Inquiries to experts who could provide precise and technical information concerning the preservation of the nature values and the waste treatment in the mines and how the coal mines affects the environment.
- Discussions about the information obtained from bibliographical sources as well as from inquiries to experts.
- Elaboration of a set of results, including data obtained and the conclusions of the discussions.
- These outcomes have been presented both in a written version and also as an audiovisual production. In this movie each participant student presents a particular section concerning the tasks carried out and the results obtained, combined with different scenes and outlooks in relation to the environment and the different mining activities.
- Collaboration to the elaboration of the YEP Report to be sent to the UNESCO.

6. Resources and activities on-line

The international cooperation was achieved thanks to a powerful tool than ensures and makes more easy and fluid communication between the students and teachers of the participant schools. That's the web site of the European Youth Eco-Parliament

All the schools were included in this web site, where each school had the chance to create their own presentation.

Depending on the goal, each class have choose the tool they thought was the most useful for the message and content they wanted to communicate; then they have prepared the web assembling the material in the form of photos, images, films, texts… to facilitate the description of the work done and the results obtained in the different steps. The web was public, but the possibility to edit the different branches was restrained to the corresponding school by means of a login and a password.

Figure 13. Main page of the web of the project

The use of the information and communication technologies helps the students to deal with contacts and links with colleagues from different schools geographically separated, and to know the activities and the results obtained by all the partners.

The students could exchange ideas and respond to questions posed by experts, by participating in the forums. They could start to make connections between their day to day actions and their local situation in respect to the environment and sustainable development. They could share their experiences with other European students.

Figure 14. Wild fruits (blueberries) are widespread in the environment Cerredo

Additional pedagogical advantages have been offered by the forum: allows students could enter into dialogue with others about environmental issues, promotes the use of Information Technology in an educational framework, contributes to build skills in constructing effective arguments and encourages social behaviour as well as develops reading, writing and verbal skills.

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7. Pedagogical outcomes and evaluation

As it has been mentioned, the final product of this project is a report written collaboratively by the participants on this project and addressed to the UNESCO representatives.

Beside this material product, the main outcomes from which the participant students were benefited can be summarized in the following points:

- The outdoor activities are tasks that engage students to do scientific and cultural research, to explore different ways of sustainable living and implement the use of learning diaries.
- The students are encouraged to share ideas, study directly their environment, collect different categories of data and reflect on what they had learnt.
- The direct experiences carried out seem to be an extremely important factor in educating students to be environmentally aware adults.
- The information empowerment leads to an active participation and awareness of their responsibility towards the community and environmental policies.
- The knowledge and experience gained during such a project is incomparable with common curricular school activities.

Moreover, from the educational, pedagogical and social point of view the skills specially developed were:

- Determine the validity of evidence from a variety of sources.
- Analyze critical issues on economic growth and environmental protection.
- Develop presentational writing skills.
- Work cooperatively in teams.
- Independent research with news journals, magazines, statistical reports, and on-line resources
- Interview skills
- Planning and organizational skills

The participation in this project has also contributed to enhance the use of the new technologies at school and to make the students aware of the relevance of the computers and Internet in the different fields of our world.

Since the project involves international collaboration, the language used within the writing groups is English. In order to allow a good level of exchange an effective communication between students it was essential the collaboration of the teacher of English.

Figure 15. Traditional practices in Cerredo

8. Conclusions

Our work helped us to understand the factors needed to change daily habits and successfully reach the goals of the United Nations Decade of Education for Sustainable Development -for which UNESCO is the lead agency- indeed to integrate the principles, values, and practices of sustainable development into all aspects of education and learning.

We intend to share our experience in leading projects and inspire those around the world who wish to engage in such projects and commit them to change their daily habits.

Through this work we realized that any action, even small, contributes to a world where each and every one might feel good and where human beings and nature will both get their way.

9. References

[1] D.B. Botkin and E.A. Keller, Environmental Science: Earth as a Living Planet, 2nd edition, New York: John Wiley & Sons, 1998.

[2] V. Brown, Investigating nature through outdoor projects: 36 strategies for turning the natural environment into your own laboratory, Harrisburg, Pa. Stackpole Books, 1983.

[3] L.P. Pringle, Taking care of the earth: kids in action. Honesdale, Pa., Boyds Mills Press, 1996.

[4] P. Feinsinger, A. Grajal and A. Berkowitz, Some themes appropriate for schoolyard ecology and other hands-on ecology education. Bulletin of the Ecological Society of America, v. 78: 144- 146, 1997.

[5] N. Hairston, Ecological experiments: purpose, design, and execution, Cambridge Eng., New York, Cambridge University Press, 1989.

[6] http://www.actionfornature.org

 ISBN 978-989-95095-3-5

[7] http://www.envirolink.org
[8] http://www.enviroliteracy.org/
[9] http://www.epa.gov/
[10] http://www.globe.gov
[11] International Planet'ERE Collective (IPC), Environmental education towards sustainable development, Montreal 1997.
[12] S. Levine and A. Grafton, Projects for a healthy planet: simple environmental experiments for kids. New York. Wiley, 1992.
[13] J.A. Palmer, Environmental education in the 21st century, Theory, practice, progress and promise, New York: Routledge, 1998.
[14] S, Simon, Science projects in pollution, New York, Holiday House, 1972.
[15] UN. Air Pollution and Citizen Awareness, New York, 2005.
[16] J. Redondas, Environmental Research Activities in an Heavy Industrialized Region, Proceedings of the 3rd International Conference on Hands-on Science, Costa MF, Dorrío BV (Eds.); 2006 September 4-9; University of Minho; Braga, Portugal. 376-390, 2006.
[17] J. Redondas, Experiences for the II European Youth Ecoparliament Project. Proceedings of the 3rd International Conference on Hands-on Science, Costa MF, Dorrío BV (Eds.), 2006 September 4-9; University of Minho; Braga, Portugal, 433-440, 2006.

Students' Awareness of Endangered Species and Threatened Environments: A Comparative Case-Study

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Abstract: The purpose of this comparative-case study is to investigate children's awareness of endangered species and threatened environments in four countries. 5th – 7th grade students in four schools, each from Turkey (n=16), Bulgaria (n=40), Romania (n=22), and USA (n=11) constituted the sample of the study. Each group of students under the guidance of their teacher was asked to select one endangered specie and threatened environment (e.g. lake) in their neighbourhood. During the study, they went on field trips which complemented indoor discussions during club time. Student achievement was measured with five different data collection instruments each of which pertains to knowledge, skills, attitude, and behaviour. The findings indicate that students developed a global awareness from these experiences, which resulted in motivation to develop action strategies for protecting the endangered species. Student conceptions were divided into three groups; egocentric, guardianship and eco-centric.

Keywords. Environmental Awareness, Endangered Species, Threatened Environment.

1. Introduction

Nature studies with the children have long been reported in the literature to increase students' awareness of ecological processes (e.g. food chain, water cycles…etc) in the natural environment. These studies also help the children understand the language of the nature. Studies in the literature report that there are lots of ways of developing one's environmental knowledge and awareness such as media, family and the schools (within and out-of-school). Field

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trips (Neal, 1994), case studies (Matthews & Riley, 1995, as cited in Yerkes & Haras, 1997), community inventory projects, community action projects are mentioned in the literature as school activities (Howe & Disinger, 1988). Further, school garden activities can be added to this list. As claimed by Bryjegard (2001), school gardens are excellent places for introducing the concept of environmental awareness to the students. Another way of introducing environmental issues to students is to infuse studies about the environment into a traditional course offering (Wagner, 1997). In addition to these methods, outdoor activities (field trips…etc) provide teachers and the students with opportunities (Yekes & Haras, 1997) to study environmental issues first hand (Neal, 1994), and this approach has been effective in helping students develop an awareness of the environment (Palmerg & Kuru, 2000; Howe & Disinger, 1988).

1.1 Purpose of the study

The purpose of the study was to investigate children's concern for and awareness of endangered species and threatened habitats. This paper presents in-depth analysis of findings of a comparative case study including the perceptions of children from Turkey, Bulgaria, Romania and the USA.

2. Method

This study was designed as a comparative case study seeking for in-depth information on a small group of participants (Leedy & Ormrod, 2005). Patton (1990) believes that studying a small group, with a wealth of detailed information, can help the researcher(s) understand the cases in depth. However, he further claims that this reduces generalizability. Furthermore, qualitative inquiry helps the researcher carefully scrutinize the targeted sample (Patton, 1987). The findings presented here are the results of the second year of the Unique and Universal Project.

2.1. Sample and Sampling

Eighty-nine students in grades 5 to 7 participated in this study. They came from four different schools and each school was in a different country as shown on the list that follows.

Table 1. Students from each country

Country	Number of the students
Turkey	16
Bulgaria	40
Romania	22
The USA	11

a. Turkish Sample:

Fourteen 5th and two 6th grade students at METU Foundation School in the urban area of Ankara constituted the Turkish sample in the study. The group included 11 and 12 year old girls and boys.

b. Bulgarian Sample:

Forty 1st to 6th grade students between the ages of 8 and 11 from Vasil Aprilov Elementary School in Bulgaria constituted the Bulgarian sample of the study. These students only participated in the second year of the U&U Project.

c. Romanian Sample:

Twelve 5th grade and ten 6th grade students at School Number 5 in Satu Mare in Romania constituted the Romanian sample of the study.

d. American Sample:

Six 6th grade and five 7th grade students from Roland Park Country School in the USA constituted the American sample of the study. Since this school is for the girls, all students in the study were girls.

2.2. Data Collection Instruments

The Unique and Universal project has several objectives which address different dimensions of student learning. These dimensions include the cognitive, affective and psychomotor dimensions of the learning. Thus, in order to measure participants' development regarding these three dimensions, five different data collection instruments were developed by considering findings from the existing literature and the level of the students. Only the knowledge test, the attitude test and the picture form were given to the students in Bulgaria, Romania and the USA.

 ISBN 978-989-95095-3-5

Before administering the instruments, they were translated into the students' own language (Turkish, Bulgarian, Romanian and English). Each of the instruments is briefly described below;

a. Knowledge Test

This test aims to investigate students' knowledge about endangered species and threatened habitats. Further, it also aims to determine the source of students' knowledge on the topics investigated. In the test, the students are asked to rate the importance of some precautions to be taken to protect these species and habitats. Both open-ended and Likert type items are included in the knowledge test.

b. Attitude questionnaire

This questionnaire aims to investigate the attitudes of students toward endangered species and threatened habitats. There are 13 closed-ended items on a 4 point Likert-type scale (1-strongly disagree, 2-disagree, 3-agree and 4-strongly agree). In addition, the students are also asked to respond to reasons behind their tendencies / responses.

c. Picture form

Each group of students focused on a different endangered species. The picture form aims to determine to what extent the students know the characteristics of the endangered species they are studying. In the picture form, the students are required to draw a picture of the specific endangered species, and also to identify the characteristics of that species.

d. Field trip tests (two different)

These tests include two different instruments. The first one aims to determine students' knowledge about the scientific experiments carried out during the field trip. The second aims to determine the students' knowledge of the endangered species they are studying.

2.3. Data collection process

A strong communication ensured that the partner schools initiated the study simultaneously. However, this connection weakened toward the end of the spring semester due to the heavy schedule of the partner schools and the teachers. This study of the second year of the U&U Project was initiated within the schools in the fall semester of 2006-2007. The study teams were formed and the aims of the project were explained to the project teams. In order to collect data from the participants, the instruments were administered at the beginning, middle and end of the study. In the first meeting with the students, at the beginning of the project, in order to determine the initial knowledge and attitudes of the students, a knowledge test, an attitude questionnaire and a picture form were administered to the students in each country. Then, regular meetings took place with the students during the semester.

The students went on field trips (selected by the students) to a study site near to their school. Two field trip tests were given to the students before and after each field trip and observation activities. The first field trip test was given to the students to determine their initial knowledge of water monitoring parameters before and after the water parameter experiments. The second field trip test was given to determine students' knowledge of characteristics of endangered species before and after their observation of the endangered species they selected to investigate. These two tests were only given to the students in Turkey, but not the ones in Bulgaria, Romania and the USA. At the end of the study (end of spring semester), a focus group interview was performed with only Turkish students. Also, the picture form and attitude questionnaire were given to all students in four of the countries.

2.4. Data Analysis

Once all the data was gathered from the participants, the data analysis procedure could begin. In order to analyze the data, not only quantitative but also qualitative data analysis procedures were used. Since the attitude questionnaire includes closed ended items, the responses given to those items were analyzed by use of descriptive statistics, particularly mean, standard deviation, percentage, and frequency. On the other hand, the responses given to the open ended questions were analyzed by the use of content analysis.

3. Results

The results gathered from the students through the use of different types of data collection instruments revealed students' concern, awareness and perceptions of endangered species and threatened environments.

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3.1. Turkish Students

Turkish students believed that an excessive amount of hunting, water and air pollution, changes in the climate as a result of global warming, construction of factories in the natural areas and uncontrolled waste management and sewer are the main environmental problems directly influencing the loss of endangered species and threatened habitats. They also believed that the precautions and protection measures taken to deal with these problems have not been sufficient in either Turkey or worldwide. They were more concerned about individuals' unconscious attitudes and behaviours for engaging in protecting these species and regions.

The responses of the students indicated that their own knowledge about the number of the other endangered species and regions had been very limited at the very beginning of the project. However, their knowledge of these topics increased toward the end of the study.

Students reported that they obtained environmental information about the endangered species and threatened regions mostly from their school, the projects they were involved in (eco-school projects, tree planting…etc), and the Internet. As a source of knowledge regarding the topics, the students claimed that course textbooks were not sufficient, but the classroom instructions and activities were somewhat perceived as adequate.

Students' pictures of Dikkuyruk (Oxyura Leucocephela) and their explanations regarding this bird showed that their knowledge of selected endangered species was quite limited at the very beginning. Their second picture of the species at the end of the project indicated that they drew the picture of the organism in detail and identified its basic characteristics (head, tail, living area…etc). Two of Turkish students' drawings of Dikkuyruk are given in picture 1.

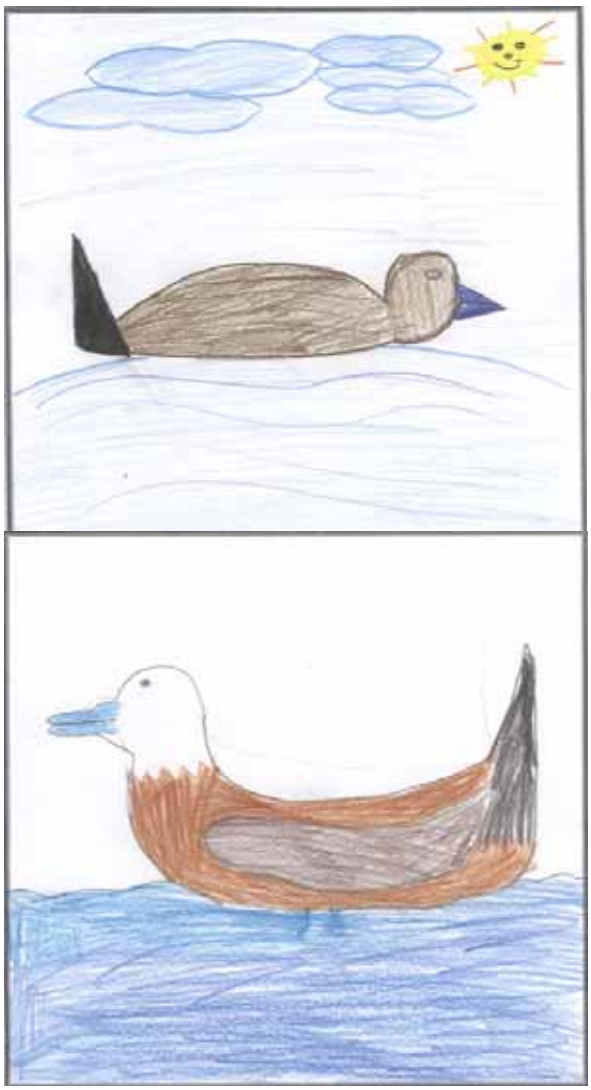
Some of the explanations of the students on Dikkuyruk are given below;

"It has blue bill. Its tail is strait. Its head is white. It lives in Eymir Lake. It is endangered" (Deniz S.)

"it is a diving duck. It is called as white-head (Akbaş). It is forbidden to be hunted. Its tail is black" (Burak B.).

"it has brown fur/hair". (Aleyna K.)

Students believed that passing new laws, fining people in case of their destructive behaviours, constructing new habitats for the species, holding conferences and seminars, and putting more information about the endangered species and threatened regions in the textbooks are the most effective ways to prevent the extinction of endangered species and threatened environments. They reported that prohibiting people from entering the endangered habitats would not be an effective precaution.



Picture 1. Turkish Students' Pictures of Dik Kuyruk (Oxyura Leucocephela)

Turkish students' attitudes toward the endangered species and threatened environments seemed to be quite positive both at the beginning and at the end. They indicated their willingness to take any action to protect the endangered species, because they believed that these animals and plants are becoming rare and endangered. They also valued that the endangered species are living organisms like human beings. Thus, students felt they have their own rights and need to be protected. For that reason, they reported that the natural resources should be carefully used. Their self-efficacy/internal locus of control appeared to be

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high, because they believed in their own ability and intrinsic motivation to take responsible actions.

3.2. Bulgarian Students

Bulgarian students believed that hunting, human activity and factories, destruction of the natural habitats, lack of food, release of waste water in water basins, and harmful / poisonous emissions of gases in the atmosphere are the main environmental problems causing the loss of endangered species. Similarly, they reported several environmental problems threatening the natural environmental region such as tourist activities in and around the region, wrong use of the area for scientific investigation, and loss of habitat and species around the region. They more concerned about the species they investigated during their field trips and reported that hunting is the most severe problem threatening the Black Kormoran.

The Bulgarian students believed that the protection studies were not sufficient in the World in general, since people do not pay adequate attention and pollute the environment which causes the extinction of species. However, they believed that the protection studies were somewhat sufficient since such protection studies have been carried out by the schools, and poachers are fined in Bulgaria.

They obtained information about the endangered species and threatened environment mostly from the project they were involved in, their school, TV, books, and the Internet. Nearly, all of the students indicated that subject taught in the classroom and classroom activities were a bit sufficient whereas the topics covered in the textbooks were not enough to be knowledgeable about the endangered species and threatened regions.

Two of the students' drawings are given in picture 2. Their pictures of Black Kormoran indicated their average knowledge of characteristics of this species.

They reported that imposing fines, putting new laws, creating special areas for the plants and the animals located in the threatened areas, and integrating much more information about these topics into the textbooks were rated as the most influential ways of solving the problems with these species and areas. Furthermore, they suggested that the laws be changed, fines be charged and stronger punishment be given.

Students indicated their own ways to solve these problems included taking part in projects and protection studies, taking non-formal biology, ecology and geography classes and cleaning the sea.

Picture 2. Bulgarian Students' Pictures of Black Kormoran Bird

Bulgarian students seemed to have positive attitudes toward the endangered species and threatened environment. They believed in the necessity of protecting endangered species in order to sustain the beauty of nature, biological diversity and natural balance. All of them were willing to take part in the project for protecting endangered species and threatened natural areas since they would like to explore nature, protect these species and regions, and ensure their sustainability. They all agreed that the natural resources should be carefully used, otherwise they would disappear. Furthermore, they agreed that everyone could do something to protect endangered species and take part in protection studies.

3.3. Romanian students

Romanian students did not complete the knowledge test, and only completed the picture form and attitude questionnaire. Only the results from these two forms are given here. Romanian students selected the pool frog as their endangered species to study during the project. Their pictures and subsequent explanations of

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the pool frog showed that they carefully examined this species and their characteristics. Two of the pictures drawn by Romanian students are given in picture 3.

Picture 3. Romanian Students' Pictures of Pool Frog

Some of the explanations of the students on pool frog are given below;

"it is green. It can jump and swim. It has got four legs, two eyes and long tongue. (It) eats insects, flies and mosquitoes. It lives in water, lakes and pools". (Gulya I.)

"…it is endangered. It is eaten by storks and snakes". (Paluca V.)

"…it lives in the water, land and swamps". (Huszti J.)

"…it sometimes sits on the water lilies. When it is not careful, it is caught by stork, snakes or birds" (Koos E.)

Their concern for the endangered species and threatened environment was quite high. They were highly concerned about natural resources, extinction of the species, wrong pesticide usage in the agriculture, hunting of the animals, population growth and urbanization and responsibilities of human being for sustaining the biodiversity in the natural areas. They agreed that endangered species and wild animals should be conserved since they all contribute to the natural balance and have their own right to survive. They believed in the negative effects of unplanned industry, population growth and urbanization on endangered species and natural regions. They emphasized the importance of protecting natural environments, because otherwise, they will end in the near future They were willing to participate in the project aiming to protect endangered species and natural habitats, because this would makes them happy, and they like animals and nature. Regarding their ability to protect species and findings ways to do so, one of the students said that "If I do something to protect something, I feel protected too" (Daniel T.). They believe in their own strength to protect these species and natural regions. They agreed that everyone on the Earth could do something else to protect these species and regions.

3.4. American students

American students believed that chopping down trees, construction of new buildings in the areas where these species live are the main actions threatening the endangered species and their natural regions. They were more concerned about the constructions of new buildings in the natural regions.

Similar to the students in the other three countries, American students' knowledge on the number of the other endangered species and threatened regions was limited.

TV and the school were the sources that students identified as where they gathered most of their own knowledge on the endangered species and threatened regions. Books and the project they were involved in were also rated as information sources which contribute to their own knowledge.

Students' pictures of the monarch butterfly indicated their knowledge of the basic characteristics of these species. Two of American students' drawings of a monarch butterfly are given in picture 4.

Some of the explanations of the students on monarch butterfly are given below;

"It has beautiful orange wings… Their wings can be yellow or orange". (Annie C.)

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"Their wings are yellow / orange with black on them. They have also antenna and legs". (Georgia M.)

Picture 4. American Students' Pictures of Monarch Butterfly

The American students had positive attitudes toward endangered species and threatened regions. They all believed in protecting endangered species since they are a part of the ecosystem. They also reported that endangered animals should not be hunted because they are limited, they may be extinct in near future and they also have rights to survive like human beings and other organisms. They were against using pesticides in agriculture since uncontrolled pesticide usage may harm species and the environment. They believed in the destructive roles of unplanned industry, and uncontrolled population growth and urbanization. They were against people constructing new buildings in the natural habitats since this would destroy the homes of many animals. They believed in their own abilities to protect endangered species and threatened environments and were willing to participate in a project aiming to protect these species and environments. One of the students said that "I am a girl who has a huge voice. And can tell people what to do" (Caroline W.). The students agreed that every individual needs to do something to protect endangered species because that way the Earth can be improved for the benefit of all living things.

4. Summary and Conclusions

This comparative case-study was carried out with eighty-nine 5th – 7th grade students in four schools from Turkey, Bulgaria, Romania, and the USA. Within the study, students' knowledge, attitudes, skills and behaviours were assessed by making use of more than one data collection instrument. Since most of the data gathered were qualitative in nature, the data were subjected to content analysis. During the project, qualitative data rather than quantitative ones were gathered because it was believed that qualitative data could provide in-depth understanding about students' awareness of endangered species and threatened environments (regions).

As far as students' responses to the knowledge test and their pictures were concerned, it can be concluded that students' identified basic characteristics of the species they investigated. Furthermore, they reported their knowledge of problems threatening the species and biodiversity in the natural areas. However, their knowledge of other endangered species was limited. The number of the species they reported was quite limited.

The major sources that students obtained information about endangered species and natural regions from where their own schools (teachers and classroom instruction), the Unique and Universal Project in which they were involved and the Internet. TV and books were more highly rated by the Bulgarian and American students. However, these two were rated lower by Turkish students. Family, friends and NGOs was not highly rated as information sources by the students. Nearly all of the students reported that classroom instructions and activities were seen as useful sources of information, but textbooks were not seen as including sufficient information about endangered species and natural regions.

The students have positive attitudes toward protecting endangered species and natural regions. They believe in the importance of protection studies to help us know how to sustain the biodiversity in the natural ecosystem. They are against using pesticides in agriculture for increasing the yield. They were against unplanned industry, population growth and urbanization, since they believe that unplanned development can harm the species and can destroy animals' homes and food sources in natural areas. They emphasize the importance of using natural resources cautiously since the resources are becoming less each day. They believe in their own ability to engage in action and take part in projects aiming to find ways to protect these species and natural regions. They suggest other people also do something to preserve the species and natural regions.

Passing new laws to protect the endangered species and natural regions, giving fines to the people who harm the biodiversity in the natural region, and taking the endangered species in the protected / special areas are seen by the students as most effective solutions to protect these species and natural regions. They do not believe that not allowing people to enter these regions is an effective solution. The results of the study revealed the importance of field trips for developing students' awareness of biodiversity in the natural region and ecosystem. Further, the present study shows that if teachers guide effectively during the field trips, students could

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develop their own solutions to the problems threatening the biodiversity in the natural regions. The study also shows that field trips to natural regions could develop students' knowledge on the diversity of the species within the selected region and understanding the interaction among the organisms in the natural processes. Their attitudes could also be developed though effective field trips. For all these reasons, field trips and outdoor studies should be considered as extra-curricular activities and also integrated into the school curriculum. American students did not go to the field trips; instead they used schoolyard for outdoor activities. Their activities further point out that a prototype natural habitat can be created in the schoolyards and then these places can be used as instructional purposes.

5. References

[1] P.D. Leedy and J.E. Ormrod, Practical research: Planning and design (8th ed.), Merrill & Prentice Hall, New Yersey, 2005.
[2] M.Q. Patton, How to use qualitative methods in evaluation, In Newbury Park: CA. Sage, 1987.
[3] M.Q. Patton, Qualitative evaluation and research methods (2nd ed.), CA. Sage, Newbury Park, 1990.
[4] R. Yerkes and K. Haras, Outdoor Education and Environmental Responsibility, (ED414 112, ERIC Document reproduction service), 1997.
[5] R. Howe and J. Disinger, Teaching Environmental Education Using Out-Of-SchoolSettings And Mass Media, ERIC/SMEAC Environmental Education Digest Nº. 1. Washington, DC: Office of Educational Research and Improvement (ERIC Document Reproduction Service Nº. ED 320 759), 1988.
[6] I.E. Palmberg and J Kuru, Outdoor Activities as a Basis for Environmental Responsibility, Journal of Environmental Education, 31 (4), 32-37, 2000.

Amelioration of Acidic Soils: School Experiments with Colour Indicators Demonstrating Cation and Anion Exchange Effects in Acid Soils

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Abstract. A concept has been developed of solving theoretical problems of applied natural sciences by means of the method of "learning by doing" on the basis of simple lab experiments for schools. Appropriate mixtures of brown coal ash and flue gas desulphurisation gypsum (FGD gypsum) were tested regarding their ability to improve acid soils. The essential positive effects on acid soils may also be demonstrated with mobile lime forms like combinations of calcium hydroxide $Ca(OH)_2$ and calcium sulphate $CaSO_4$.

Figures : Simple experiments carried out by students
1.Exchange of cations on acidic soils
Humus and loam (Lehm) probes were suspended in water (left) and saturated calcium sulphate solution (right) in the presence of the indicator bromic cresol green. Filtrates are demonstrated in test tubes.
The experiment clearly shows that the pH value is decreased, if acidic soils are treated with calcium sulphate. In this case calcium cations replace protons from the surfaces of acidic soils and release soluble acid into the soil water.

salt-effect with gypsum in the presence of bromic cresol green

2. Exchange of anions on acidic soils ("Self-Liming-Effect")
Humus and loam (Lehm) probes were suspended in water, potassium chloride and potassium sulphate solutions (left to right). Concentrations were equimolar for potassium ions c(KCl) = 1 mol/l and $c(1/2\ K_2SO_4)$ = 1 mol/l. Filtrates are demonstrated in test tubes.

The experiment clearly shows that the decrease of pH value is high (middle) in combination with the chloride and low with the sulphate salt. Since the cation exchange effect caused by potassium ions is the same in both cases the difference is due to anion effects. In contrast to chloride anions sulphate anions manage to replace hydroxide anions from the soil surface leading to an higher pH value in the soil water (Self-Liming-Effect) in the case of potassium sulphate salts or alternatively saturated gypsum suspensions.

salt-effect with potassium chloride and potassium sulphate in the presence of bromcresol green

left side humus, right side loam
test tubes in the following order: left control with water, middle with potassium chloride, right with potassium sulfate

The combination of both allows to improve soils to a nearly constant pH-value of the soil water. The ion exchanges easily can be demonstrated by use of acid-base indicators. The cation exchange, calcium Ca^{2+} against protons H^+, always leads to a decrease of the pH-value and the anion exchange, sulphate SO_4^{2-} against hydroxide $2OH^-$ ions to an increase

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of the pH- value of the soil water ("Self-Liming-Effect").The pH-value always is decreased if acidic soils are treated with neutral salts like calcium sulphate $CaSO_4$, because calcium cations Ca^{2+} replace protons $2H^+$ from the soil surface. In addition the exchange of anions in acidic soils has been demonstrated by comparing probes of humus or loam in soil suspensions at equimolar potassium ion concentration: c(KCl) = 1 mol L^{-1} and c(1/2 K_2SO_4) = 1 mol L^{-1}. The decrease of the pH-value was higher in probes with the chloride Cl^- and lower with the sulphate SO_4^{2-} salt because sulphate SO_4^{2-} anions in contrast to chloride anions Cl^- manage to replace hydroxide anions from the soil surface as has been shown by the use of the indicators bromic cresol green or methyl red.

Keywords. Hands-on, Chemistry, Biology.

Between Deficiency and Abundance: School Experiment to Demonstrate the Ambivalence of Environmental Relevant Compounds Like Nitric Acid HNO_3 by Demonstrating the Concentration- Dependent Effect on Plant Growth

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Abstract. It is a component of an environmental educational concept to realize the fact that the quantity constitutes the poison (Paracelsus) and that conditions are essential. The cognition that nitrogen, which is needed by all living organisms, may be harmful means a cognitive conflict. The solution of this conflict requires an appropriate understanding of the ambivalence of compounds and materials in the environment. In principle they are neither utilizable substances nor pollutants. It always depends on conditions and circumstances. It is important for a scientific instruction at school to realize that this can be pointed out and confirmed by practical examples and experiments. For instance it may be shown that the resulting effect of the addition of nitric acid HNO_3 to cultures of germinating cress seedlings depends on the quantity, that too much or too little may be disadvantageous and that there is an optimum with c(HNO_3) = 10 mmol L^{-1} Serious environmental problems like acidification of soils and the forest decline have been explained with the formation of strong acids like nitric acid HNO_3 in the atmosphere. Consequences may be deficiencies of minerals like Ca^{2+}, Mg^{2+} or trace elements like selenium, molybdenum, zinc and others as a result of acidification and elution of soils and the over fertilization with plant available nitrogen. The phenomenon of eutrophication of environment which leads to a loss or decrease of biodiversity is essentially based on an excess of plant-available nitrogen, which results particularly from ammonia NH_3 or from nitrogen oxides.

These gases are transferred by the airway into ecological systems and after oxidation as nitric damage acid forest and agricultural soils and habitats.

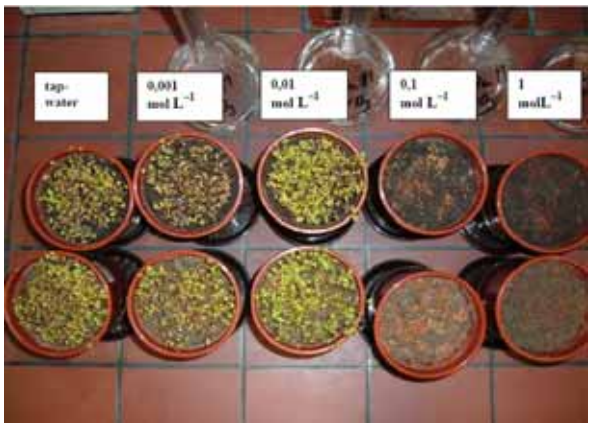

Figure 1. Effects of nitric acid HNO_3 on germinating cress seedlings: From left to right: Plants after application of tap-water, 1 mmol L^{-1} HNO_3, 10 mmol L^{-1} HNO_3, 100 mmol L^{-1} HNO_3 and finally 1 mol L^{-1} HNO_3

The optimum is near the concentration of 10 mmol L^{-1} HNO_3. Upper row: cress seedlings growing on sandy soil. The row below: the same on a loess - loamy soil.

Keywords. Hands-on, Chemistry, Biology.

5th International Conference on Hands-on Science
Formal and Informal Science Education
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Experimental Contribution to Climate Protection: Attempts and Problems with the CO_2-Capture by Ammonia

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Abstract. The climatic topic moved into the foreground of public and scientific interest. Because of the fact that fossil fuels, above all coal and natural gas, are indispensable sources of energy, all efforts arrange themselves on realizing the CO_2- free power station in future. CCS (Carbon-Capture-Storage) - power stations which bind the CO_2 from the flue gases and dispose it into the underground are favoured as future model and tested intensively. If school wants to participate in problem solutions it is interesting to ask how carbon dioxide CO_2 can be fixed from the incineration gases. For this aim simple concepts and model experiments are useful.

Figure 1: Approach of combination of carbon dioxide CO_2 with ammonia NH_3 in the presence of water H_2O. The question was: Is it possible to get crystalline ammonium carbonate $(NH_4)_2CO_3$ salt, which can be precipitated and transported? The answer is that it is not so easy, since water is needed for the reaction

The main target is to learn a responsible human acting in relation to environment and climate. In this context the question arises, why one cannot capture the CO_2 with ammonia NH_3 under production of ammonium carbonate $(NH_4)_2CO_3$ as a solid salt. Therefore it was examined whether ammonia forms the solid salt ammonium carbonate together with water and carbon dioxide by the reaction: $2NH_3 + H_2O + CO_2(NH_4)_2CO_3$ or $2NH_4OH + CO_2$ $(NH_4)_2CO_3 + H_2O$. For these reactions water molecules are required in stoichiometric quantities. The technical implications how water may be applied in an appropriate form are discussed. Is it for example possible to eliminate CO_2 from flue gas with dispersed saturated ammonia solutions in water? According to this concept clean CO_2 may be set free from the ammonium carbonate $(NH_4)_2CO_3$ salt by the addition of sulphuric acid H_2SO_4 and the formation of ammonium sulphate $(NH_4)_2SO_4$.This salt can be decomposed by heat into ammonia NH_3 and sulphuric acid H_2SO_4. Both products may be recycled into the proposed process.

Keywords. Hands-on, Chemistry, Biology.

Respiration and Photosynthesis in Context: Experiments Demonstrating Relationship between the Two Physiological Processes

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Abstract. Plants are living organisms. But this fact is not so easy to recognize, because plant life cannot be seen by the naked eye and takes place in the secret. How can one find out for instance that there is life into branches or roots? This will be shown to children by simple experiments with the indicator bromthymol blue, which changes the colour from blue to yellow within one hour during respiration. Additionally to the use of indicators the fact that respiration and photosynthesis are opposite physiological processes can be demonstrated by an experiment measuring the electric potential between the respiration of peas and the photosynthesis of aquatic plants (*Elodea canadensis*) connected together with a voltmeter. The oxygen consumption during respiration develops a minus (-) pole and the oxygen production during photosynthesis a plus (+) pole. The context of respiration and photosynthesis was extended on the basis of other biological examples: respiration and photosynthesis in ecological systems, in a plant cell, in lichens, in plant galls and in leafs of horse-chestnut (*Aesculus hippocastanum*) after infestation with larvae of the moth *Cameraria ohridella*. The structural and the functional aspects of the relationship between respiration and photosynthesis have been introduced by the comparison of branches with crust pores ("lenticells") on the surface like elder (*Sambucus)*, hazel (*Corylus)* or golden bell (*Forsythia*) with green branches of such shrubs which do not have crust pores (*Kerria japonica*, rose or bamboo). In the first case branches take up the oxygen for respiration by the pores and in

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the second case the oxygen is supplied by photosynthesis of the green parts of the plant.

Keywords. Hands-on, Chemistry, Biology.

1. Introduction

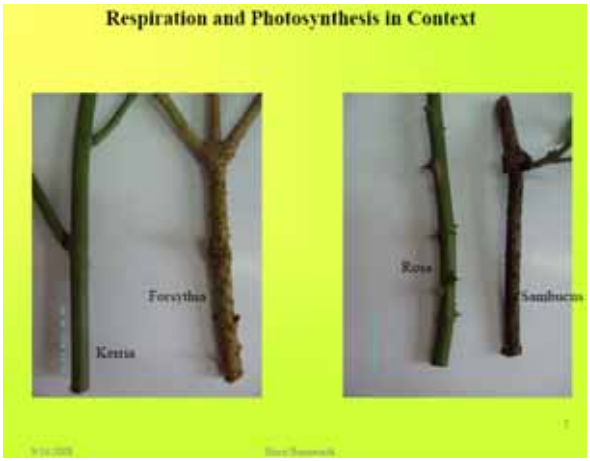

Figure 1. Relationships concerning structure and function of photosynthesis and respiration. Green branch pieces without crust pores ("lenticells") of Jews mantle (*Kerria japonica*), *left, or* Rose (*Rosa spp.*), right, were compared with grey or brown pieces of branch of Golden Bell (*Forsythia spp.*), left, or Black Elder (*Sambucus nigra*), right, with crust pores ("lenticells"). In every case the green photosynthesizing plant parts had no crust pores while the respirating parts showed a lot of "lenticels" (Table1)

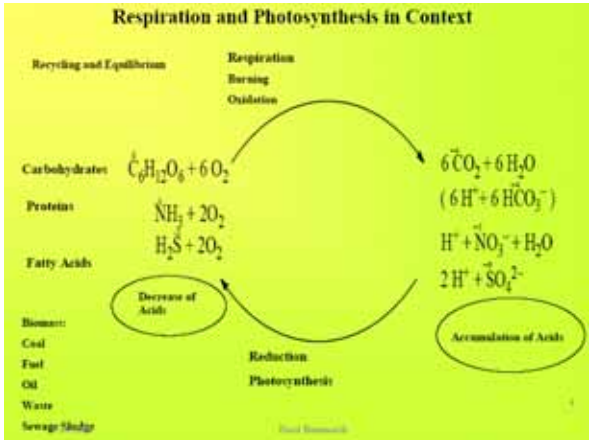

Figure 2. Photosynthesis and respiration in context Photosynthesis and respiration represent chains of redox – reactions in a steady state or in a dynamic equilibrium running in opposite directions. During photosynthesis carbon, nitrogen and sulphur are reduced and acid (H+-ions) are consumed. During respiration carbon, nitrogen and sulphur are oxidized an acid is produced. This leads to an acidification of the environment. Burning augment this process. This means that burning should be reduced and photosynthesis reinforced by human actions

The most important metabolic processes in living organisms are respiration and photosynthesis (Bannwarth and Kremer, 2008). Both are interconnected in many ways (Figure 2). In a single plant cell, in lichens (Figure 10), in plant galls (Figure 11), in natural habitats and in ecosystems they are united in complex biological systems. At school photosynthesis and respiration often are taught separately. But on the other hand they belong together and one should not forget that they are correlated. The emergence concept of modern biology means that the whole, intact and complete system is more than the sum of the parts. From these considerations one may conclude that photosynthesis and respiration should be introduced in context (Bannwarth et al., 2007). This may be done in schools with the classic Priestley-experiment, but the problem is, that this experiment cannot be carried out in schools because one should not let die animals by this way (Figure 9).

On the other hand animals are able to dissimilate and plants to assimilate in different separate organisms in natural habitats. In addition photosynthesis and respiration are opposite physiological pathways separated in isolated compartments like chloroplasts and mitochondria and maintain a metabolic equilibrium in a steady state in a plant cell. Chloroplasts and mitochondria have common features according to the endosymbiotic theory of evolution. They are surrounded by a double membrane layer and are able to synthesize ATP using a proton gradient after accumulation of protons between these two membranes according the concept of Peter Mitchell (Figure 7). Halobacteria similarly transport protons outside the outer cell membrane comparable to chloroplasts and mitochondria. This outer membrane corresponds to the inner membrane of chloroplasts and mitochondria (Figure 8).

We will present here an experiment showing the decrease of the pH - value in the surrounding medium when halobacteria are exposed to light. The acidification is due to the light driven proton transport from inside to outside.

Both physiological processes, photosynthesis and respiration, are not visible and only in the rarest cases detectable by our senses. The physiology knows however informative and elucidating experiments, which permit to make important aspects of such life procedures visible.

Since photosynthesis and respiration both are opposite pathways their effects may be compensated in some situations. In this case one cannot expect to detect any change of an indicator colour in the surrounding medium of a water plant. Alternatively photosynthesis and respiration can easily be studied together in a

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combination of a photosynthesizing O_2 producing system with an O_2 consuming system (Figure 6) by a simple experiment measuring the electric potential between both (Bannwarth and Kremer, 2007)

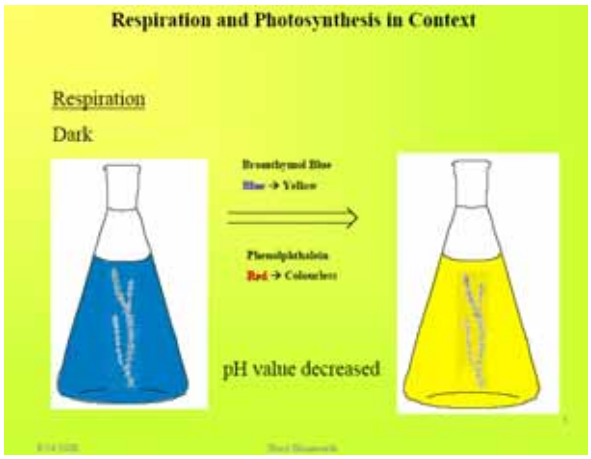

Figure 3. Respiration of plants. The production of acid (Figure 2) during respiration can be demonstrated by the use of indicators. For instance bromthymol blue changes the colour from blue to yellow

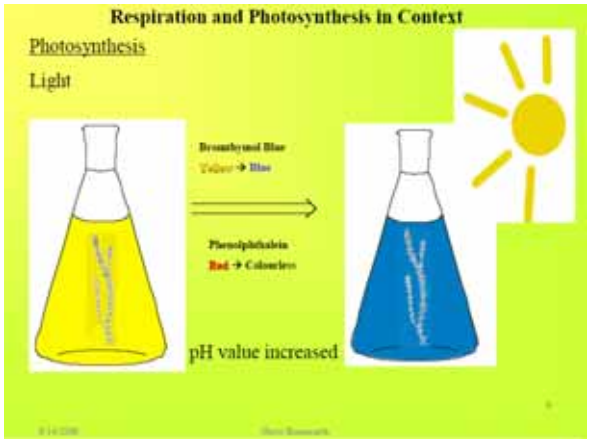

Figure 4. Photosynthesis of plants. The consumption of acid during photosynthesis of plants can also be demonstrated by the use of the same indicator. But in this case the colour of bromthymol blue changes from yellow to blue in the presence of light

2. Methodology

Results may be obtained by experimenting, by observing, comparing and combining. At first some experimental approaches will be presented and later on further expanding aspects will be included into the consideration in order to elucidate the importance and advantage of the view of seeing photosynthesis and respiration in context.

2.1.1. Respiration of organisms: Base process of life

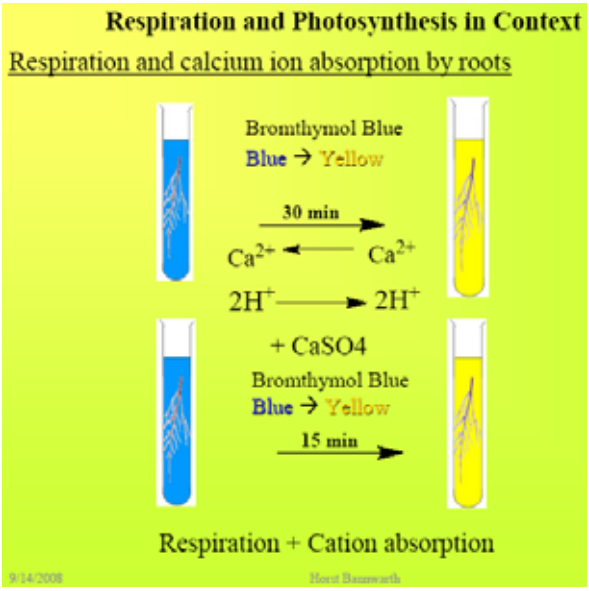

Figure 5. Roots: Respiration and cation exchange. Respiration of roots with and without the addition of gypsum CaSO4.During respiration the pH value is decreased since carbonic acid CO2 or H2CO3 is produced. This decrease is indicated by the change of the colour of the indicator. It is faster in the presence of CaSO4.This is due to the exchange of Ca2+-ions against H+-ions or protons by the plant roots

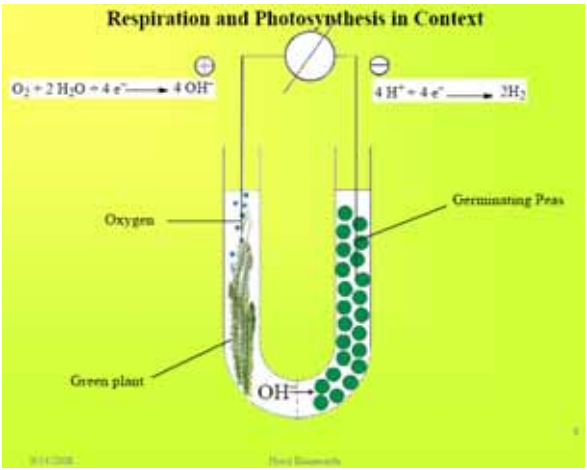

Figure 6. Photosynthesis and Respiration interconnected: Electric potential measurement. Experimental combination of photosynthesis (left) with respiration (right).Photosynthesizing water plants produce oxygen O2 and respirating peas consume oxygen O2. By this reason on the left side a plus pole and on the right side a minus pole is developed

Questions: How can one show that something lives? Is there for instance life in branch pieces of shrubs in the winter time (Figure 1)? Do plant roots live (Figure 5)? *Material:* 2 measuring cylinders 250 ml - Erlenmeyer flasks, 50 ml and 250 ml - Short test tubes – Drinking straw.

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Chemicals: 1 L of saturated gypsum (calcium sulphate $CaSO_4$) solution coloured with bromthymol blue (0.1% in 20% ethanol) or phenolphthalein (1% in ethanol): Adjust the pH value with a NaOH-solution, c(NaOH) = 0,01 mol L^{-1}, in such a way that the colour change takes place immediately from yellow to blue or from red to colourless with minimal acid addition. Therefore solutions should be added drop by drop!

Test objects: Roots of the wild flower plants from gardens, tufts of grass, Petty Spurge (*Euphorbia peplus*) or Annual Mercury (*Mercurialis annua*). The plants are loosened with root with the help of a small grave shovel carefully from the ground and washed off afterwards with tap water. - Finger-long grey, brown or red branch pieces of Black Elder (*Sambucus nigra*), Red Dogwood (*Cornus sanguinea*) with crust pores ("lenticells") as well as green branch pieces of Golden Bell (*Forsythia spp*.), Jews mantle (*Kerria japonica)*, Blackberry (*Rubus fruticosus*) or Rose (*Rosa spp.*) without crust pores ("lenticells").

All branch pieces were well washed with tap-water before the experiment.

Procedure: The plants are given to the measuring cylinder filled with test solution with their roots. The branch pieces are also placed in test tubes with test solution. A measuring cylinder with test solution without plants serves as control. One also can place recognizably dead branch pieces or roots into the solutions for comparison.

The results with the branch pieces are noted in a table, where the colour of the branches, the occurrence of crust pores or "lenticells" and the time until colour change is registered. Subsequently, one can give the comparison solutions in Erlenmeyer flasks and blow with the help of a drinking straw carefully to exhaust bubbles into the solutions (Figure 1).

2.1.2. Respiration and photosynthesis: A cycle as in nature

Question: Respiration and photosynthesis are the most important physiological life processes in nature. They are opposite running pathways, so that they can be joined to a cycle (Figure 2). Thus oxidants (O_2) are consumed by respiration and set free again by photosynthesis. The opposite direction of both processes may be demonstrated by indicator changes or with the help of a potential measurement in the following experiment. How may be demonstrated in a model experiment based on the consumption and formation of oxidizing agents (oxygen O_2) that respiration and photosynthesis are included in a natural cycle (Figure 6)?

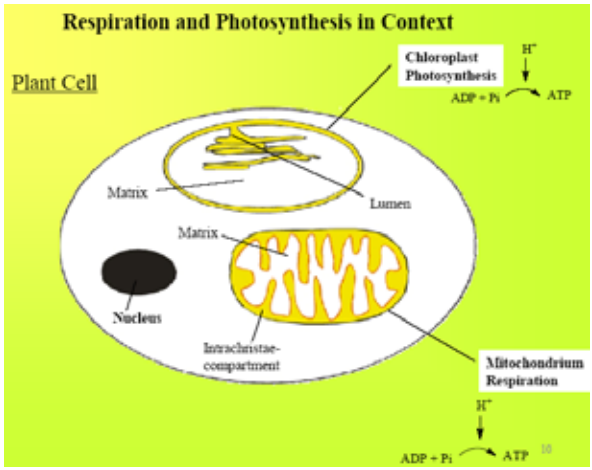

Figure 7. Chloroplasts and mitochondria: Compartments and ATP synthesis. Protons are pumped by the kinetic energy of the moved electrons into the gap between the two membranes (lumen of the thylacoids) in chloroplasts and in mitochondria and cannot be detected therefore in the external medium. This can be done with halobacteria. During the reflux of protons ATP is synthesized according to the chemiosmotic theory

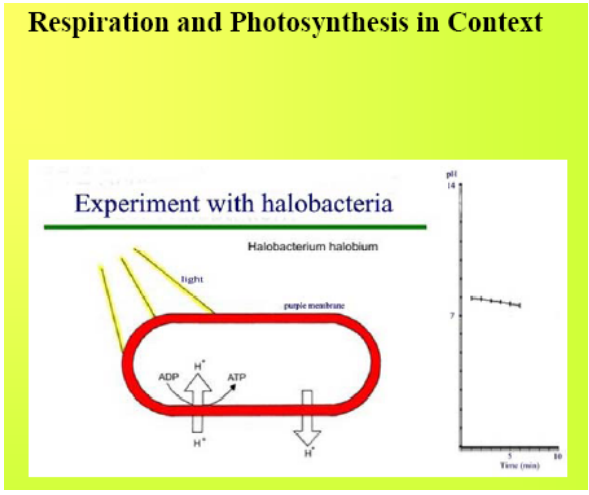

Figure 8. Halobacteria: Light driven proton transport. Under the effect of the light electrons are moved. With the kinetic energy of electrons protons are exported from the cells of the halobacteria (light - driven proton transport).Thus the concentration of hydrogen ions (H+-ions) rises in the medium and the pH value decreases. During the reflux of protons ATP is synthesized (left). The light driven proton transport in halobacteria corresponds to the light driven proton transport in chloroplasts in eukaryotic plants. The pH value drops slightly with illumination of the culture containing halobacteria in the course of 1 hour (right)

Material: Voltmeter - Measuring clips (alligator clips) with cables - U-bend with porous glass -frit - Graphite electrodes - Lamp (200-250 Watts).

Chemicals: Sulphate - rich mineral water (mineral water).

Test objects: For respiration: germinated

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seeds, e.g. peas (*Pisum sativum*) in mineral waters or alternatively yeast suspension *(Saccharomyces cerevisiae*) in glucose solution (1%). For photosynthesis: Aquatic plant, e.g. Canadian waterweed (*Elodea* spp.) in mineral waters.

Procedure: Respiration is prepared in the left part of the U-bend, photosynthesis in the right part. Connect the voltmeter and note the voltage levels. After 10 min the photosynthesis is started by exposition with the light of a lamp.

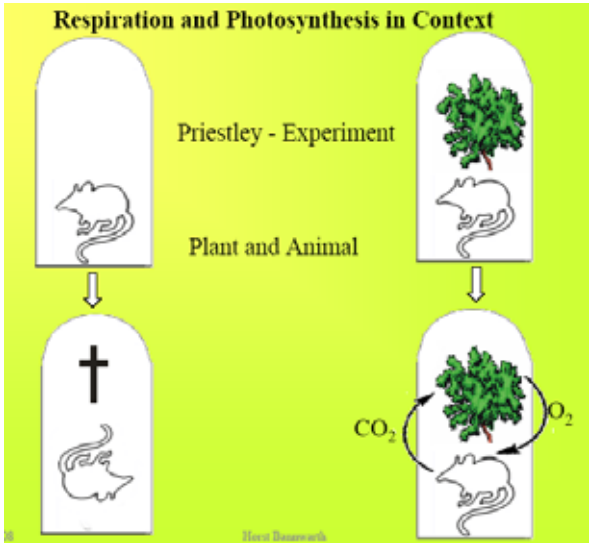

Figure 9. Priestley-experiment. Joseph Priestley (1733 - 1804) described the dependency of animal life from plant metabolism by simple experiments. This experiment is often used in schools for the introduction of the relationship of photosynthesis and respiration in order to clarify the dependency of heterotrophic animals and autotrophic plants from each other. The disadvantage of this approach according to Priestley is that this experiment cannot be carried out in schools. (see the text)

2.1.3. Sun and life: light driven proton transport by halo bacteria

Question: Life needs necessarily energy of the sun. This energy is first taken up by plants. The primary step is the transformation of light energy into electric energy in certain biomembranes, which contain photoreceptors (e.g. chlorophyll). The moved electrons provide the operating proton pumps with energy. By this light-driven proton transport H^+-ions are transported outward into the surrounding medium. The resulting proton gradient at the external membranes is used to synthesize ATP (chemiosmosis). How can the light driven proton export in the external medium be experimentally demonstrated*?*

Material: pH value measuring instrument with electrode for automatic recording (e.g. Cassy system, pH box No. 524035, Leybold,Hürth,Germany) - 250 ml Erlenmeyer flasks – graduate measuring pipette 5 and 10 ml.

Chemicals: 1L saline solution, c(NaCl) = 4 mol L^{-1}.

Test objects: Suspension culture of halobacteria (*Halobacterium halobium*) in 4 mol L^{-1} solution of common salt NaCl or alternatively suspension culture of blue bacteria

(blue-green "algae ", cyanobacteria) in tap - water. Procurement reference: One may get Halobacteria from journeys to salt lakes (e.g. Dead Sea), but also from research institutes (look into the Internet).

Procedure: As much material is given with a pipette from the halobacteria stock culture to an Erlenmeyer flask filled with saline solution that straight all light is absorbed. The cells from halobacteria are illuminated with a lamp. The pH value is measured in the medium by an electrode connected with an instrument for graphical registration. The measured values are noted and the measuring curve is projected to the wall (Figure 8).

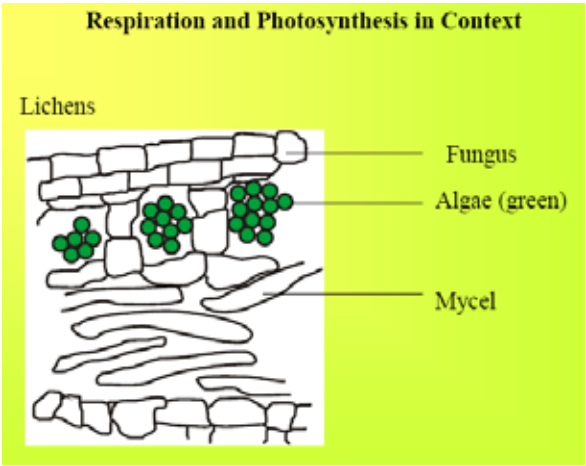

Figure 10. Lichens - symbiosis between alga and fungus. The heterotrophic organism in this case is the fungus which provides carbon dioxide and obtains vice versa oxygen and organic compounds from the autotrophic alga. The alga on the other hand is protected by the fungus by retaining water and keeping wet. Photosynthesis of algae and respiration of fungus are integrated in a living system

3. Results

3.1. Experiments

3.1.1. Respiration of organisms: Base process of life

Observation: Within 1 h, often already after approximately 20 min, it may be observed a clear colour change of blue to yellow with bromthymol

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blue and of red to colourless with phenolphthalein in direct proximity of the roots or the branch pieces. With the green branches (Jews mantle, Rose or Blackberry) the colour change takes place later than with branches with "lenticells". The colour change is substantially faster, if one gives breathing air with a drinking straw to the solutions.

Explanation: In all cases acid is excreted over the surface by the living plant parts.

To a large extent this is due to carbonic acid or carbon dioxide, which is set free by the respiration. Additionally in the calcium sulphate solutions Ca^{2+} -ions were exchanged against H^{+}-ions. Thus the colour change takes place more rapidly in solutions with calcium sulphate salt (Fig5).The green branches produce fewer carbon dioxide (CO_2) quantities than the branches with crust pores. Partially photosynthesis may compensate the respiration effect. The crust pores ("lenticells") are to be interpreted as structures in connection with the respiration and the gas exchange (structure function relationships in biology). As respiration and ion exchange are physiological processes, these experiments are suitable for the demonstration of life phenomena. The experiment with the exhausted air bubbles points out the comparison of human respiration with the respiration of plants and underlines the importance of the respiration for all organisms including humans.

3.1.2. Respiration and photosynthesis: A cycle like in nature

Observation: An electric potential is to be determined between both sides, which increases due to the living processes of the participating organisms during the experiment. When photosynthesis is started a clearly stronger change of the measured electric potential is observed.

Explanation: The oxygen on both sides is differently used by the respiration. Therefore the output potential begins to change. When photosynthesis is started oxygen is produced, so that on the side of the photosynthesis a positive pole develops. In the respiration part the oxygen dissolved in the water is consumed. This may be the onset of fermentation and perhaps even reducing agents (H_2S, NH_3) may appear. Thus a negative pole forms. The changes of the potential are therefore direct consequences of physiological events. They are based on physiological processes such as oxygen consumption and oxygen production (Figure 6).

3.1.3. Sun and life: light driven proton transport by halo bacteria

Observation: It is recognizable from the course of the curve that under illumination the pH value drops slightly within 1 hour.

Explanation: Under the influence of light electrons are moved (see solar - pocket calculators). With the kinetic energy of the electrons protons from the cells of the halobacteria are exported (light - driven proton transport).Thus the concentration of hydrogen ions (H^{+} -ions) rises in the medium and the pH value decreases (Figure 8). It may be of interest to emphasize that the pH value in the external medium rises with the photosynthesis of eukaryotic green plants and algae in contrast to the situation of halobacteria because of the consumption of carbon dioxide or carbonic acid and other acids. On the other hand in eukaryotic plants the light driven proton transport in chloroplasts corresponds to the light driven proton transport in halobacteria. In chloroplasts the protons are pumped into the gap between the two membranes (lumen of the thylacoids) and therefore cannot be proven in the external medium.

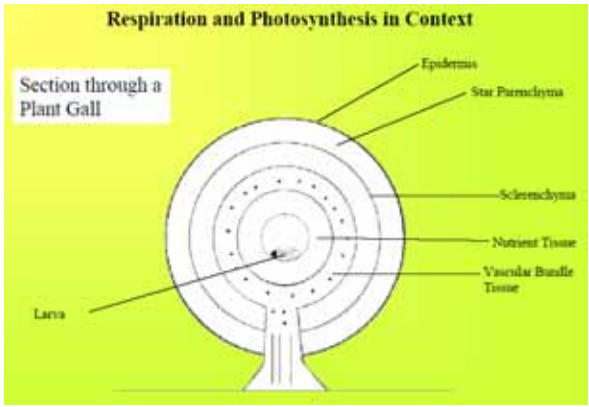

Figure 11. Plant galls - cooperating organisms. The advantage is clearly on the side of the insect larva. It is uncertain that the tree leaf profits from hosting the insect. But it should be emphasized that this is not a parasitic relationship because the insect larva does not normally damage the leaf of the tree. Moreover the plant offers all the animal needs for life and development. This situation is completely different from a parasitic relationship, especially since the plant supports and sustains the foreign animal organism and does not attack it. In this case plant photosynthesis and animal respiration are integrated in an emergent biological system

4.1. Discussion: comparison and combination

The relationship of photosynthesis and respiration is introduced in school books by the

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well known Priestley experiment (Figure 9). Here a new approach arising from a direct observation on the living object is offered. The comparison of branches with and without crust pores and the colours of the epidermis lead to a better understanding of structure-function relationships of plant surfaces adapted to photosynthesis or respiration (Tab.1). In most cases the green branches of shrubs did not have crust pores and in contrast to this observation crust pores occurred on brown, red or grey coloured branches. The conclusion is that green parts maintain photosynthesis and obtain the oxygen by this way and that the others get the oxygen through the crust pores from the air.

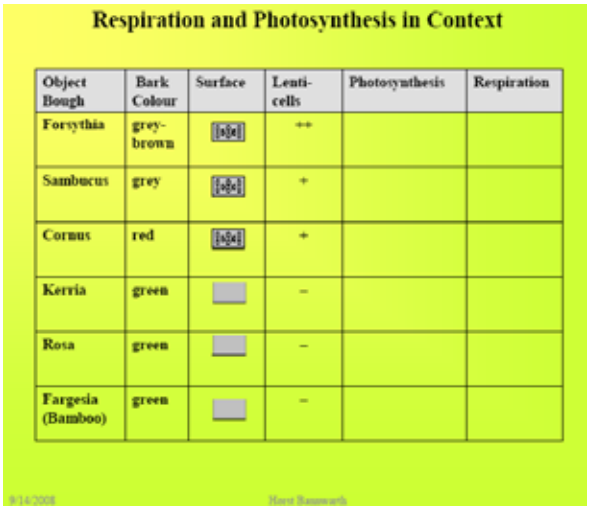

Table1. Survey of properties of selected shrub branches with and without crust pores. The table demonstrates, that objects without crust pores have a green surface and should be able to perform photosynthesis and to produce oxygen O2.The others which are not green show crust pores. In this case the oxygen is taken up by the pores from the surrounding air

The fact that respiration and photosynthesis are opposite physiological processes can be demonstrated by simple experiments with the indicator bromthymol blue (Figure 3, 4, 5).

In our hands it changes the colour from blue to yellow within 1 hour during respiration of whole plants or plant roots (Figure 5). One can accelerate this change by the addition of calcium sulphate $CaSO_4$ because of cation exchanges between the plant surface and the medium. The opposite colour change from yellow to blue occurs when plants perform photosynthesis (Figure 4).

In addition to the use of indicators the electric potential between respirating peas and photosynthesizing aquatic plants (*Elodea canadensis*) was measured with a voltmeter. The oxygen consumption during respiration develops a minus (-) pole and the oxygen production during photosynthesis a plus (+) pole (Figure 6).

The context of respiration and photosynthesis may be extended on the basis of other biological examples: respiration and photosynthesis in ecological systems (Figure 2), in a plant cell (Figure 7), in lichens (Figure 10), in plant galls and in leafs of horse-chestnut (*Aesculus hippocastanum*) after infestation with larvae of the moth *Cameraria ohridella*. These examples show clearly the photosynthesis and respiration in context in addition to well known experiments with plants and other organisms (Beller,1985; Prat,2007).

5. Conclusions

1. Instructions about photosynthesis and respiration can be combined by simple experiments.
2. By these experiments it could be clarified that both are opposite physiological processes.
3. The idea of emergency in the modern natural sciences is promoted by the concept of regarding photosynthesis and respiration in context.
4. Structure-function-relations of photosynthesis and respiration may be better understood by a common treatment.
5. The inclusion of chemical and physical aspects into a new concept of emergence may favour the biological understanding.

6. References

[1] H. Bannwarth, B.P. Kremer and Vom Stoffaufbau zum Stoffwechsel, Schneider Verlag Hohengehren, Baltmannsweiler, 2007.

[2] H. Bannwarth, B.P. Kremer and A. Schulz, Basiswissen Physik, Chemie und Biochemie. Springer Verlag, Heidelberg, 2007.

[3] H. Bannwarth and B.P. Kremer, Pflanzen in Aktion erleben. Schneider Verlag Hohengehren, Baltmannsweiler, 2008.

[4] J. Beller, Experimenting with plants Projects for Home, Garden and Classroom. Arco Publishing, New York, 1985.

[5] R. Prat, Expérimentation en Biologie et Physiologie Végétale. Hermann Editeurs, Paris, 2007.

 ISBN 978-989-95095-3-5

The Use of Everyday Life Problems in Secondary Education: How to Boil an Egg

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Abstract. The main didactic aim is the understanding of scientific concepts by secondary level pupils. Working with household applications provides a way to our students to become accustomed to problem-solving processes and scientific methods from an early age.

Problem-solving processes are related, most of the times, to modelling processes. A proper model of a physical system must be simplified, so it can be understood by our pupils. Nevertheless, the model must maintain the basic characteristics of the physical system. Questions given to the pupils should require their full attention to the experimental process. At the end of the experiment they must be in the position to check if their answers correspond with the results of the experiment. Therefore, questions related to everyday life activities help the pupils in learning to apply scientific laws and procedures in different situations.

Keywords. Everyday life, Hands-on.

1. Introduction

The question to the practical problem analyzed in this paper is:

How long does it take to boil an egg?

To answer that is not so simple. The answer depends on:

- Factors that determine the heat dissemination to the interior of the egg (heat conductivity of the egg)
- The chemical structure of the egg
- The relationship between the temperature and the structure of the protein of the egg.

We give a fairly simple model of the egg to the pupils in order to inspire them to work with:

- Modelling of physical systems
- The theory related to the experiment
- Comparison of the theoretical prediction with the experimental data
- Calculations and diagrams
- The New Technologies

We simplify the geometry of the egg (we consider it to have a cubic shape) and we make certain assumptions about the egg's density and thermo physical properties. In such a way, we end up with a fairly simple mathematical formula. The formula refers to the change of the egg's structure according to the temperature's change in the interior of the egg placed in boiling water.

The outcome is the graph of the temperature inside the egg versus the time. The graph is plotted automatically on the computer screen using temperature sensors. The pupils compare the experimental data with the theoretical hypothesis.

We formed two groups: a control group and an experimentation group. Both groups were taught the theory of thermo dynamics, but only the experimentation group carried out the small experimental activities we designed: boiling eggs in water. During the experimental procedures pupils in the experimentation group solved all kinds of practical-technical problems.

At the end of the school year we gave a test to both of the groups. The results were encouraging. Carrying out experiments like the one described in this paper, has raised the interest and led to better results for our students. The work will be continued the next school year.

2. Design and procedure

A. THE EVERY DAY LIFE PROBLEM – OBSERVATION – INITIAL FORMULATION

Experiments that demonstrate basic laws of physics, using household items, have certain advantages. Students become familiar with the process of simplification of the everyday life problems. The purpose here is that our secondary level pupils develop the ability to choose the characteristics of the real phenomenon which are necessary in the simplified model. The initial formulation of the problem could be as following: "**Place an egg mass M in the boiling water at a temperature Θ_{water} (which remains stable). How is the temperature inside the egg changing?"**

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B. CONSTRUCT THE HYPOTHESIS

We consider the following assumptions:

1. The material of the shell of an egg is homogeneous with a density of ρ, specific heat c and thermal conductivity k.

2. The egg is a cube. It is placed in boiling water. The heat from the boiling water spreads to the interior of the egg by its six sides of length L (simplification of the geometry of the egg).

3. The egg is in thermal equilibrium with the environment (i.e. the interior of a refrigerator or the room). Initially all its mass is in temperature Θ_{egg}.

4. Within a time interval τ, heat amount Q is transferred from the environment (boiling water) to the interior of the egg. The temperature inside the egg grows and reaches in the centre of the egg the value Θ_{yolk}

3. Applying the Physics laws

We assume that the final temperature of the whole egg is equal to the temperature of boiling water. The relationship between heat and temperature change is:

$$Q = M \cdot c \cdot (\Theta_{water} - \Theta_{egg})$$

We apply the Fourier law of conduction. It states that the rate of heat flow, $\Delta\mathbf{Q}/\Delta\mathbf{t}$, through a homogenous solid is directly proportional to the area, **A**, of the section at right angles to the direction of heat flow, and to the temperature difference along the path of the heat flow,

$$\frac{Q}{\tau} = \frac{\Delta Q}{\Delta t} = k \cdot \left(\frac{\theta_{water} - \theta_{yolk}}{\frac{L}{2}} \right) \cdot A$$

$\theta_{water} - \theta_{yolk}$

4. Hypothesis

Assuming that the rate of heat transfer is stable, we can write:

$$\tau = \left(\frac{1}{12} \right) \cdot \left(\frac{M.c}{k \cdot L} \right) \cdot \left(\frac{(\Theta_{water} - \Theta_{egg})}{\left(\Theta_{water} - \Theta_{yolk} \right)} \right)$$

At the equation above we replace the quantity: (mass) with: ((density) *(Volume)). Thus:

$$\tau = \left(\frac{1}{12} \right) \cdot \left(\left(\frac{\rho \cdot C}{k} \right) \cdot L^2 \right) \cdot \left(\frac{(\Theta_{water} - \Theta_{egg})}{\left(\Theta_{water} - \Theta_{yolk} \right)} \right)$$

In other words, the time required to reach the egg a certain temperature depends on:

- The initial Θ_{egg} and the final temperature of the egg Θ_{yolk}
- The temperature of the boiling water.
- One of the basic quantities in Thermodynamics: the thermal diffusivity

$$\alpha = \frac{k}{\rho \cdot C}$$

The thermal diffusivity *α* is expressed by the ratio of k, the coefficient of thermal conductivity, over the product of the density times the specific heat (ρC). Substances with high thermal diffusivity rapidly adjust their temperature to that of their surroundings, because they conduct heat quickly and they don't need a lot of heat to adjust to this temperature. This quantity is almost the same for all eggs.
- The geometric characteristics of the egg. The assumption here is that the egg has cubic shape. This is we multiply with the 1/6.
- The dimensions of the egg. We consider that the cross section A is proportional to L^2. So for two eggs of different sizes i.e. L_1 and L_2:

$$\tau_1 = \left(\frac{1}{12} \right) \cdot \left(\left(\frac{\rho \cdot C}{k} \right) \cdot L_1^2 \right) \cdot \left(\frac{(\Theta_{water} - \Theta_{egg})}{\left(\Theta_{water} - \Theta_{yolk} \right)} \right)$$

$$\tau_2 = \left(\frac{1}{12} \right) \cdot \left(\left(\frac{\rho \cdot C}{k} \right) \cdot L_2^2 \right) \cdot \left(\frac{(\Theta_{water} - \Theta_{egg})}{\left(\Theta_{water} - \Theta_{yolk} \right)} \right)$$

Thus:

$$\frac{\tau_1}{\tau_2} = \frac{L_1^2}{L_2^2}$$

Note: In the equation above, we consider that the internal temperature of the eggs is the same.

C. TEST THE HYPOTHESIS

We try to get our pupils familiar with the test of the assumptions in Science. In the process of stating the main hypothesis of the work

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presented here, we had to make different assumptions. For example one assumption is:

"All eggs have approximately the same density"

To verify the above assumption the pupils:

- Designed small experiments to test the assumption.
- Carried out the measurements.
- In the process, they have used eggs of different size.

D. VERIFYING THE HYPOTHESIS

To verify equation (3) we should measure the time intervals needed for the temperature inside two different eggs to reach a certain value.

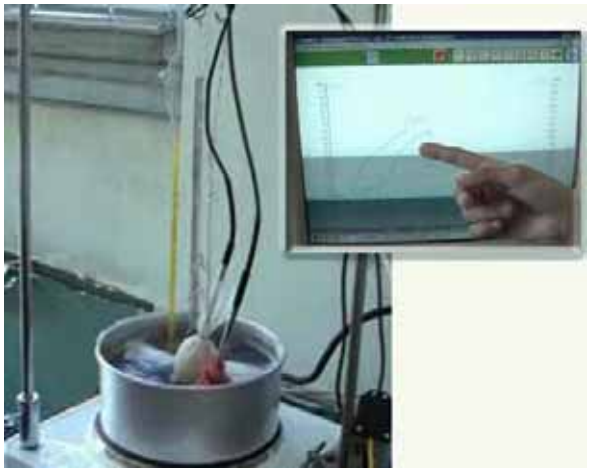

Figure 1

The temperature inside the egg is measured by a temperature sensor (Figure 1). We take the graph of temperature inside the egg versus the time on the computer screen, by the appropriate software (Coach 5 CMA). Using two temperature sensors we can measure simultaneously the temperatures within two eggs of different size which originally had the same temperature (Θ_{egg}). Then, we get the two graphs together (Figure 2)

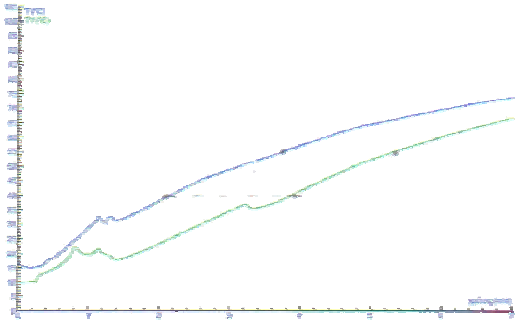

Figure 2

The experiment was repeated for different values of the temperature θ_{egg}. By observing the chart our pupils completed the list of the time intervals for different values of the temperature $\Theta_{yolk.}$ They used spread sheets to write down the measurements and calculate the ratio. They came to the conclusion that regardless the yolk temperature the two ratios are equal.

E. IMPLEMANTATION

A survey was carried out in the Experimental School of the University of Athens. 44 pupils took part, at the age of 14. They separated into two equal groups. The first group was the experimentation group and the other the control group. All pupils were taught by the same teacher the thermal phenomena included in the curriculum of the Greek Gymnasium (lower secondary level). In addition, the pupils of the experimental group carried out all the activities described above, in the laboratory. The pupils of the control group carried out the conventional experiments. Two months later all pupils were given a test. They were asked to solve problems referring to thermal phenomena. (See Annex)

5. The results

The results are indicated in the histogram (Figure 3).

First conclusion: "The pupils of the experimental group tried to relate the problem with the "egg problem" in more than 50%"

Second conclusion: "A significant percentage of the pupils of the experimental group succeeded in creating a model and find the similarities with the 'egg problem'". On the contrary, the pupils of the control group answered arbitrarily.

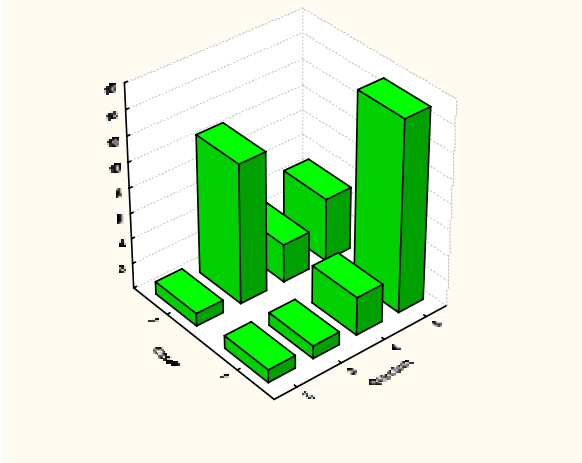

Figure 3

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6. Conclusion

The results are encouraging. They show that pupils of the lower secondary level can develop abilities of problem solving and modelling through experimental processes which refer to household phenomena. The program will be implemented the next school years to increase the statistical sample.

7. Prospects-Proposals

Working with household applications provides a way to our students to become accustomed to problem-solving processes and scientific methods from an early age. We think that it would be useful to teach similar to the "egg problem" applications in the Science class, introducing scientific concepts through them. Moreover, we must try to create simplified models of the phenomena and work following the steps of the scientific method.

8. Thanks

We would like to thank Mr. P. Lykoudis, Professor Emeritus of Nuclear Engineering and former Dean of the University of Purdue U.S. for his help in simplifying the "problem of egg".

9. Annex

Studding the problem concerning the time it takes to boil an egg we reached the conclusion that the time to boil an egg depends on the size of the egg, the initial temperature and the final temperature. The equation is:

$$\tau = \left(\frac{1}{12}\right)\cdot\left(\frac{M.c}{k\cdot L}\right)\cdot\left(\frac{(\Theta_{water} - \Theta_{egg})}{\left(\Theta_{water} - \Theta_{yolk}\right)}\right)$$

M is the mass of the egg
C is the specific heat of the egg
k is the coefficient of thermal conductivity
L is the diameter of the egg.
Θ_{egg} is the initial temperature of the egg
Θ_{water} is the temperature of the environment
Θ_{yolk} is the final temperature of the yolk

10. The worksheet of an Application

A warm summer day Tina went with her parents, her brother George and her sister Helen an excursion to the mountain. Her mother used two thermal insulation cube-shaped containers. The volume of the first was $(40cm)^3$ and of the second $(80cm)^3$. In the first she placed icy soft drinks and in the second, water.

Initially, the temperature inside both boxes was 5 ^oC. The first box had a thermometer inside to measure the temperature.

Three hours after they arrived at the top of the mountain, George felt thirsty and opened the first box to get a drink. He saw that the temperature inside the box was now 25 ^oC

He wanted to find the temperature inside the other box and asked to open and place the thermometer inside.

Helen recalled the "problem of egg" and claimed that she could calculate the temperature of the second box without opening it. George, on the other hand, argued that only by using a thermometer they could find the temperature inside the box.

A. Do you agree with Helen?
Absolutely False 1 2 3 4 5 6 7 Absolutely True
B. Do you agree with George?
Absolutely False 1 2 3 4 5 6 7 Absolutely True
C. In the relationship (1) can you find the respective values of the physical quantities for the first box?
D. In the relationship (1) can you find the respective values of the physical quantities for the second box?
E. Calculate the temperature inside the second box.

11. References

[1] De Kleer I. and Brown I., Assumptions and ambiguities in mechanistic mental models. In D. Gentner and A. Stevens (Eds) Mental Models. 155-190, 1983.
[2] Driver R., Squires A. and Rushworth P., Wood-Robinson V., «Οικο-Δομώντας τις έννοιες των Φυσικών Επιστημών, Μια παγκόσμια σύνοψη των ιδεών των μαθητών», Επιμέλεια – πρόλογος: Κόκοτας Π., Μετάφ.: Χατζή Μ., Εκδόσεις: Τυπωθήτω, Δάρδανος Γ., Αθήνα, 2000.
[3] Duit R., Research on students' conceptions developments and trends, 1993.
[4] Frey Karl, H., Μέθοδος Project. Proceedings of 3 International seminar on misconceptions and Educational strategies in science and Mathematics Cornel University, Ithaca, NY, 1998.
[5] Tolman, E.C., Principles of purposive behaviour. In S. Koch (Ed), Psychology: A study of a science. Vol. 2., N.Y: McGraw-Hill, 1959.
[6] Wertheimer, M., Productive thinking, N. York: Harper & Row, 1945.
[7] http://newton.ex.ac.uk/teaching/CDHW/egg/

 ISBN 978-989-95095-3-5

[8] P Roura et al., How long does it take to boil an egg? A simple approach to the energy transfer equation, Eur. J. Phys. 21 95-100, 2000.
[9] Βοσνιάδου, Σ., Brewer, W., F., "Θεωρίες αναδιοργάνωσης της γνώσης κατά τη διάρκεια της ανάπτυξης", Σύγχρονη Εκπαίδευση, τχ. 34, σσ.35-45.

issues of the script. We argue and evaluate these activity and we point out their potentialities such as for the effectiveness as instruments of learning in the conception of the hands-on science philosophy.

Keywords. Experiments, Energy Conservation, High School's classroom.

Conservation of Energy Activity in a High School Classroom

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Abstract. The discipline of Learning Practices IV (Fis.416), from teacher education undergraduate in Physics course of the Federal University of Itajubá, Brazil, aim to bring High School students to the concepts physics through experimental activities. The goal is to develop experiments of which energy conservation is investigated, and for such experiments materials at low cost or recyclable are used. The experiment was worked out by undergraduate students as an activity of Fis.416 discipline under the teacher supervision. The activity was presented to the colleges and applied to students in a High School class. The goal of our work was clarify the connection between kinetic and potential energies by analyzing the trajectory of an object throughout a path to be determined. After approval, the experiment was presented at State School Marquês de Sapucaí in Delfim Moreira city, near Itajubá. The activity was to High School last year's student. The students were spited into five teams. By using the script of the experiment, they had to mount and develop the proposed activity. The undergraduate students made a theoretical explanation about energy and its conservation before the experimental activity implementation, in order to allow to the High School students a better understanding of the proposal. Each team mounted their experiment and the doubts had been resolved by the undergraduate students and by the teacher's High School classroom. At the end of the activity each team presented its results. A final questionnaire was proposed to the High School students in order to evaluate the learning of the concepts discussed in the experiment. In this work we present the script used in the activity as well as the responses of High School students´

Science Communication: Science is Everywhere but Where?

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Abstract. The main purpose of this article is to discuss the effect of science and to suggest ways to bridging the gap between science and society. Because one of the aims of science communication, which is very crucial but not well conducted, is to make science understandable and enjoyable to public. The main question rises at that time: How well is science communicated to the public? From starting our earlier ages science seems something very apart from our lives. This even continues in the older ages. In schools instruction is generally used to transport the knowledge. The main purpose of science education does not seem to grow up individuals that enjoy with the impact of science in life. So, what is 'science', why does it have such a dramatic influence on our lives? According to Friedman et al. 1986, science comprises not only the biological, life, and physical sciences but also social and behavioural sciences and such applied fields as medicine, environmental sciences, technology, and engineering. But how science is so far away from our lives while it is broadly inside our lives? CIBA Foundation Conference (1987) which is related to Communicating Science to the Public, mentions about this subject: "People go to Science Museums, Centres, zoos and watch science programmes on TV to satisfy their curiosity. This is the primal motive. They are not generally interested in science as a formal discipline." This can be emerged from not being informed on the effect of sciences in universe, in the country, even in our lives.

In this article, alternative ways were discussed in the light of recent literature to promote a better understanding and impact of science and science communication.

 ISBN 978-989-95095-3-5

Keywords. Science, Science Communication, Public.

1. Introduction

The main purpose of this study is to assess the effect of science communication on building scientific awareness in the society and suggest ways to bridge the gap between science and society as one of the aims of science communication is to make science enjoyable and exciting to public.

2. The Importance of Science

The world is surrounded with some concerns related to science such as global warming, cloning, acid rains etc… Schooling is an important factor in sharing this knowledge with students, yet it is not clear whether the society outside the school environment is informed about the underlying reasons of these occasions. According to Roth (2005), the value of hands-on activities to learning observational and theoretical language is one of the major unexamined presuppositions in science education.

Figure 1. Hands on activities should be preferred in science education

Therefore a successful science education environment requires interaction, participation and hands on activities…

To build scientific awareness and sensitivity, science communication is an important asset but is not very much developed in Turkey yet.

The main question rises at that time: "How well is science communicated to the public?". In schools, it is generally more important to transport pure knowledge, rather than linking science with real lives. The main purpose of science education does not seem to raise individuals that enjoy the impact of science in life. Although science is related to almost every subjects, not only the biological, chemistry, and physical sciences but also social and behavioural sciences such as psychology and technology, it becomes so far away from our lives while it is broadly inside our lives. So, "What is science, Why does it has such a dramatic influence on our lives?"

Figure 2. Interaction is important in science education

According to Friedman, Dunwoody, and Rogers (1986), science comprises not only the biological, life, and physical sciences but also social and behavioural sciences and such applied fields as medicine, environmental sciences, technology, and engineering. But how science is so far away from our lives while it is broadly inside our lives? CIBA Foundation Conference (1987) which is related to Communicating Science to the public, mentions about this subject: "People go to Science Museums and Science Centres and zoos and watch science programmes on TV to satisfy their curiosity. This is the primal motive. They are not generally interested in science as a formal discipline." This can be emerged from not being informed on the effect of sciences in universe, in the country, even in our lives. Applications of science and technology can change a country's future in a both political and economic way. At

 ISBN 978-989-95095-3-5

that time science communication appears. According to the scholars, science communication is not as "effective" as it could be and they suggest two dominant themes about science communication: it is important and it is not done well (Hartz and Chappell, 1997). The question of "What should be done for promoting science among society?" requires a comprehensive answer.

The scientific enterprise has become too much specialized and complicated to be understood by the general public. Therefore a form of mediation is needed in order to make scientific achievements more suitable and accessible for the public. (Bucchi, M., 1998).

Public want to know what the latest advances in science and technology mean for people, businesses, or the natural world even when they don't understand how the science or technology works. Scientists and other researchers, therefore, can play an important role not only in communicating the facts, but also the value of science and technology. (Hayes & Grossman, 2006)

3. Science Communication

As the world changes, so does what is required to make science understood by the various publics that make up society. (Knight, D., 2006).

The presentation of science to the public has taken several different forms (books, magazines, educational films, radio and TV programmes) although often labelled with the term 'popularization'. (Bucchi, M., 1998).

Although communication of science to the public is important, it is not as "effective" as it could be. The question of "What should be done for promoting science among society?" requires a comprehensive answer. Since, governments, media, educators, scientists should collaborate for enhancing a better science communication. Because these sources have key missions to promote scientific view.

3.1. The Importance of Science Communication

It is widely accepted that the importance of the communication of science to the public can be summarized under five headings: importance, economic, utilitarian, democratic, cultural and social.

The economic imperative, regrettably, is today the main driving force towards a better scientifically educated public. The concept of intellectual property, however, has filled many of the arguments in favour of the public awareness of science.

The utilitarian argument is closely allied to the economic one. It is the view that the public should scientifically aware because of the way the community uses science.

In a sense, the democratic argument is a subset of the utilitarian argument. Unfortunately few politicians or financial experts have any scientific training at all. But scientifically aware politicians would have an influence on multinational corporations.

Next, there is a cultural argument. Science is one of the things people do and, like all of the things people do, it can be done, at the highest or the lowest level.

Finally there is the social argument. As science permeates all levels of human activity then an awareness of the basis of science and the issues surrounding it will serve to enhance social cohesion. (Stocklmayer, Gore & Bryant, 2001).

4. Discussion and Suggestions

In this study, critical points of current knowledge related to Science and Science Communication were reviewed. In addition to this, alternative ways to enrich science communication was discussed. All in all, in order to enhance science communication media's, government's, business sector's, scientists' and educators' support should take into consideration.

As it was mentioned before it is indisputable that mass media is important in science communication. Nisbet and his colleagues (2002) found a positive relationship between the use of science magazines and science television and factual scientific knowledge, as well as a positive relationship between the use of general newspapers and science magazines and procedural scientific knowledge, after controlling for age, gender, and general education. Therefore using media in science communication seems very effective since media may reach a wide population in a short time.

Next, governments should support science and science communication by funding or organizing events like science festivals, shows or building interactive science centres, museums. Government should be aware of the impact of science in technological meaning. Using science and technology in an effective way may change a nation's future situation among the others.

Educators should use different techniques in transporting scientific knowledge like drama, interactive science experiments that involves the audiences, and field trips zoo, fabrics etc…

 ISBN 978-989-95095-3-5

Scholars should share their knowledge especially related to the topics that are popular in media (global warming, AIDS, cloning, acid rains...etc) while adjusting the subject according to the audience.

"Science Communication" departments should be opened in the universities to educate specialists in the field.

5. References

[1] Bucchi, M., Science and the Media. Alternative Routes in Scientific Communication. London: Routledge, 1998.
[2] Friedman, S., S. Dunwoody, and C. Rogers, Scientists and journalists: Reporting science as news. New York: Free Press, 1986.
[3] Hartz, J., and Chappell, R., Worlds Apart. How The Distance Between Science And Journalism Threatens America's Future. Nashville, Tennessee: First Amendment Center, 1997.
[4] Hayes, R. and Grossman, D., A Scientist's Guide to Talking With the Media. Practical Advice from the Union of Concerned Scientists New Brunswick: Rutgers University Press, 2006.
[5] Knight, D., Public Understanding of Science. London: Routledge, 2006.
[6] Nelkin, D., Selling science: How the press covers science and technology. New York: W. H. Freeman, 1995.
[7] Nisbet, M., D. A. Scheufele, J. Shanahan, P. Moy, D. Brossard & B. V. Lewenstein, Knowledge, Reservations, or Promise? A media effects model for public perceptions of science and technology. Communication Research 29: 584-608, 2002.
[8] Roth, W.M., Talking Science Language and Learning in Science Classrooms, New York: Rowman&Littlefield Publishers Inc., 2005.
[9] Sarah, D,.R., Constructing Communication: Talking to Scientists About Talking to the Public Science Communication 2008; 29; 413, 2008.
[10] Stocklmayer, S., Gore, M. and Bryant, C., Science Communication in Theory and Practice. Dordrecht: Kluwer Academic Publishers, 2001.

"Hands-on Science" During the Holidays

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Abstract. "Hands-on Science" during the holidays is a project of a secondary school in the North of Portugal (Vila Real). This project has the agreement of the parents and the teachers of a class of the 8th grade which has 25 pupils aged from 13-15. The Hands-on Science activities are very diversified and from different domains of Science: on Robotics we did a contest with hand-made robots; on the Astronomy; we identified the stars, planets, constellations with a telescope; on Natural Sciences we identified different species that live in OLO river with electronics magnifying glass; on Maths we constructed different families of polyhedra models with polydron; we made forest vigilance doing foot walking during the morning with military maps and binocles and in the afternoon we visited the Senhora da Graça observation poste.

In this week centred on Hands-on Science we worked at the same time, the different dimensions of the human being: the personal one, the social and transcendental dimensions. We talked and reflected about the different values that are essential to be in society like: inclusion, solidarity, respect towards the differences, the sexuality and friendship, the bad or good uses of science results ….

This project involved 5 teachers of different areas at full time and a mother that is a Biology teacher at UTAD university hat helped us with the Biology subjects. All this project was developed by teachers and pupils during a week in "Fisgas of Ermelo" (Mondim de Basto) a very beautiful area in Alvão Mountains: preparing the meals, cleaning, making a wall paper, were tasks that each team had to do in a rotative scale. At the end of the week we invited all parents to join us and celebrate.

Keywords. Science Education, Robotics, Hands-on Experiments.

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Support Material for In-School Hands-on Experiments

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Abstract Expanding learning opportunities and giving access to quality education for children in under-served communities has been the focal point of CLT's developmental work since 1997. Technology has been an enabler in this key process. To counter and respond to shortage of elementary school teachers and resource-starved government schools, CLT has engaged in sourcing teachers with subject-expertise and digitally capturing their pedagogical practices. Multi-media and video-recorded content as ICT Tools is integrated with classroom teaching to make it more effective. For experiential learning, as support material for popularizing Hands-On-Science, demonstration experiments as DVDs, hand-written-notes and a Touch &Tell lab is given.

Keywords: Hands-On Science, ICT Tools, Support Materials

1. Misconceptions about Science

Generally, Science Lab is misunderstood to be a very expensive affair with fancy apparatus and gadgets and schools in poorer communities think it is out of their reach. In addition, Elementary School teachers with 12 years of schooling - including 2 years of teachers' training- find it challenging to do experiments in classrooms, even if they had Labs. They do not have the band-width to relate Science with everyday situations to make it more relevant and interesting to kids. These limitations confine kids with only textbook knowledge sans practical experience.

2. Supplementing with Support Material to inculcate Hands-On-Science in Classroom

One of CLT's initiatives to make up for the lacunae is to supplement classroom teaching with support materials to help teachers to teach their lessons with more confidence and ease. Live recordings of Hands-On Science demonstration experiments with locally available and affordable materials is an effective supplement that has multiple advantages to change the dynamics of a classroom into an interactive one. It can also be a capacity-building tool for teachers with no subject expertise on Science.

e-learning modules created at CLT Resource Center keeps the curricula-based text books as a reference and is enhanced with value-additions. This content can also be for self-learning, when it is given along with Hand-books with illustrations and materials.

Thus mode of support-material is easy to reach and impact many schools

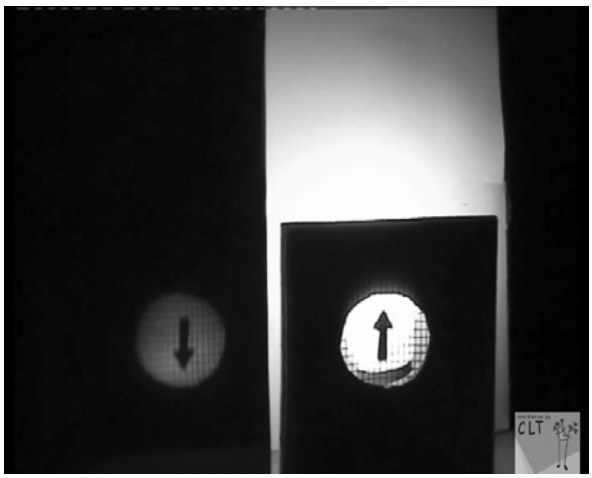

Figure 1. Light Experiment

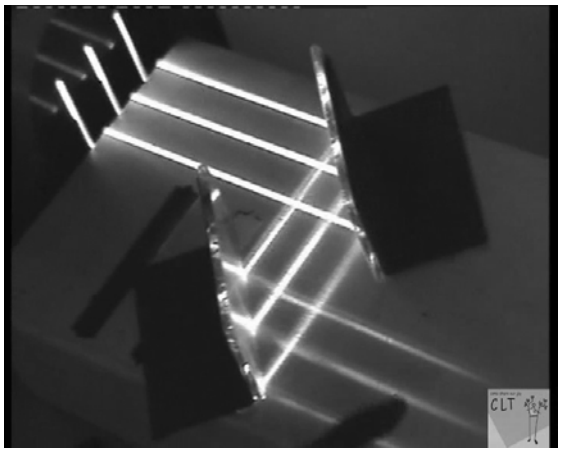

Figure 2. Light Experiment

3. Acknowledgements

D.R. Baluragi

5th International Conference on Hands-on Science
Formal and Informal Science Education
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"Hands-on: Oral Health" Science- and Health Education in a Constructivist Classroom

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Abstract. "Oral health" is of great importance and essential for the daily life of every human being. It is closely related to good quality of life and to "health education". "Oral health" is a tailor-made subject to realise constructivist methods including "hands-on"-instructions in schools. In order to approach this subject with a constructivistic background we developed a series of lessons on "teeth" and "oral health" in the context of a student project titled "Science education in a constructivist classroom". Part of this project was a study with 48 third graders (2 classes of 24 pupils each), that was based upon theses and methods of "interactive constructivism". Those pupils attended morning classes at the university once a week for this year´s summer term. Four pre-service-teacher students of our faculty joined this project. This group of students was responsible for the preparation and the planning of the lessons including the realisation of work sheets that had been prepared in advance.

Figure 1. Learning station: "Types and structures of teeth"

Every class of pupils had been divided into four groups. Those four groups, who contained six pupils each, have been supervised by one of the students. By approaching the subject "oral health" this way, we wanted to demonstrate how constructivist principles, ideas and methods could be applied within the course of such a project. For example constructivist methods according to Kersten Reich, John Dewey et al. can be applied in order to realize such a project.

Figure 2. Learning station: "Dental hygiene"

Figure 3. "Role plays with an expert"

Following the principles of constructivism during our project, we decided that the pupils should find their own way in proceeding because they should make "real sensuous experiences" since students, especially children, according to constructivist thesis, tend to show the largest learning success if learning and "real life" situations are combined. We designed four learning stations ("Types and structure of teeth" (Fig. 1), "Dental hygiene" (Fig. 2), "Prophylaxis" and "Role play with an expert" (Fig. 3)) that tackle the topic "oral health" from different perspectives and thus encourage the pupils to make "real sensuous experiences". During the learning station "Role plays with an expert" the pupils had the chance to get to know more about their own sets of teeth. A positive side-effect of this role play was that the pupils could experience that there is no need of being afraid of dentists. This project is great value to the oral health of the pupils who took part in those lessons, they did not only learn about teeth, dental hygiene and prophylaxis but also could

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experience during the role play that there is no need of being afraid of a dentist.

Keywords. Oral Health, Science- and Health Education.

"Science Camps-A Hands-on Experience" An Experimental Contribution to Science- and Health Education

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Abstract. Science Camps provide an interesting opportunity for children to explore and discover natural sciences in an age group-orientated and cheerful way. The goal is to lead children to a positive attitude towards health and natural sciences by fascinating them with the "hands-on" approach which enables them to make their own experiences.

Teaching natural science, physical activities and health education within a group during Science Camps allow the children to get accustomed to a healthy lifestyle by independent research and experiments. Furthermore, they are enabled to transfer their gained knowledge and skills into everyday life.

Not only have the children profited from the camp but also the pre-service-teacher students. For them it is a great way to gain teaching experience. On top of this they collect credit points for their participation.

Since 1996 the Institute of Biology and its Didactics annually organizes Science Camps for up to 100 children aged 6 to 12. During a period of two weeks the children have the opportunity to explore and experience natural science hands-on. The children stay at the university from 7:30 am and are picked up between 4 and 4.30 pm. They are provided with two balanced meals (breakfast and lunch) every day and have time for breaks which for example can be used for physical activities such as ball games and gymnastics. Every year 5 different topics are selected, prepared and taught (Table 1). During the 10 days of the camp each topic will be addressed within a period of two days. In those two days eight units of science classes are taught, two in the morning and two after lunch. Since the children shall be addressed as individually as possible and the studies shall be created as efficiently as possible they are divided into 5 age-related groups with approximately 20 children.

About 30 pre-service-teacher students of our faculty are involved in the annual Science Camp. On one hand the students are responsible for the preparation of the selected topics and their "hands-on" realization during the camp on the other hand they take care of the participating children (one student is mainly responsible for four children). Each of the topics chosen:

Noise/Water/Soil/Air/Earthquakes/Landscapes/Weather/Agriculture/Anatomy/First Aid/Microscopy/Nutrition/Bionic/Environmental/Management/ Birds/Animals in Zoo/Forest/The Senses/Wholesomely/Cooked Food/…

for the camp is coordinated by a chosen pre-service-teacher student who serves as a contact person for the other students and as an expert on this field. The topics have been selected and prepared in a seminar during the summer semester. Furthermore each camp is always evaluated by two students. On top of the summer camps, the Institute of Biology and its Didactics offers one-week Science Camps that take place during the spring and the fall break and host up to 30 children.

We believe that science camps are a valuable contribution to enhance the children's interest in science and health. We are looking at a win-win situation because the pre-service-teacher students gain experience in every aspect of the teaching process.

Keywords. Science Education, Interdisciplinary Approach, Science Camp, Extracurricular Activities.

Contributions of a Scientific Society (Society for Developmental Biology) and Its Members to Science Education at All Levels

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Abstract. Most scientific societies' mission is to promote advances in that particular discipline and to further their members' interests, by providing the appropriate venues to realize these goals. The Society for Developmental Biology's (SDB- http://www.sdbonline.org) mission is to promote the field of developmental biology and its advances by fostering excellence in research and education. Almost all our full members are

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faculty in higher education institutions, thus involved with undergraduate to postdoctoral training. In addition, a significant number of them are personally involved with pre-college and public science education outreach, by volunteering in their local schools and civic activities. SDB gives these members several opportunities to share their experiences at all teaching levels with other members at the Society's annual and regional meetings' education workshops and poster sessions. In response to increasing requests from the membership to address issues not usually covered in the graduate and postdoctoral training of research scientists, SDB has included the following themes in these education sessions: teaching skills, laboratory exercises for undergraduate courses, working with K-12 teachers, and outreach to non-specialists and lay public.

In the last few years, the themes expanded to include career opportunities, survival in the academe, grant writing, science writing skills and training abroad. At the same time, the Board of Directors made inclusion of an education session mandatory in the 6-9 SDB regional meetings held every year in various parts of the United States and Canada. Several of these regional meetings offered workshops with hands-on exercises on developmental biology and related subjects to local K-12 teachers; a few of them even offered local school district credits to the teachers upon completion of the workshop. In order to help the junior faculty in their first few years of an academic position and postdoctoral fellows on their way to such a position, SDB offers biennially, at the annual meetings, the "Boot Camp for New Faculty" (http://www.sdbonline.org/2008Mtg/08%20Boot%20Camp%20index.htm). To address the unique situation of teaching evolution in American public schools (K-12), SDB is an active member of the Coalition of Scientific Societies (38 scientific, professional and civic societies, and the National Academy of Sciences) to support inclusion of evolution and not other non-scientific ideas in the science classrooms. American voters' opinion on this topic plus their understanding for the nature of science was surveyed and the data will help the disciplinary societies develop toolkits and strategies for respective members to work locally with their teachers, school boards and legislators. [In the United States education standards are set by local school boards, and the federal recommendations are only voluntary.] Internationally, in collaboration with the Latin American Society for Developmental Biology (LASDB), SDB co-organizes a satellite short course (http://www.sdbonline.org/ShortCourse/05_ShortCourse%20Program_FINAL.pdf) to LASDB's international meetings to promote learning of concepts and techniques in developmental biology , with practical laboratory sessions, for 30 students (15 based in Latin American and 15 based in US institutions). In partnership with the American Physiological Society (http://www.the-aps.org) SDB is developing a teaching digital library in developmental biology and related areas where peer-reviewed learning objects for all education levels are available to scientists, teachers and the general public: Library of Educational Annotated DEvelopmental biology Resources (LEADER- http://www.sdbonline.org/index.php?option=content&task=view&id=24). Details of these projects will be presented at the meeting.

Keywords. Scientific Societies, Postgraduate Training, Outreach, Collaboration, International, Developmental Biology.

The Tulla Rectification of the River Rhine. A 19th Century Intervention and its 21st Century Impact

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Abstract. The river Rhine is a large alluvial river system that flows from the Swiss Alps to the North Sea. It drains large parts of central Europe (189.000 km2). The main river channel stretches 1.320 km. Its catchment area includes land in Switzerland, Lichtenstein, Germany, France, Luxembourg, and The Netherlands. The river Rhine has a long story of human interventions, they became significant in the Middle Ages when the construction of dykes in the floodplain began. In the early 19th century fears of floods were part of daily life in the Upper Rhine Valley. The visionary hydraulic engineer Colonel Johann Gottfried Tulla launched "The taming of the wild Rhine". The rectification of the upper part of the river was supposed to control floods, to eliminate diseases like malaria, and to enhance the use of the river for transporting goods.

According to Tulla's anthropocentric vision of the perfect river, the ideal waterway had geographic length, but no geographic breadth, floodplains should be used for farms and towns, rather than the absorptions of high water during seasonal variations in water level. This ideal resembled a canal: "straight, predictable, easily

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controlled, and specifically designed for navigation" (Figures 1 and 2). This project can be considered the greatest civil engineering scheme that had ever been undertaken in Europe. "In civilized countries, the rule should be that rivers and streams are canals..." [1] The Rhine between Basel and Worms was shortened from 354 km to 273 km, almost a quarter of its lengths. The results as dissenting voices predicted, were larger and meant more devastating floods downstream. The recent rush of enormous "hundred year floods "along the Rhine (1983, 1993, 1994) was thus the result of these activities as much as the extreme events by nature.

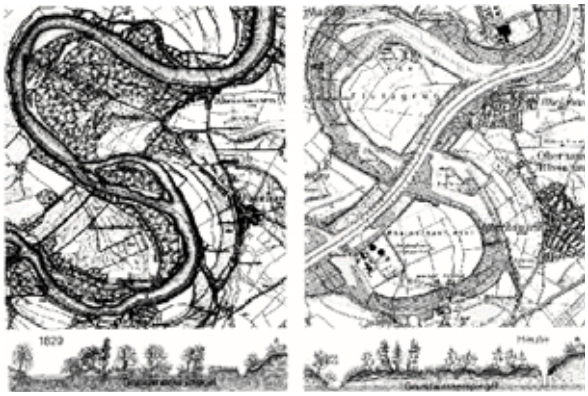

Figure 1. Comparison of a Rhine section in 1820 and today

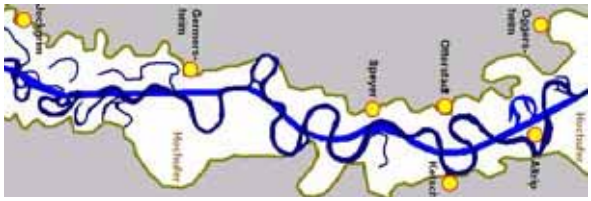

Figure 2. A Rhine section before and after the rectification

Figure 3. Our functional model of the Tulla Rhine rectification

Our experimental approach is to examine the impact of the rectification. We use the literature data that show a shortening of the upper river by. approx. 23%. We developed a model. The children are being provided with appropriate material, work sheets and data. Figure 3 shows our model to study the impact of river rectifications.

Keywords. Rectification, Floodplains, River, Water Level, "Hundred Year Floods".

References

[1] J.G. Tulla (1770-1828)

Waste Water Management – A Hands on Experience

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Abstract. The contribution of waste water to the ecological status of rivers in Germany is significant. During the sixties and seventies of the last century the water quality of our rivers deteriorated since industrial-, community- and waste water from private sources got into the rivers without passing through a waste water plant. Legislation within the European Community and an increase of awareness among our society let to relevant changes in waste water management. We still believe that the use of water and the handling of waste, specially- water related waste- needs attention among the general population. We have developed a functional model of a waste water treatment plant. The pupils can gain hands on experience.

We provide the theoretical background by focusing on the mayor waste water plant in Cologne/Germany, one of the largest and technological advanced set ups in Europe. This is done by providing a CD that gives an overview of the technological processes, their impacts and the economic implications, like cost development. The functional model (Figure1) contains all stages the real plant provides for the cleaning process. We reconstructed the process. It is obvious that we cannot work with contaminated waste water or with real sludge. To stay close to reality, we fabricated waste water that contained: oil, mechanical debris, organic compounds (glucose) and phosphate (Figure 2).

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With these mixtures we started the cleaning process integrating all stages of a real waste water treatment plant (Figure 3). As microorganisms we used yeast. The degradation process during the biological stage was quantitatively measured by a bloodglucosemeter (Figure4).

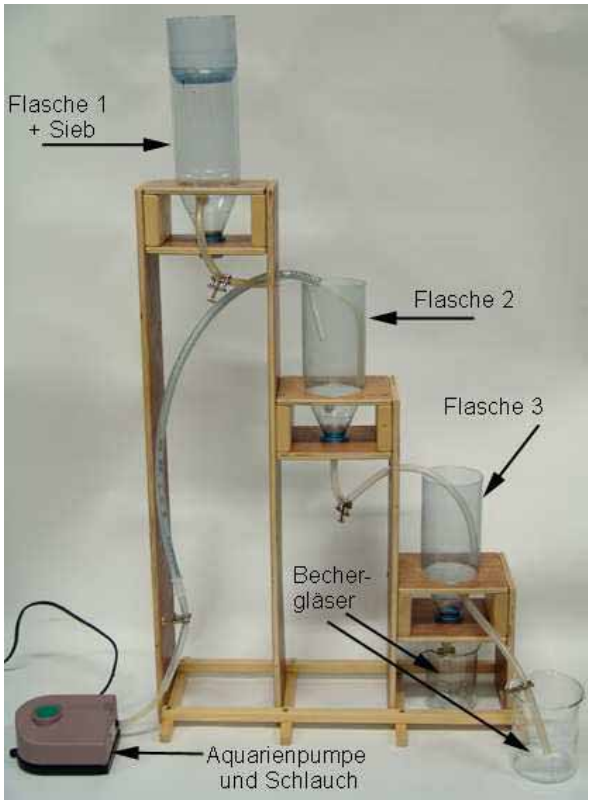

Figure 1. Functional model of a waste water treatment plant

Figure 2. Waste water before clarification

Figure 3. Waste water after clarification

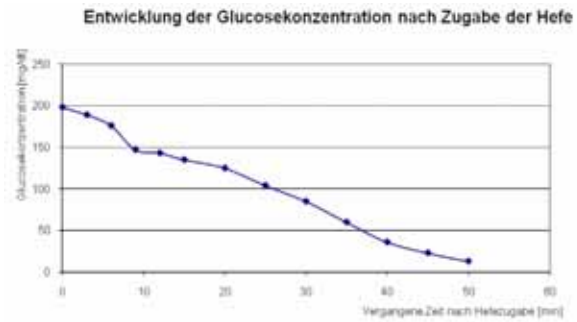

Figure 4. The degradation of glucose in the biological stage

Keywords. Waste Water Treatment, Biological Stage, Sludge, Phosphate, Organic Compounds, Yeast, Rapid Testing System.

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Water Purification

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Abstract. Clean water is very important for living. How does ground water get clean? How the earth does works as a water purification plant? We can answer to this kind of questions using simple experiments. We don´t need expensive laboratory equipments. Students have a lot of hands-on experience with experiments designed with easily obtained materials. This work describes some hands-on experiments of water purification.

Keywords. Clean Water.

Robotics. Robot's Construction

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Abstract. The Project that we present was first included in "Área de Projecto" and is based on the construction of a robot. We chose this project essentially for the development of diversified abilities (including the acquisition of knowledge) that could be useful in our professional life. For this, we had to do some research, followed by a reflection about the functionally and structure of the robot. We decided to opt to construct a mobile and autonomous robot according to the supplied material, which was able to follow a track, to go up and down slopes, to get out of the way of some obstacles and to distinguish some colours.

We were confronted with some kinds of problems, including technical, logistical and financial problems. The logistical problem was decided appealing to ANPEE (national association of electrotechnic and electronics teachers) that has available a kit that allowed the robot assembly; the financial problem was decided by resource to sponsorships of local companies (Laboratório Pioledo of Vila Real); the technical problems were solved by the support in carrying out and the accompaniment of a electrotechnic teacher in our school, José Alexandre Breda.

After that, we participated in Robotics Festival 2007 and 2008, and in Hands on Science 2007. We decided to improve the robot and present it again.

The carrying out of this project has allowed us to increase abilities in different areas. We hope to share with other young people (inside and outside school) this experience and to find out about other built up projects.

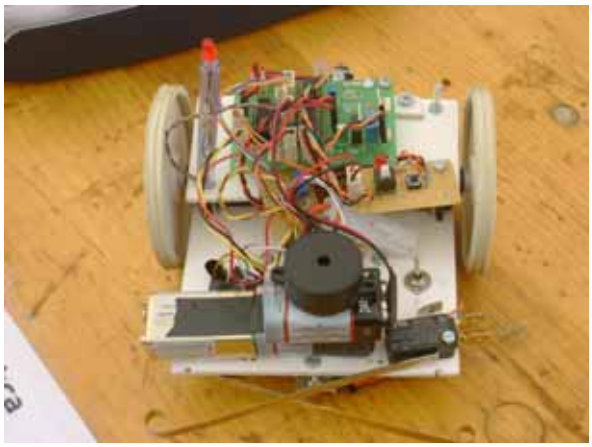

Figure 1. Our robot

Keywords. Robot, Robotics.

Science and Technology Fair of the Rio de Janeiro State

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Abstract. The program of Science Fairs devoted to high school students was implemented for the first time in Rio de Janeiro on the 1960´s. Although it has been a very successful experience, it happened just a few times. Recently, CECIERJ Foundation retook the implementation of the State Science Fair in an updated format. Since 2005, three fairs were organized according the following guidelines: each science project must be must be enrolled in the fair by the responsible teacher and the group that will develop the project ought to have the maximum of five components: three students

 ISBN 978-989-95095-3-5

and two teachers. After registration, all projects reports are analyzed by a committee of professors and scientists, and the best ones are selected for presentation at the State Science Fair.

The presentations were divided on six major themes: Physical and Earth Sciences; Health and Agriculture; Biology and Ecology; Technology and Innovation; Interdisciplinary Projects and Junior High science projects. The State Science Fair occurs in two days (a weekend) and, in this period, the selected science projects are presented to the public as well as to a committee that evaluates and selects the best ones for each major thematic area. The six best science projects then are rewarded and automatically enrolled in the National Science Fair.

In this paper the regional distribution in Rio de Janeiro state of the enrolled science projects was investigated. The distribution of science projects amongst the different thematic areas and also the ratio of gender participation in general and regarding the subject of the project were also analyzed.

Keywords. Science Fair, High School Students, Non-Formal Education.

Learning How about Climatic Alterations in Urban Areas from Simple Experiment of Thermology

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Abstract. The volume of buildings in cities is capable of modifying the original characteristics of the climate. Furthermore, tons of pollutants are released into the atmosphere every day, thereby modifying the climatic attributes and contributing towards increasing the surface temperatures, since these pollutants make it difficult for the heat energy to escape from the system. These modifications are called the "urban climate". The first study dedicated to the climate of the cities, carried out by Howard, in 1833, about the climate of London mentions the differences of temperature between the field and the area urbanized. That phenomenon known as - urban heat island - is the clearest example of not deliberate climate modification in urban areas that can bring harmful biological, economic and meteorological consequences.

The course had the objective of discussing the climatic alterations in urban areas and the occurrence of the island of heat from a simple experiment of measurement of temperatures of different surfaces as land and stone and of the air immediately above these surfaces. The course had three phases: first phase: the achievement of experiment, second the reading and discussion of newspaper texts about environmental impacts in urban areas and the third phase the exposition and argument of the concepts about urban climate.

The experiment consisted of measuring the temperatures of the surface land and of the stone in a time interval of five minutes with the light on during half hour and by more half hour with the light turned off. The students noted the values in a table and subsequently elaborated graphics in order to analyses the behaviour of the temperatures. Before the beginning of the experiment the students had raised hypotheses about the possible results in the different environments. From the analysis of the results it was possible to understand the climatic problems in the cities and the environmental repercussions, pointed out in newspapers. A theoretical presentation links what has been discussed in an experimental approach to formal concepts.

Keywords. Environmental, Climate, Urban, Heat Island.

A New Approach in Biology Teaching: Exploration of an Online Educational Resources Centre

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Abstract. The “Estaleiro da Ciência” is a plataform with information about all the events and initiatives promoted by the Office for Science Communication of IBMC•INEB (Institute for Molecular and Cell Biology, Institute for Biomedical Engineering, University of Porto). This project results of the necessity to increase

 ISBN 978-989-95095-3-5

and improve the connection between scientific investigation and society. In this way, the site "Estaleiro da Ciência" (URL: <www2.ibmc.up.pt/moodle2>) as a section that is an Educational Resources Centre, which aim is to built a gateway of educational resources to make available for schools and teachers learning strategies and contents. Is it also aimed to generate a network of teachers that participates in training activities of the project. Other cibernauts are also welcome to try and experiment the activities available in this centre.
These educational activities, called "Oficinas", are the product of a multidisciplinary work, involving investigation groups, designers, university teachers and students of FCUP (Faculty of Sciences, University of Porto), and school teachers. Every activity is organized in three stages: challenge, "hands-on" and results presentation. This is a new perspective in science teaching, which emphasis the role of student in is knowledge construction and, in other hand, the role of teacher as a guide in scientific outreach. A new approach to science teaching, in particular biology themes, is present in these b-learning activities.

The oral presentation and workshop/hands-on experiment demonstration in this conference become pertinent for the spreading of "Estaleiro da Ciência" next to the professionals in science education. It is also important to exchange experiences, to reflection and to improve our work. This is address, in particular, to Biology teachers, of third cycle, secondary and university.

Keywords. Science Education, Biology, b-Learning Activities, Online Resources Centre.

Reception of Students in the Museum of Sciences. A Look under the Perspective of Extended Scientific and Technological Literacy

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Abstract. This work relates part of a research that analysis a program of scholar assistance developed by the team of the Museum of Sciences Parque Newton Freire Maia (PNFM), institution supported by the Secretaria de Educação do Estado do Paraná (SEED), regarding the diffusion, popularization and spreading of science and technology. The program, entitled "Pequenos Cientistas – Grades Cidadãos" (Small Scientists - Great Citizens) (PCGC) aims to assist students of the initial grades of the basic education, using a methodology that involves the School, the Center of Sciences, the students and their teachers. Based on the experience of one of the authors, who worked as general coordinator of the Program from 2004 to 2007, the study was developed through a qualitative research which data was collected by the participation of education professionals who visit museum, under the orientation of PCGC, as well as monitors, professionals of PNFM, involved in the program. The theoretical context was supported on the concept of extended scientific literacy, and also on the concept of informal education and learning in Museums of Sciences and Technology Centers. It is distinguished, still in the theoretical context, the discussion about how the knowledge produced by science is translated, in the Museum of Sciences, in museum knowledge, and the importance of considering, in such discussions, the alternative conceptions of the students regarding the phenomena reproduced in the Museum of Sciences, under a social-interactionist perspective. The results of the inquiry indicated that the discussion and preparation of the visit with the teachers in the schools, the reception of the students in the Museum of Sciences and the posterior development of activities after the visit in the schools, were showed as actions that have been differentiated and that have incorporated a methodology that approximates the practical pertaining to school of the museum practical, disclosing elements of reflection regarding scientific and technological extended literacy of the involved ones. The analysis also showed the necessity of the discussion of the practice of the PCGC, in order to deepen the dialogue between students, teachers and monitors, establishing a wider reflection regarding the concepts of science and technology deeply experienced in the museum PNFM towards a Scientific and Technological Extended Literacy.

Keywords. Science, Scientific Literacy, Sciences Museum.

5th International Conference on Hands-on Science
Formal and Informal Science Education
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"Science and Technology with Creativity". A Case Study on the Use of the Classroom as a Privileged Space to Teach and Learn Natural Sciences

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Abstract. "Science and Technology with Creativity (Ciência e Tecnologia com Criatividade, CTC) is a program developed for science education in elementary school (Brazilian 1st to 9th years, corresponding to ages 6 to 13). The CTC combines the use of a student book, teacher book, materials for investigation and experimentation, continued teachers formation and a careful methodology that prioritize the investigation within the classroom. There are 36 thematic units developed by a team of tenths of professionals, including scientists, teachers, education specialists, psychologists, scientists, product engineers, graphical artists, illustrators and photographers. The CTC is aimed to be a complete solution to teach and to learn Natural Sciences in the public and private schools, and it is a product under continuous development for more than 10 years. CTC is currently being used by more than 350 thousand students in different places in Brazil, including 250 private schools, more than 500 public schools (including several municipal schools and, more recently, all the public schools of the Federal District, Brasilia). It is worth mentioning that all the books are being translated to Spanish and English, to respond to a continuous demand of the international market. In this presentation, an overview of this innovative program will be given, with an emphasis on the evaluation and challenges.

Keywords. Science Education, Novel Methodology, Classroom.

Methodology of the Inquiry: the Classroom as Investigative Space

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Abstract. The development of the conceptions of education of natural sciences throughout the XXth Century left an important inheritance to the educators of today: students, motivated by adequately formulated problems, mobilize their knowledge and learn new concepts, procedures and attitudes while they look for proper answers to each different challenge. Considering this conception of teaching and learning, in which the relationship among teacher, students and knowledge is the background to push the educational process, we have systematized the so-called "Methodology of the Inquiry", an investigative perspective of teaching and learning natural sciences. Within this perspective, teachers do consider the previous knowledge of the students through problem propositions that favour the cognitive conflicts that eventually would lead to learning in a process of conceptual change. The activities, besides starting from specific challenges, must be varied in order to offer a different perspective on the contents, thus increasing the possibilities of each pupil to establish new relations and to learn meaningfully. Based on this methodology, Sangari Brazil created the "Science and Technology with Creativity", a program for scientific education of Basic Education Schools in Brazil. In this presentation, we will present a detailed view of the conceptual basis of the "Methodology of the Inquiry", including the challenges to turn an ideal theoretical picture into a reality.

Keywords. Inquiry, Novel Ideas on Science Education.

 ISBN 978-989-95095-3-5

Application of Technologies in Physics and Mathematics Education in some Culture-Specific Countries

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Abstract. Teaching physics in schools and colleges effectively in some developing countries did never face any special difficulty until the advent of computers. The use of computers in class-rooms has been able to teach less of physics and mathematics but more about using computers. Computers have unnecessarily consumed class-slots, contributing to less learning-time for abstract thinking. This is harming the basic thinking abilities of young learners. As the process of learning lies in integrating observation with abstract thinking, computers appear to pose a barrier between the two. Both observation and thinking times are killed, especially in these countries endowed with a long tradition of studies in mathematics through centuries.

The thoughts pronounced above require clarifications. Illiteracy is a challenging problem in many developing countries (ref: World Education Report, 1991, UNESCO: illiteracy rate %, age 15 and over 1990: Bangladesh 64.7, Bhutan 61.6, China 26.7, Egypt 51.6, India 51.8, Iran 46, Pakistan 65.2, Sri Lanka 11.6, Nigeria 49.3, Argentina 4.7, Brazil 18.9 etc.). Resources are required to be mobilized for eradication of illiteracy and spread of primary education. Modernizing physics syllabus in schools and colleges subservient to use of computers is uncalled for in many of these countries burdened with high rate illiteracy. Moreover, colour display of curves or playing with data or some such computer-abilities are irrelevant in teaching process in the classroom. These young aspiring physics learners have nothing to do with "data" or "data-base" etc., which are ably handled by computers. The teacher must always remain the principal attraction in the classroom for the learners and not the magic-machine computer. A teacher can never be replaced by a CAI (computer-assisted-instruction). A teacher only can and must "inject" the abstract concept linking the physical phenomena into the tender brains of the young learners. A computer has a very little role to play along this basic principle of teaching. A computer indeed cannot fit into the teaching-learning processes taking place between teacher and the learner, specially, so far learning abstract concepts are concerned (ref. Structures in Mathematical Theories, San Sebastian, Spain, 1991, p. 339).

What is immediately required is to imbibe the spirit and culture of abstract thinking by garnering as much GNP as possible. Computers are a hindrance to achieving these essential and primary objectives in the field of teaching physics.

In so far as physics teaching is considered, a physical phenomenon or an experimental result may be viewed as part of a broader and larger idealized or mathematical or abstract "model" phenomenon or situation. The power to get into abstract "modelling" or "mathematizing" physical phenomena, probably, all will agree, is the key to achieving path-breaking success in the field of physics. Thus abstract thinking need be emphasized in this level of physics teaching. Classical examples are well-known.

The countries under reference are used to producing export-quality physicists by employing meager GNP and using chalk-duster-blackboard and not-so-costly equipments through a vibrant, age-old, excellent teacher-learner relationship. This will be amply clarified by a serious look at the phenomena of "brain-drain" from the developing to the developed countries in the fields of physics and mathematics (ref : detailed study by R.K.Bhattacharyya, IOSTE Symp., 1994, The Netherlands, Pt. I, p.74).

The pronouncements made above must find justification or endorsement by a brief review of the situation prevailing in industrialized countries (such as, say, USA, Japan, Germany with no illiteracy). "Simply put, students in our Nation's schools are learning less mathematics, science and technology, particularly in the areas of **abstract thinking** and problem solving", - US National Science Board Commission on Pre-college Education in Mathematics, Science and Technology, Washington, 1983. "….over 5000 American women got medical degrees in the US in 1990 compared with 63 in physics' – Physics Today, 1993 (also ref. : RKB 1994 : large number of non-US born Americans obtained Ph.D. in Mathematics etc).

It is imperative on education planners to recognize the significance of diverse cultural perspectives and endeavour to improve quality by strengthening the cultural tradition of learning.

Keywords. Mathematics, Physics Education, Technologies, Culture Specific Countries.

5th International Conference on Hands-on Science
Formal and Informal Science Education
© 2008 HSci. ISBN 978-989-95095-3-5

A Mathematics Scholar Project

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Abstract. The main purpose of this project in Escola Secundária de São Pedro, Vila Real (at North of Portugal) is to improve the mathematical knowledge on students of 3rd cycle of the Basics Education. As math's teachers and professionals on education we believe that improvements on mathematical learning should pass by new arrangements on the curriculum, which should be more flexible and practical. This method has two points that should be fully covered to achieve positive results:

a) Teachers who teach the same level should collaborate between each other, because the improvements on Mathematical learning cannot be achieved by one single person alone in his classroom. There also should be an interactive environment between teachers using the new curriculum as reference.
b) Inside classroom teachers should create specific methods of work in order to students achieve high levels of mathematical learning. This new awareness should give them an appropriated level of concepts domain and work methods, in order to appreciate and understand the value of math's itself. In addition students by gaining this new awareness should use the mathematical learning to analyze and solve complex situations, which would give them the opportunity to gain self-confidence and power of communication.

Keywords. Mathematics, Collaborative Work, Mathematical Learning, Curriculum.

Spreading Science Fairs: Knowledge and Training

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Abstract. Science Fairs are a lucky method to spreading science. Previous Knowledge & training in is necessary to go to the best practices making fairs. Historical, structural and didactical approaches are shown to contribute to the previous knowledge and training of teachers and organizers. Like all social variation, the communication of scientific knowledge and the formation in science is subject to a history in which diverse influences are pronounced. If we consider the events type "Science fair" like advisable training and educational element in the scientific field, is desirable to remember not only his present history or manifestations as performance base, but also metadidactical strategies for his transmission, expansion and continuous didactic improvement.
As far as history, their diffusion and evolution will draw up to the main lines of. As far as the present manifestations, they will be classified depending on diverse criteria. As far as the didactic improvement, a line of formation for professors/promoters of manifestations of science and education like Science Fairs will set out. In addition, we will schematically put in relation the three previous sections.

Keywords. Science Fairs, Hands-on Science, Collaborative Science, Didactics, Organization.

 ISBN 978-989-95095-3-5

Young Talent for Sciences Program

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Abstract. This program was implemented last 1999, and is devoted to students from high school, especially the ones on second and third years. In the first beginning, it was just for students from the capital of the state of Rio de Janeiro and nowadays it is extended to 25 cities in the state, and includes 500 students. The main objective of the program is to promote the introduction of the students on scientific environment, as a Scientific Initiation as well as stimulate new talents for scientific career. The students are placed at research laboratories at the Universities or industries, under the supervision of an advisor. The student's performance is followed by the program administration. This program promotes also a social inclusion offering to the students a grant and better perspectives for the future.

We have remarked that the program has a positive influence under the student´s way of life. In order to know on details in which way the student´s style of life was modified, we performed a research about that by sending to the egress of the program a questionary about their professional life, their options, the courses they have followed and so on.

We have performed a research about the influence of this program on the student's life, 200 cases were analyzed. We investigated their career options, for the ones that are attending a University. Some of them choose the same career on which they have trained and others changed the domain. An investigation about the influence of the program on the student's stile of life was also performed. Once a year a symposium where the research developed by the students is organized. The new perspectives for the Young Talent for Sciences Program are permanently being evaluated to follow the new trends of the science market.

Keywords. Scientific Initiation, High School Students, Scientific Education.

Surfactant

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Abstract. The chemical-pharmaceutics industrialists manufacture and trade, yearly, long ton of personal hygienic products. Have you thought about how can these products remove the dirty, mainly the fat ones? What makes possible an insect walk on the water? Our studying group on education to the science learning developed a workshop about the tensoactive agents which looks for the use of problem-situation way. There, it proposes to the members the realization of some activities to its development. It will be available some material to the students, such as: detergents, vegetable oil, water and others. Their use will promote the main idea construction about the superficial tension water and about how some cleaning products act on it.

Keywords. Surfactant, Surface Tension, Hands-on Experiments.

Discursive Trajectory of the Concept of "Energy" in a Science Class

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Abstract. The present study pertains to discussions regarding science teaching and its implications for the education of teachers. The discursive trajectory of the concept of "energy" in a science class is discussed and analyzed. The analysis is cantered on the discursive dynamics and teacher's strategies in this process and is founded on a linguistic approach to scientific interactions of etnomethodological inspiration (Mondada, 1994; Alencar, 2004). The teacher's strategies were found to enable the inclusion of

 ISBN 978-989-95095-3-5

the students' discourse in the construction process on the concept of "energy".

Keywords. Science Teaching, Teachers´ Education, Discursive Trajectory.

Models of Explanation in Science Class

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Abstract. This present study is part of an idea that is still in an early stage of development, but is driving future investigations regarding explanation. We will first present the theoretical bases for the analysis of the structural aspects of three models of explanation: Hempel´s renowned Deductive-Nomological (DN) Model, Wesley Salmon´s Statistical Relevance Model and Bas van Fraassen´s Pragmatic Theory of Explanation (believing that explanation is a combination of three terms: theory, fact and context). The study was carried out in a 5th grade elementary school science class. Based on preliminary results, we observed the teacher´s use of the deductive-nomological model as a form of validating her explanation.

Keywords. Science Teaching, Teacher Education.

Introduction to Drama as a Teaching Strategy

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Abstract. There has been a fundamental change of government policy towards the teaching of fact-based subjects in the UK, with a new impulse to free up science to a more imaginative and cross-curriculum approaches allowing 20% of a teacher's time to be at the discretion of the individual teacher.

The Government minister responsible, Ken Boston, and his chief advisor, Professor Hepple, have used the example of how this might be interpreted through the subject of Climate in Crisis and the issue of sustainable growth, as this connects with Geography, History, Physics, Economics, Ecology, plus current and international affairs. In other words removing the confining boxes.

At both school level and across all ages, the nature of this challenge is fourfold, for us to find ways for science to become:

a) more appealing and interesting
b) more relevant, to connect with other subjects and broader issues.
c) more involving, participatory
d) more playful

By taking a key controversy currently in the news - for example, how the advancement of genetic science has thrown up the issue of Designer Babies, and the possibility of parents choosing the sex and characteristics for their children - I would then engage the group in the debate, recruiting advocates for and against. Thus giving n illustration of how complex factual material can be communicated through argument. I will illustrate how these techniques are transferable to any number of other areas - e.g. the issue of employing atomic power to solve the fuel crisis, or the recent debate around bio-fuels (food vs. fuel) or the use of the MMR vaccine, or even the ongoing debate as to the evolutionary origins of Homo sapiens indeed anything with a controversial or ethical dimension.
I would also explore and discuss a range of other drama techniques that can be exploited in the teaching of science.

Keywords. Science Teaching, Teaching Strategy.

 ISBN 978-989-95095-3-5

The Violin as a Tool for Teaching and Learning Physics

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Abstract. The major difficulty faced by Professors of Physics, and especially by high-school teachers, is the lack of motivation of their students to whom this subject sounds really far from the daily life world. One attitude to overcome such problem is the use of examples and activities related to the students interests. Thus Music may become a strong ally in search of motivation. For example the study of a vibrating string can be studied in a Physics laboratory as well as a perfect illustration in class if directly applied to the vibration of a string instrument such as violin or a guitar.

Keywords. Musical Acoustics, Physics Teacher.

Discovering the Human Body. An Interdisciplinary Project in High School

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Abstract. From the axis of thematic series "Who I am?", Which has as objective to enlarge the understanding, both in physiological and sociological sense, by language and concepts of the disciplines of Biology, Physics, Chemistry and Mathematics, teachers in the Area of Science of Nature, Mathematics and their Technology, developed the project "Discovering the Human Body." Where the students present to the teachers the anatomic model mounted by them, reporting all the steps undertaken during the project, and that interdisciplinary concepts were used to obtain the final result. Along the presentation students produce and deliver a story, in the form of comics, which use a more colloquial language so they can count the different stages of the project. With these activities it was possible developing chemical, physical mathematical and biological concepts inter-related, which allowed the student a systemic view of the human body.

Keywords. Interdisciplinarity, Teaching of Sciences, Hands-on.

Playful Activities to Know Better the Group of Insects in Espaço Ciência

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Abstract. The Espaço Ciência is one of the largest interactive museums of science in Brazil. Where we find Biology workshops and activities in permanent expansion, divided into the following groups: zoology, ecology, microscopy, human body and botany. Among these are workshops related to entomology using the species of insects collected in the mangrove and entomological collection of the Laboratory of Biology of Espaço Ciência, helping to provide some information about the importance of insects in the environment, their biology, the dangers of insects as vectors of disease, methods for collection and criteria for identification. These activities are designed to develop a new way of teach entomology within the museum of science, disseminating and building the scientific knowledge for students and teachers, and the general public. The observations and collections of insects were held around the mangrove Chico Science, in order to register the occurrence of some species. For this, were collected weekly, with the use of some equipment (sticky trap, tray of water, soil trap, funnel of Berlese, box of emersion, collecting network, and others). Workshops were held

 ISBN 978-989-95095-3-5

mounting boxes of entomological classification for students of high school and a different workshop, targeted to students of elementary school called "Life of Insects," was created. This different work for students and visitors as well as training of teachers, shows up as a good factor for the public access to the knowledge.

Keywords. Insects, Entomology, Hands-on activities.

Investigating Extraction of DNA in Popular Plants of Brazil as a Way to Approach Issues of Genetics in the Classroom

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Abstract. The DNA extraction presented here in this work is simple, and helps a lot when used to provide a new point of view over DNA examination, location of this molecule in the cells and its roles. The activity presented here aims to stimulate the sense of seeking results and explanations on a determined fact. Comparing results observed on DNA extraction of three different species of plants, the students will test which one is the best to visualize DNA molecule and infer on what makes one plant better than other to visualize DNA.

Keywords. DNA, Genetics, Education, Secondary School, DNA Extraction.

An Research of a Sun Movement Model for Different Seasons and Latitudes

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Abstract. How does the sun move in the sky throughout the year, over a certain place on the planet? For the purpose of knowing the previous knowledge of future teachers a pre-questionnaire was applied. After that, these future teachers worked in a guided way with a geocentric model of the sun´s movement. In the questionnaire applied to them afterward, a percentage of right answers close to one hundred percent were observed. Moreover, the students proposed and “solved" the most diverse problems. The results indicate that the use of models, manipulated and conceptually explored in a free way, is a didactic strategy of great value.

Keywords. Previous Conceptions, Geocentric Model, Astronomy of Position.

The Teachers' Knowledge in Science Classes of Elementary School

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Abstract. The research pertains to qualitative perspective of education, exploratory and descriptive in nature. The objective was to identify and analyze the teachers´ knowledge that emerge in the daily teaching of science in the early classes of basic education. The theoretical discussions depart from Maurice Tardif's proposals in conjunction with the teaching of science and his implications for teachers´ education. The methodological procedures were the videography, non-participant observation and field notes. The

 ISBN 978-989-95095-3-5

results point to teaching practices in which the knowledge is inarticulately evidenced.

Keywords. Science Teaching, Teachers´ Education.

Teachers' Knowledge in Elementary School Science Classes

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Abstract. The present exploratory, descriptive study was carried out based on qualitative approaches to education. The aim was to identify and analyze teachers' knowledge emerging in science classes in youth and adult elementary education. The theoretical approaches used were those put forth by Maurice Tardif and Clermont Gauthier. Methodological procedures included videography, non-participating observation, field notes and interviews. The results indicate that the teachers exhibited knowledge related to the reading-and-writing process, curricular knowledge and experience.

Keywords. Science Teaching, Teachers´ Education.

Interactive Learning Environment and Human Communication

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ABSTRACT

Abstract. The interactive museums provide learning through dynamic and participatory manner. There are some interactive museums in the world dealing with Human Communication and Vocal Production topics, as the Cité des Sciences et de l'industrie – La Villette in Paris that have a interesting permanent exposition named "Communication – Sounds", that treats content of production and reception of sounds, synthetic speech, mechanisms of animal communication, relation between the spoken language of an adult and a child babbling exposed to the same language, parameters of articulation of vowels sounds, among other related subjects. From the analyses of this example and others, came the idea of creating an interactive exposition about health, using Telemedicine resources from the Medical School/USP and images from the "Virtual Man" project, exploring the aspects of Human Communication. The goal of this project is to establish a proposal of an Interactive Learning Environment and Human Communication to be implemented at Estação Ciência/USP that will use the volumes I and II of the "Virtual Man" of voice.

Keywords. Science Museum, Informal Learning, Communication.

Hands-on Universe

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Abstract. The Hands-on Universe (HOU) project aims at re-awakening the interest for science by challenging middle and high schools pupils. It relies on real observations through an internet-based network of robotic optical and radio telescopes. The dedicated software SalsaJ has been developed for allowing pupils to manipulate and measure images in the classroom, within pedagogical resources built in close collaboration between researchers and teachers. Gathering 14 European countries, EU-HOU is developing a network of teachers through training sessions. The worldwide Global-HOU project is also developing and will take advantage of the International Year of Astronomy in 2009.

Keywords. Hands-on Universe, Astronomy.

 ISBN 978-989-95095-3-5

About Champagne, Antrax...and Louis Pasteur (1822 - 1895)

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Abstract. Genetic manipulation and biotechnology are new and promising fields in biology. Returning to the roots of the molecular biology one is confronted with the experimental work of the French scientist Louis Pasteur. The work of Pasteur changed our world: another view on medical science but also a change in the life of many citizens. The bubbles of champagne, the different taste of beer or cheese, the typical taste of wine, the production of human insulin, the knowledge of antibodies and the development of artificial vaccines: all this scientific knowledge found his origin in Pasteur's experimental work.

The young Pasteur was ambitious, had a truth seeking spirit and was very determined to acquire his goal. His earliest work was on the optical activity of certain crystalline substances. The formation of asymmetric molecules seemed to be linked to tiny living creatures. His interest in these substances brought him to the study of the mechanism of fermentation. Yeast was seen as a purely "physical" mixture of chemical substances. Alcoholic fermentation or lactic fermentation led both to the growth of "micro-organisms".

In the middle of the 19th century the theory of "generatio spontanea" was commonly accepted and Pasteur became involved in the controversy whether life forms could arise from non-living matter. He used the growth of yeast cells to introduce the term "germs" explaining that these germs were the possible cause of many infections and diseases. Based on a range of systematic experiments it still took him 20 years to counter the theory of the spontaneous generation.

In 1797 Jenner had saved many people's lives from the smallpox using the vaccine virus as a protecting agent. 50 years later Pasteur added the scientific fundamentals of this process of vaccination which lead to a better understanding of the immune system. Pasteur's career started by solving some problems of the French wine industry, but finally ended with the study of human diseases and prevention.

Since biotechnology is a compulsory biology topic in many countries, these experiments will make pupils familiar with the basics of microbiology and the importance of Pasteur's work. Two groups of experiments will be presented: the yeast fermentations and the bacterial growth experiments with the S-shapes vessels. Pupils learn about applications like aseptic techniques, sterilisation and pasteurisation.

Keywords. Biology, Microbiology, Pasteur.

Role of Hands-on Activity in Development of Students´ Skills in Science Education

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Abstract. Development of students´ skills is very important educational objective of science education. There are a lot of students´ skills in science education. We found the taxonomy of these skills and identified the role of hands-on activities into the acquiring of science experimental skills. Measurement of science quantities is the crucial science skill to be developed in primary and secondary schools. Science teachers would keep in mind the motivation of students into the acquiring of science skills. Gifted students have special needs also in the acquiring of science skills. The paper opens the problem field of development of gifted students´ skills. Concrete examples of hands-on activities applicable in the acquiring of experimental science skills are presented in the paper. The content of these hands-on activities is the human body measurement.

Keywords. Development of Skills, Hands-on Activity, Gifted Students, Measurement of Human Body.

 ISBN 978-989-95095-3-5

Asymmetries and Symmetries in Science Communication

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Abstract. In the mass media, every new advance in scientific knowledge the discovery of a new galaxy or a new particle, the solution of Fermat´s Theorem tends to be presented as good in and of itself, as also occurs with all new technologies and products resulting from them making it increasingly difficult to distinguish between new and advertising when we are told how, for example, a new plasma screen or a new molecule for a drug was conceived. The message is that only good things are to be expected from science, whether they have practical applications or not, whether their contribution to our understanding of the world is understood or not, whether their potential impact on society and their potential repercussions can be anticipated, etc. All science news is good news.

However, when negative aspects of scientific endeavour are discussed, they are usually cast as abnormal cases, and accordingly are often reported in sensationalist tones. Thus, the fraud perpetrated by a Korean scientist is the product of his ambition, an Italian scientist´s attempts to clone a person are pure folly, uranium enrichment in Iran is one more Islamic plot, and the harmful effects of a drug are the consequence of the mercantilism of the pharmaceutical industry, which is not like it was before, when the marvel of aspirin was invented. The common denominator is the abnormality of the events, the deviation from the pursuit of greater good for humanity which is science´s true calling.

Science communication, scientific divulgation, has largely taken a similar approach, extolling the positive side of scientific endeavour in an effort to convince society of the benefits and marvels of science and its importance for humanity, human progress, and the betterment of the world. Little is said about the anomalies of science which prefers discretion to avoid blemishing its irreproachable image and when it is, it tends to recur to its antithesis, an image of science similar to that used by its harshest critics, for whom all new technology, all new lines of research, invariably are the harbingers of multiple catastrophes and the products of plots and covert interests, and who, when confronted with something with which no fault can be found, are unwavering in their suspicion, taking the stance that it is a facade concealing some form of deceit.

The question, then, is how to break this dichotomy, how to account for both facets using the same processes, the same initial conditions, in short how to revert the asymmetry.

Keywords: Science communication, Critics of Idea of Progress, Image of Scientist in Medias.

A Variation of an Ordinary Biology Experiment in the School Laboratory. Temperature Sensors Detect Enzyme Catalase´s Activity in Potatoes

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Abstract. The purpose of this paper is to present a variation of an ordinary experiment in biology. The common practice is to perform the experiment in front of the pupils and let them observe. Our task is to give the opportunity to our pupils of the secondary level to observe the phenomenon, analyze properly the data and draw conclusions. The experiment is about the activity of the enzyme catalase in potatoes in correlation to the temperature.

Catalase is a common enzyme found in many plants and animal tissues. Its role is to destroy toxic substances like hydrogen peroxide. It speeds up a reaction which breaks down H2O2 into two harmless substances: water and oxygen. This reaction is critical for the life of cells because H2O2 is a common by-product of many cellular reactions which take place in every cell. The above reaction terminates, in case catalase is denatured; then, the cells are poisoned and die. In the experiment we examine the dependence of catalase´s activity in potatoes from the temperature.

We design the experiment in a way that will give the essential information to our pupils without becoming boring to them. We take the minimum number of observations (four in this experiment) and we follow the same method of analyzing the sensors output on the computer screen each time. This way the pupils´ interest remains intact. Moreover, their attention is focused on the phenomenon. They are relieved of the process of taking measurements continuously and creating the relevant diagram. For that purpose we use a set of temperature

 ISBN 978-989-95095-3-5

sensors connected to a computer. We consider the Microcomputer Based Labs (MBL) an effective tool for the development of a good conceptual understanding of the phenomenon.

Keywords. Catalase, Enzymes.

Determination of the Impulse of a Super-Ball in a Collision with a Wood Block and a Sponge-Kitchen Using a Force Sensor

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Abstract. The main objective of the present work is to present an easy way to obtain a graphical representation for the force as function of time, in order to extrapolate de numerical value for the impulse in a collision. The experiment was done using a super-ball and a force sensor in two situations: using a wood block and a sponge-kitchen. The data were collected with data studio Pasco Software (version 1.9.7). The motion of the super-ball was filmed with a digital camera (30 frames per second). The motion picture, in avi format, was analyzed with Tracker video-analyzer, in order to determine the velocity of the super-ball, before and after the collision. With the present work, the first conclusion was that the concept of impulse was understood by the students. The analyses, the discussion and interpretation of the variation of force with time in a collision of a super-ball, after this experiment, allowed a much better understanding of the concept by the students, when compared with a simple analysis of a F = f(t) graph.

Keywords. Force Sensor, Impulse, Collision, Tracker Video Analysis.

Cosmic Ray Physics in High Schools: The Phoenix Project

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Abstract. Cosmic rays are the generic denomination of charged particles, like protons or heavier ions, produced in astrophysical processes. They are impinging all the time the Earth atmosphere after their long journey from their cosmic sources. When a cosmic proton interacts with the matter from Earth's atmosphere it produces a huge number of many different subatomic particles. Despite their very short living time (fractions of billionth of a second), they are constantly decaying and transforming in other lighter particles, among them are the so-called muons. The particle multiplication process goes further, creating a kind of disk travelling downwards through the atmosphere. The disk size increases till the available energy from the primary proton is not more enough to create new particles, when it stars to diminish in size and particle number. This phenomenon is called "Extensive Air-Shower". Arriving at the ground, most of the charged particles in the showers is made of muons. The imprint of high energy showers on ground can cover an area that can be large as tens of square kilometres. The Phoenix Project is a proposal to install a simple muon detector in the High Schools, working together in time coincidence, building a kind of giant shower detector. The Project has a modular structure and can grow with no limits in scale as the modules will be installed over the Brazilian schools. The detector apparatus consists of two superposed blocks of plastic scintillator, connected via light-guides to photomultipliers, which are read by a specially built data acquisition board installed in a computer. In each School, students will participate in assembling and adjustments of the setup to start its operation. The main scientific task of the Project is to identify the cosmic sources of these high energy particles. The multidisciplinary profile of the cosmic rays research put the students in direct contact with frontier issues of modern science. It deals with astrophysics, electronics, computing, information technology, particle detection, statistics, just to name some of the topics that can be explored with the aim to give rise in the students the interest to scientific culture, this is the fundamental goal for the realization of this project.
Keywords. Cosmic Rays, Particle Physics, Experimental Physics, Astrophysics

 ISBN 978-989-95095-3-5

Hands-On Activities in Food-Science. An Experimental Contribution to Health Education

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Abstract. A balanced diet and physical activities are the basis for healthy living since overweight and obesity are a major risk for chronic diseases such as type 2 diabetis, cardiovascular diseases, hypertension and certain forms of cancer. In today's society there is neither given enough importance to a balanced diet nor to physical activity. This is clearly demonstrated by the fact that worldwide statistics of the last decade show an enormous increase in the number of overweight and obese people including children and adolescents. In Germany for example 15% of the children and adolescents aged 3 to 17 are overweight and 6,3% even are obese. In comparison to statistics of 1980 and 1990 this shows an increase of approximately 50% [1].
In order to prevent overweight and obesity and its negative impact on health within the young generation it is of the essence to teach health education in school. By teaching health education at school certain awareness of the importance and the necessity of a balanced diet and physical activity should be created.
As a possible approach to teaching this subject at elementary schools we created an "experimental box" based on the "circle of nutrition" published by the German Society for Nutrition. This "experimental box" is ideal for hands-on school labs since it includes a collection of worksheets and materials and thereby offers great opportunities for teachers to implement experimental and knowledge based health education components into regular school life. In regard to balanced diet subjects like cereals, fruit, drinks, milk and its products; fat and sugar are covered. The pupils shall experience cooking as an experimental science. To reach this goal the pupils for example learn how to bake bread and prepare fruit salad and test food for its contents of vitamins, sugar and fat. In addition to that the box contains an experimental component dealing with physical activity (mobility profiles with pedometers).
By working with the "experimental box" the children are enabled to gain knowledge about a balanced diet, develop practical skills regarding the selection and preparation of daily meals and the diversity of nutrition. Thereby they shall be empowered to take over responsibility for their own diet.
By this experimental approach -combining natural science, physical activities and health education- the pupils shall get accustomed to a healthy lifestyle and shall be enabled to transfer their gained knowledge and skills into everyday life.

[1] Kurth & Schaffrath Rosario 2007

Keywords. Health Education, Nutrition, Obesity, Physical Activity.

A Classroom Practical Activity to Teach Concepts on Image Digitalization and Transmission

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Abstract. The general guidelines for the secondary education in Brazil, the so-called PCNEM (Parámetros Curriculares Nacionais para o Ensino Mêdio) suggests a constant recycling in the methods and approaches used to teach the topics of the regular high school disciplines. One interesting feature is the recommendation to an interdisciplinary approach, to stimulate the development of a critical analysis capability in the students and their self motivation to search for answers and solutions for problems. Based in these principles, we have developed an in-classroom activity to teach the principles of Image Digitalization and Transmission. It consists in an introductory talk where the basic features of digital images are explained followed by a split of the students in smaller groups, each one responsible to establish their own rules for image digitalization, such as number of pixels, colour codes and scanning rules. Afterwards an advisory panel is formed by representatives of each group when an agreement on details of the digitalization process and encoding/decoding of information must be achieved. The final task has a practical approach, when the groups have to build their own digital images with the help of squared paper (or any similar media), encode the images following the compliance rules and exchange the encoded data among themselves, so each group have to reconstruct the image transmitted from the others. The topics embedded in Image Digitalization and Transmission, were brought to the day-by-day life of the students mainly

 ISBN 978-989-95095-3-5

through the large diffusion of digital cameras, and the exchange of images via internet. They are very attractive and can be explored to cover an expressive number of items in mathematics and physics syllabus: numeral systems, nature of colours, geometrical optics, analogical-to-digital conversion, optoelectronics, reference systems, just to name a few. Moreover it is flexible enough to be adapted for different education levels, complexity, number of syllabus topics to be covered and the choice of materials and tools for the practical session. In this work it will be described one of the realizations of this activity, which was successful applied in the 2007 edition of the Brazilian program "Teia do Saber" ("Web of Knowledge"), a series of workshops for high-school teachers aiming the diffusion of new educational methods.

Keywords. Teaching Digitalization Concepts, Interdisciplinary Methods

"Recreio nas Fêrias": Workshops for Children

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Abstract. In the months of January and July, school vacation months, Espaço Ciência receives more than 2 thousand children and teens from the project "Recreio nas Fêrias" (Recreation in Vacations). Promoted by de City Departament of Education, the project congregates pupils of the schools of the city and children from institutions that render social welfare work as shelters and day-care centres. Differently of the students with scheduled visits, these children do not come to Espaço Ciência following a script of visit or a project elaborated by a teacher that has to fit the program of the formal school. On the other hand, servant's children of Espaço Ciência are used to visit the exhibitions and search in them new features. Then the challenge was to think about interactive activities that could captivate and stimulate these children to try science, allowing that Espaço Ciência could be transformed in a valuable space to be explored and appropriated by them. With this aim workshops of about 45 minutes each one were proposed for groups of about 20 children, approaching subjects as palaeontology, optics, electricity, ecology and mathematics. The workshops were planned to offer different degrees of difficulty depending on age of the participants. In common to all, the making of individual materials (rejoinders of fossils, kaleidoscopes, mobiles, electromagnets, and origamis) aided by explainers and following simple instructions that they could take with them home. The script of the activities was established following tracks that depended on the solution of related enigmas proposed in the different exhibitions.

Keywords. Workshops for Children, Science Education.

ICT at Physics Field Work

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Abstract. Being a natural science, Physics requires accurate measurements in order to better understand natural phenomena. If conducted in the field, these measurements are the best and at highest possible quality. ICT enables the students to perceive and measure natural phenomena in an interesting and very flexible way. Its importance enriches the field work quality and quantity. Due to the ICT, certain measurements, formerly impossible to execute at schools, can now be conducted. Such measurements are reliable, relatively simple and, what is most important, accurate. Use of ICT drastically decreases the number of measurement errors.

Due to the sudden environmental changes we experience nowadays, these measurements are even more important, for they enable the young people to confront the man-caused problems of our environment. They talk about them, rate, measure and analyse them. Gaining such critical perspective provides them with the opportunity to directly or indirectly develop the appropriate attitude towards nature. ICT provides realistic picture, which can still be improved or at least remedied.

By performing different measurements, the students can directly affect the activities or changes in the field. They go beyond the virtual perception in the classroom and the simulations of the usual experimental measurements, and feel the direct connection between the data and its origin.

 ISBN 978-989-95095-3-5

This work includes some exercises (16 different measurements), which could be conducted during field work. Field work increases the motivation, which is a great problem of today's education. The usefulness of this method does not positively affect only the educational part but also influences the personal growth of an individual.

Keywords. Hands-on Activities, Physics.

The Bibliographic Citations and the Visibility of the Women on Science

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Abstract. Although we believe that it was undersigned, the fact that on the bibliographic citations of scientific publications are given first by surnames (most of times the husband's ones) and names being given after only by initials, turned off that some scientist women have been seen for a long time as men. We will analyse two examples of mathematicians: one from Germany, another from France.

Keywords. Bibliography, Women, Mathematics, Visibility.

Practical Activities for High School Mathematics

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Abstract. We report a few practical activities for math which can be integrated in regular high school programs. These activities usually take two class-hours and need simple materials. The students are encouraged to work in small groups. The teacher can use an easy step-by-step manual. The students show great interest, dedication and concentration, although we do not have quantitative data to measure the impact of the activities. We are discussing some alternatives to check improvement in learning, cognition and reasoning.

Keywords. Hands-on Mathematics, High School.

University Meets School in Hands-on and Minds-on Activities

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Abstract. Science education in which observation, investigation and interaction between students, and between students and teacher play a most significant role have been recognized by a few nations as the standards to be adopted in education. This perspective is indicated by studies from different areas on how people learn. The change in traditional practice of teaching, based on acquisition of information, requires that future teachers encounter the process of formation through investigation and debate in their own graduation course. In this study, hands on and minds on activities are developed both at the undergraduate courses, coordinated by university lecturers, as well as in schools, tutored by undergraduates, side by side with experienced teachers, under supervision of university instructors. In this work, we shall report on this experience at the teachers instruction program of the Institute on Physics of the University of Sâo Paulo.

Keywords. Teachers Instruction, School Science Education.

Understanding Sunlight Energy through Multidisciplinary Experiments

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Abstract. Renewable energy is a subject of utmost importance that should be explored in our schools as extensively and as early as possible. Among those clean energy sources solar energy is being increasingly used and its importance and potential recognised. In countries like Portugal the particularly favourable weather conditions and geographic location raised

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significantly solar energy awareness not only among politicians and industrial investors but also private user and at the community at large. The conditions are set to establish a learning/teaching strategy among our young students on these subjects. Furthermore this topic may lead to the study, in a more motivated and productive way, of basic science subjects. In particular we have approached basic optics topics included in the curricular orientation of Basic Teaching and in the syllabus of Physics and Chemistry classes of the 10th and 11th grades. Our approach starts from remembering studying and reproducing the Archimedes's Legend, exploring thereafter a variety of daily life applications in an interdisciplinary way.

Keywords. Renewable Energies, Solar, Optics, Basics Schools.

Set-up for Studies of the Vascularization of Choriolantoic Membrane from Quail Embryo

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Abstract. Angiogenesis is the sprouting of new vases from preexisting vase and it is an important process for life of organism. Studies of this process has permitted understand as pathological as normal processes of the vascular growth. The activity proposed in this work uses the vascular network of quail embryo chorioallantoi membrane, due it to be an excellent model for the study of angiogenesis as well as an appropriate model for application of the fractal analysis. Here, is proposed a made home set-up formed by a special incubate device that allow look the chorioallantoic membrane during the embryogenesis and to obtain this image using a camera connected to stereo microscope. Software is used to evaluate the fractal dimension the obtained images.

Keywords. Angiogenesis, Chorioallantoic membrane, Fractal dimension, Incubate device, Quail embryo and Vascular network.

"Atomística": An Interactive Experience

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Abstract. The present paper is a report of a project that has been developed by Chemistry Institute, Caxias do Sul University. The project Engineer of the Future, is developed with high-school students and teachers. These experiments were selected in order to present low cost and simplicity in carries through. Show the importance of experimentation in the teaching of chemistry, propose some suggestion to improve the interdisciplinary study and hands-on experiments. Relevance of the application of the interactive activities was verified in the process of learning teaching so that these they contribute for the students' effective learning.

Keywords. Chemistry, Interdisciplinarity.

Exposures of Science and Technology: An Experience in the Paraíba Interior

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Abstract. This work describes of an experiment developed within the Project: "Exposures of Science and Technology: an experience in the Paraíba interior". The Project lies in the context of policies of Popularization and Dissemination of Science, that in developed by the Universidade Estadual da Paraíba (UEPB), the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) and the Museu Vivo Ciência of the city of Campina Grande, were one has done travelling exhibitions of science and technology in popular fairs in some counties in the Paraíba interior. This communication is an event held in the Remígio's county.

Keywords. Popularization of the Science, Technology, Exhibitions in Popular Fairs.

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Preservice Science Teachers' Perceptions on the Use of Science Models as Pedagogical Tools to Enhance Hands-on/Minds-on Curriculum Activities

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Abstract. This article reports the results of teacher-as-researcher study on an instructional unit aimed at teaching the conceptual base of hands-on, minds-on activities to preservice science teachers through the use and evaluation of science models. Twenty-one students participated in the study that took place on a science education methods course at a major public university in Midwestern Brazil. Seven students were randomly selected to voice their perceptions about the unit on this study. The findings showed that the use of models in the classroom and the analysis of science textbooks pictorial models had contributed on a meaningful way to the participants' learning of the subject matter. Students developed a deeper understanding of the role of models to improve hands-on, minds-on science activities. The preservice science teachers conceived the use of models in the classroom as tools to facilitate the learning process. This result is consistent with the empirical research base on the field.

Keywords. Hands-on, Minds-on, Models, Preservice, Science Teachers, Teacher´s Education.

Science Museums - Places for Intergenerational Conviviality

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Abstract. In Portugal, to visit a Science Museum of state institutions had an exponential increment after the 70s. At the same time, the fact that big enterprises had promoted exhibitions and created museums about their own activities after the 80s to show their technology and art had as a consequence that people look at them not only as places of visual pleasure but also as places where the taste for science and technology may increase. Besides spaces to learn science and the interest for it, museums are also good places for intergenerational relationships. Examples will be given.

Keywords. Science Museum, Intergenerational Relationships.

The Student as "Investigator" and the Understanding of Science: Project Scientific Journey

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Abstract. In this work we presented a project of teaching of sciences based on the investigation accomplished by the own students, the "Scientific journey", developed by the teachers (of the technical teaching integrated into the middle school) in the Escola Agrotécnica Federal de Cáceres-MT, during the period of one school year Implications in the teaching and the students' learning are studied.

Keywords. Teaching of Sciences Based on the Investigation, Technical Teaching Integrated into the Medium Teaching, Investigation Done by the Own Students.

Dynamic Geometry: A Hands-on Perspective for Geometry Teaching

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Abstract. The importance of the classical geometry in the maths curriculum changed through the time: representing, for example 40% of the maths contents taught in France 50 years ago, the geometry represents today only 20% of the same contents with the modern maths reform, with an abstract and axiomatic, meaning algebraic, approach. Today, without being as important as 50 years ago, the classical geometry has again a significative importance in the maths curriculum. Geometric knowledges and the geometric way of thinking are very important elements in the teaching of maths and sciences in general, for the scientist, the

 ISBN 978-989-95095-3-5

engineer, the artist, as for the simple citizen (space perception, logical-deductive reasoning, maps reading, graphics,). This renewed importance of the classical geometry in the curriculum is also attributed to the apparition of dynamic geometry software. Although the existence of such tools of geometric studies hasn't been so important in the come-back of classical geometry in the curriculum, without doubt, these tools contribute for a new approach of geometry teaching. Dynamic geometry software gives an opportunity of teaching mathematic knowledge in an experimental way, as physics, chemical and others sciences knowledge can be taught. In this communication, we are planning the show various hands-on geometrical situations explored with the help of dynamic geometry software.

Keywords. Hands-on, Mathematics.

The Teaching of Concepts through a Chemical Workshop in the Museum of Science

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Abstract. In the area of Chemistry, o Espaço Ciência Laboratory presents in several thematic workshops, among them one titled as "Álcool e Etanol?", involving situations of daily life with practical experiments conducted by student's visitors, with the monitor as a mediator between scientific knowledge and groups. It is the alcohol? Will be that have different types of alcohol? Does know other types of fermentation, than those used in the preparation of a cake ... These are some of the questions raised by the experimental approach of this workshop. Following a string of activities, students learn various concepts chemicals that are dispensed by the monitor on the alternatives presented by groups, so interactive, encouraging them to interact with colleagues and with the experiments. The practices of this workshop demonstrate the production of two main products of fermentation of sugar cane (the carbon dioxide and ethyl alcohol), the separation of ethyl alcohol to a saturated solution of sucrose fermented; qualitative determination of ethyl alcohol consumed in drinks by society and gasoline, closing the experiments with the "burning" of money, a practice known as "Queimando o Real". Thus the Espaço Ciência allows the development of actions to popularize the science through unconventional methods, which indicate be much more effective than traditional, targeting the general population. The training of citizens more active leads to building a society geared more to exercise critical skills, promoting necessary changes in various everyday situations, and allows the understanding that the chemistry, specifically, can contribute to economic development, technological and social. The way these concepts are transmitted during the visitation in Espaço Ciência, may arouse greater interest to science, making the scientific knowledge available to all.

Keywords. Hands-on Activities, Science Museum.

Educação a Distância: uma Experiência de Formação de Professores em Ensino de Ciências

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Resumo: Este trabalho relata à experiência de um curso a distância de formação de professores em ensino de ciências, com a temática de diagnóstico ambiental. O curso foi realizado de forma semipresencial, utilizando-se a metodologia adotada pelo programa "ABC na Educação Científica – Mão na Massa". O tema e as atividades realizadas foram bastante significativos para os professores e seus alunos e a intenet mostrou-se uma boa opção para o acompanhamento e a troca de experiência entre os participantes, no entanto, os professores ainda possuem muitas dificuldades de acesso, o que acarreta a evasão e baixo índice de aprovação.

Keywords. Educação a distância, ensino de ciências, formação de professores.

 ISBN 978-989-95095-3-5

Aulas de Astronomia como Recurso de Inclusão de Deficientes Visuais

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Abstract. Apresentamos uma série de experimentos para auxiliar ao professor na tarefa de proporcionar a melhor compreensão possível sobre alguns conceitos e fenômenos pertinentes ao ensino de Astronomia. A característica inovadora de tais experimentos, a possibilidade de que eles venham a atender toda a turma, inclusive a eventuais alunos com diferentes níveis de deficiência visual, desde a mais branda ata a mais intensa, ou seja, alunos completamente cegos.

Keywords. Ensino de Astronomia, Deficientes visuais.

Jardim da Percepção do CDCC - USP: um Espaço de Cultura e Lazer na Cidade de São Carlos – SP

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Abstract. O Centro de Divulgação Científica e Cultural – CDCC da Universidade de São Paulo – USP localiza-se na cidade de cidade de São Carlos, interior do Estado de São Paulo. Desde 1980 preocupa-se com a promoção da ciência e da cultura visando (re) inserir a ciência na cultura dos cidadãos. Em julho de 2006 foi aberta ao público a proposta intitulada "Os Jardins da Percepção" cuja finalidade é "tornar a ciência acessível a todos". O Jardim da Percepção constitui uma das áreas de exposição de ciências do CDCC – USP idealizada ao ar livre ocupando, aproximadamente uma área de 600 m^2. É concebida na forma de jardins temáticos destacando as sensações e percepções nos processos de apreensão da natureza e de importantes conceitos científicos. Nessa exposição, o uso dos sentidos possibilita ao visitante uma forte identificação e associação com fenômenos do cotidiano resgatando suas experiências prévias como primeira abordagem no "diálogo" com os objetos expostos. A integração dos conhecimentos com as habilidades é adquirida pelo uso dos sentidos como forma de diálogo com a natureza na apreensão de novos conhecimentos. A temática proposta oferece ao visitante a oportunidade de questionar nossos próprios sentidos como sendo intérpretes da natureza destacando o respeito aos outros, por revelar que uma mesma "realidade" pode ter mais de uma interpretação (em função das habilidades, capacidades, treinamento e história prévia de cada visitante). Recorrer às nossas sensações e percepções significa compreender as múltiplas maneiras de se apropriar ou não da ciência e, acima de tudo, reconhecer a capacidade que temos de organizar, internamente nossas emoções, as quais são expressas diariamente, por meio de nossos sentimentos. A exposição dispõe de objetos com potencial para comunicar a ciência de forma simples e agradável. As temáticas expositivas contemplam as áreas de Física e Biologia dentre as quais se podem destacar experimentos que despertam a percepção do som, da forma, de tamanho, de temperatura, da vertical e dois ambientes representando o cerrado e a mata ciliar. Possui uma característica marcante quanto à disposição dos objetos, possibilitando aos indivíduos inúmeras correlações entre eles, facilitando desta forma, na apreensão dos temas expostos; seu caráter interdisciplinar, viabilizando infinitas maneiras de experimentar e desvendar a ciência, em seus diversos aspectos: histórico, artístico e cultural científico e tecnológico. O CDCC recebe, anualmente cerca de 80000 visitantes. Durante o ano de 2007 foi registrado um total de 3283 visitantes. A crescente valorização dos aspectos científicos e culturais da ciência pelos visitantes pode ser verificada nos registros dos visitantes atendidos durante o primeiro semestre de 2008, perfazendo um total de 3031. Para finalizar, é importante destacar que o processo de comunicação se efetiva a partir do "acordo" estabelecido entre o visitante e os objetos expostos visando refletir questões acerca da ciência como parte integrante do nosso cotidiano e para a importância de nos posicionarmos perante a ela de forma ativa e dinâmica para inserir, efetivamente, em nossas ações diárias o significado atribuído ao termo expresso hoje por vários estudiosos como "cultura científica".

Keywords. Centro de Divulgação Científica, Cultura Científica.

5th International Conference on Hands-on Science
Formal and Informal Science Education
© 2008 HSci. ISBN 978-989-95095-3-5

Project for the Ecological Development of BUZAU County's Hilly Area

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Abstract. The project had as results a theoretical study, environmental activities, protection of the reservation area, a documentary film, a model of an area of the "Paclele Mari" reservation, a kit with functional modules of electrical piles, photovoltaic cells and the functional model of a house that uses environmental friendly sources of energy.

Keywords. Environmental protection, natural reservation, Muddy Volcanoes, anticline, sandy marls, white gritstones, model, kit, conductivity, electrical piles, photovoltaic cells.

The project for the ecological development of the hilly area comprises several phases:

1) Identifying the hilly areas from Buzau and Mehedinti County that witness geo-morphological phenomena that can lead to soil degradation.
2) Identifying the economical factors that lead to the degradation of the environment.
3) Ways to prevent and fight against soil erosion.
4) Using non-polluting energy sources.
5) Recycling non-biodegradable materials.

In order to achieve these goals we intend to carry out individual and group studies, both theoretical and on the field, trough research expeditions, collecting samples and photographs, presenting, debating and analyzing them during the weekly meetings of the Club's members.

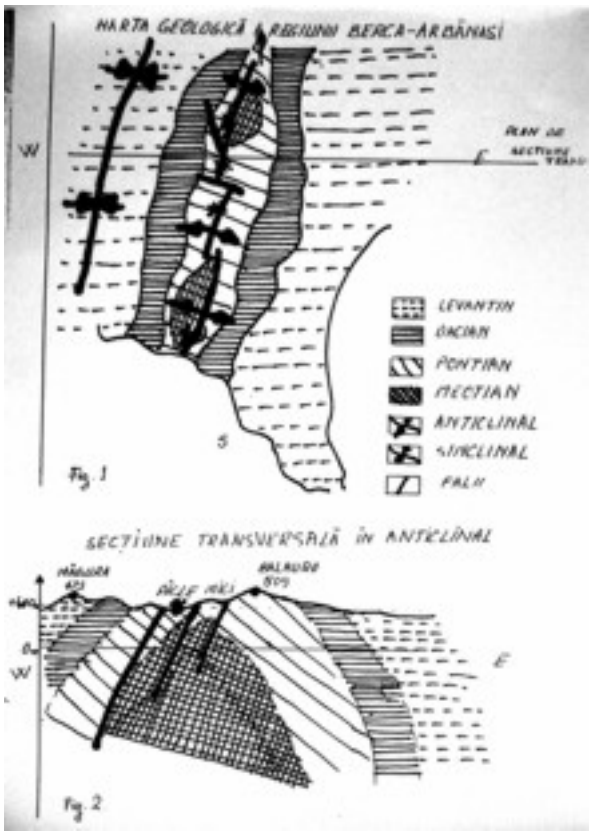
During the first phase we took a trip in order to study the 'Fierbatori', Paclele Mari, Paclele Mici, Beciu areas, situated on the Berca Arbanasi anticline and The Living Fire from Terca area, we realized a documentary footage, collected samples of soil, water and gas.

The area between Berca (on Buzau River) and Arbanasi on Slanic known under the name of Berca Arbanasi anticline, Picle's Hills or the area of the Muddy Volcanoes lies about 25 Km from Buzau.

From the geological point of view, it's an anticline with a length of about 16 km, stretching on a SSV-NNE direction, eroded on the centre, so that on its axis there are some older formations, and on the sides newer layers, marked by a series of longitudinal and strike faults, fracture faults on which we find the Muddy Volcanoes.

From a morphological point of view, the area has two particularities: one is an excavated weald along the anticline excavated by the Muratoarea Piclei Valley and by the superior basin of the Beciu Valley, and the second is represented by the soil erosion, including the Muddy Volcanoes.

The weald derives from the anticline geological structure, and the erosive formations from the petrographic composition, deforestation, oil exploitation, intensive grazing.



The forms composing the anticline are Pliocene, but we may also find some Sarmatian blocks, brought to light by the Muddy Volcanoes' activity, in a period when they were much more active than they are today.

The Meotian appears under the form of two long stretches situated on the anticline's axis at Berca and Beciu, the rest of the axial fault with a width of maximum 3 km, being formed by the Pontian. On the sides, relatively close to some maximum altitude alignments, we may find bands of Dacian overlapped by Levantine. (Figure 1).

 ISBN 978-989-95095-3-5

The layers' inclinations vary from 10 m in the upper part of the Levantine to 80 m in the culminating parts of the anticline (Berca, Paclele mici, Beciu) or in the area of some other faults. (Figure 2)

The petrography is as important as the structure, the dominant being sandy marls of a bluish-gray colour with rare sand intercalations in the Meotian, Pontian and Inferior Dacian layers.

Among the hardest formations we mention a white and gray gritstone, intercalated in thin layers at the upper part of the Meotian, sand banks slightly cemented in Meotian marls and the marls from the superior and inferior Pontian, as well as layers of limonitic sand in the marls of the inferior Dacian.

The most important are the sands of the middle-Pontian, sometimes cemented till the gritstone level, the yellow-gray sands from the superior Dacian as well as the sands and the gravels of the superior Levantine, which are placed practically outside the anticline.

The anticline's existence made possible the development of a longitudinal valley, Muratoarea Piclei, which stretched from Berca to Beciu creating a weald. In the same way, from the Nordic direction, the weald was dug towards Beciu valley, which had made its way here in a transversal direction, from Baligoasa River.

Due to the layers' outward inclination, Muratoarea Piclei valley doesn't have the opportunity of constant alimentation from the ground sources, this being the reason why it remained well behind when talking of depth, to this being added multiple side-slides, which grow in numbers as the valley deepens, their edge points often reaching the talveg and blocking the valley. Such phenomena may be observed each spring, when some slides reach the river bed, creating small temporary lakes behind.

Unusual phenomena through their effects produced on the anticline's axis, in the faults area, are given by gas irruption from Meotian or even Sarmatian rocks, which, due to the pressure exercised by the Dacian and Levantin layers come to the surface taking along infiltration water. Passing through sandy marls and clay, water softens them and raises them to the surface, creating small mud eruptions, fact that gave them the name of muddy volcanoes, fierbatori, picle or muratori.

Together with the Pontian and Meotian marls salts and oil are dislocated, that can be found at the surface, giving white or black colour to the spots on which they crystallize, preventing the growth of the vegetation, reason which gave them the name of bad lands, salty lands or muratori.

These conditions for the mud eruptions are also met by other areas in the country, such as Transilvania Plateau (at Mahaceni, Dumbrava, Aiud, Betea, Sorostin, Sarmasel, Sincai, Reghin, Homorod, Fagaras, Avrig….), The Moldova Plateau, Oltenia's Hills, and Sub-Carpathians. On the globe we may find such phenomena in Italy, Iceland, Iraq, Iran, Indonesia, Central America and U.S.A.

The Muddy Volcanoes from Buzau County, from Beciu, Piclele Mici, Piclele Mari and La Fierbatori are different from the others due to the amplitude of the mud eruptions, which form real plateaus.

Thus through the No. 5/2000 Law, Piclele Mari with a surface of 15,2 hectares and Piclele Mici with a surface of 10,2 ha, have been declared natural reservations, not only for the uniqueness of the relief, but also for some rare plant species: Nitraria Schoberi, originating in Central Asia identified at the west limit of the anticline, (this being the only region in the country where it can be found) and Obione Verucifera, a salty-land plant, and a vegetation usually found in the southern forest and steppe region with numerous Pontic species covering the sides of the weald created by the anticline.

The landscape is unique, alternating craters and cones with heights from several centimetres to 7-8 meters, throwing out differently coloured marls, with a vast network of ravines, tracks, and torrential formations, remodelled after each rain which suggested the resemblance to a moonlike landscape.

The phenomenon is especially impressive at the time of maximum amplitude of the eruptions that is at Cyclonic passings/changes (rainy season) and at high tide (Moon and solar attraction combined).

Laboratory tests of the collected samples have shown that the mud from the craters has a 6,8 ph, with a very weak acid character.

The collected water has a high level of Ca Mg Fe and NaCl carbonate of Tortonian age (Miocene).

The emanated gases have variable concentrations, but still insufficient for the flame to burn without interruptions.

Collected for a longer time, 2-3 hours, they allowed the visualization of a flame for a few seconds.

The soil degradation by natural factors through volcanic eruptions, land-slides due to the anticline's evolution, the washing away effects and the torrents created during the rains is accentuated by the uncontrolled interaction between man and nature.

Oil exploitation is mentioned as early as 1517 (November 22) through the system of lateral

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galleries and evolved to the drilling system which transformed the region of Buzau's arched hills into the most important area for the inter-war oil extraction industry.

Towards the end of the XXth century the oil reserve is diminished, but the area is strongly affected by erosion due to deforestation, unsuitable access networks and oil spills that prevented the development of vegetation.

Soil erosion is also due to a type of intensive grazing still in practice today, preventing the stabilization of surface layers through grassing.

A short economic survey showed that agricultural exploitation of the land is not profitable, but higher revenues may be obtained from touristic activity instead.

This implies the following:

- Building a fence around the protected area;
- Stopping the agricultural exploitation of the land, allowing it to be afforested again
- Prohibiting grazing
- Identifying the gritstone heads or slightly cemented sands in order to identify the alignments of small terracing works for the afforestation works
- Planting furry oak, evergreen oak and pine trees, trees that are found around the volcanoes area proving their level of adaptation to the area's characteristics
- Establishing tree plantations with economic value, such as Hipophae rhamnoides and ornamental such as Syringa Vulgaris

The members of the Club intend to undertake the necessary steps both at local government level, but also handing a survey to Romania's Parliament in order to establish a legal framework and the economic support in the area, necessary to the implementation of measures aimed at environmental protection of the region.

To this purpose the young members of the Environmental Club at Dr. C. Angelescu College address an invitation to all teenagers around the country, to come and spend their summer holidays at Arbanasi (a few km from the reservation) where they can organize field trips to study the area.

Model for the Project of Ecological Development of the Muddy Volcanoes Natural Reservation

The model was done on a 1:300 scale for an area of 13,5 ha situated in the Piclele Mici region, representing both a part of the volcanoes reservation and of the weald created by the anticline.

At the centre we may find the volcanic plateau made of eruptive marls and on the sides breaking formations that didn't allowed the deepening of the valley. The utilized colours tend to get as close to the natural ones as possible, in order to accurately render the landscape around the Piclele Mici area. We have representations of the ravines and of the tracks dug by rain water through the mud that came out of the volcanoes, nature's creativity here being really impressive.

Soil consolidation through terracing and afforestation may be observed around the volcanoes area, on the higher slopes around the volcanoes.

In order to exploit the area's touristic potential in an ecological manner, we proposed the building in the area of holiday homes and cabins that would utilize solar energy, wind power and that of the hydrocarbons coming out to the surface.

The house is modelled at a 1:100 scale and it utilizes solar energy provided by photovoltaic cells.

In the presence of light, the photovoltaic cell transforms the energy of the light ray in to electrical power that charges batteries through the D1 diode. At the same time, the base of T1 's transistor is polarized through the R1 resistance. This one becomes saturated and shifts the T2's transistor base to mass.

In the absence of light, the photovoltaic cell doesn't produce electrical tension anymore, the T1 transistor is blocked and the T2 transistor is polarized in the base, entering a conductivity mode.

This oscillating setting (RC) powers the luminescent diode (LED) with intermittence for economy reasons and with a high enough frequency for it not to be perceived by the eye.

This set-up emphasizes both the conversion of solar energy to electrical energy through photovoltaic cells and the utilization of new illuminating sources LEDs, which in the near future may become the most common illuminating sources due to the following advantages:

- Energy consumption is 75% lower
- The high efficiency of 25 up to 80/lumen/watt is better than that of the light bulb 917 lumen watt) halogen (22 lumen/watt), neon (50 lumen/watt).
- Longer lifespan. The LED's lifespan is of at least 100000 hours, compared to 1000 for the light bulb or 10000for the neon.

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- Safety, durability, endurance. LEDs don't have filaments or mobile parts. It can't be broken. It can take high temperature variations. It can be turned on and off without affecting its lifespan. It emanates very little heat.
- The emitted light has fixed range. (perfect colour)
- Small dimensions (1 mm)
- Low voltage (max 4 volts)
- High reaction time (it turns on much faster)

All these characteristics make the LED the future source of light, as the 100 lumen /watt LED is on the way.

References

[1] G. Posea, Buzau's County Geography, 1973.
[2] G. Posea, General Geomorphology, Didactical and Pedagogigal Publishing House, Bucharest, 1970.
[3] P. Cotet, Elements of Geomorphology anf Geology, Didactical and Pedagogigal Publishing House, Bucharest, 1967.
[4] A. Rosu, Romania's Physical Geography, Didactical and Pedagogigal Publishing House, Bucharest, 1973.
[5] V. Tufescu, The Sub-Carpathians and Transylvania's marginal plateaus, Scientific Publishing House, Bucharest 1966
[6] A. Odabescu, Pseudo-Kynegeticos, Tineretului Publishing House, Bucharest, 1966.
[7] A. Dicu, D. Bortas, Discover Romania- The Muddy Volcanoes from Buzau's Area.

Model for the Project of Ecological Development of the Muddy Volcanoes Natural Reservation

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Abstract. The model was done on a 1:300 scale for an area of 13,5 ha situated in the Piclele Mici region, representing both a part of the volcanoes reservation and of the weald created by the anticline.

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References

[1] Posea, Grigore, Buzau's County Geography, 1973.
[2] Posea, Grigore, General Geomorphology, Didactical and Pedagogigal Publishing House, Bucharest, 1970.
[3] Cotet, Petre, Elements of Geomorphology anf Geology, Didactical and Pedagogigal Publishing House, Bucharest, 1967.
[4] Rosu, Al Romania's Physical Geography, Didactical and Pedagogigal Publishing House, Bucharest, 1973.
[5] Tufescu, Victor The Sub-Carpathians and Transylvania's marginal plateaus, Scientific Publishing House, Bucharest 1966.
[6] Odabescu, Alexandru Pseudo-Kynegeticos, Tineretului Publishing House, Bucharest, 1966.
[7] Dicu, Ana; Bortas Dicu Discover Romania-The Muddy Volcanoes from Buzau's Area.

WORKSHOP 1
Cognitive Motivational Teaching Techniques in Science

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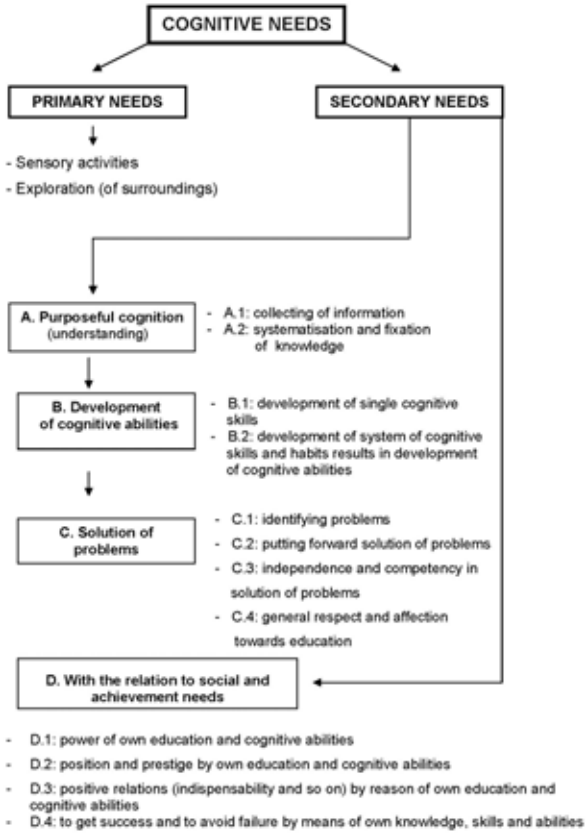
Abstract. Motives have the main role in motivation of students. Motives are the psychological characteristics of a personality which we consider to be the internal cause of behaviour towards experiences. We suggest the definition of motives as factors which awake, keep going, and focus the behaviour. Motivation is a psychological process, in which motives are implemented into the behaviour and experiences of an individual (by outside factors). Motivation results in certain, aimed activity.
Motives consist of elementary innate and learned structures of consciousness which are called needs. Needs are the elementary structures of motivation, which we can imagine as a condition of a lack or abundance in an organism, causing tension in an organism which is directed and starts activity.
This scheme illustrates the relationship between needs, motives, motivation and behaviour:

The classification of needs according to A.H. Maslow (1954) is important to mention: physiological needs, needs of security, needs of solidarity and love, needs of appreciation, and needs of self-fulfilment (inclusive of cognitive needs).

Keywords. Learning, Motivation, Science Education.

1. Introduction.



Education (teaching and learning) are complicated activities, implemented in schools typically in a social context, when a student reacts to the achievement requests of the teacher and school. In education, we can put forward three special groups of dominant needs in students which are being continuously developed: social needs, achievement needs

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and cognitive needs. The group of social and achievement needs usually includes the needs of identification and positive relationships (especially the teacher-student and the student-student relationship), status, influence, competence, realised goal of successful performance, and the avoidance of failure. Social and achievement needs lead to external motivation of the student which has a high motivational impact and which quite often contains a dominant motive. This boosted motivation can be both positive and negative and this is its biggest disadvantage. Luckily this disadvantage isn't included in the group of cognitive needs on which we will concentrate.

Our system of cognitive needs in science education afore mentioned we compared with student's activities in science education. What is identified is a set of cognitive motivation techniques by which students can be motivated including internal science cognitive motivation techniques and interdisciplinary cognitive motivation techniques.

2. Science cognitive motivation techniques

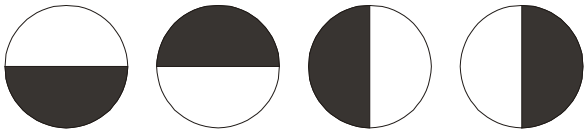
a) Stimulation through unconscious perception and experimentation.
b) Use of models of natural objects and phenomena.
c) Application of systematisation of science knowledge.
d) Use of similarity and analogy between natural objects or phenomena.
e) Undertaking problem exercises and projects.
f) Demonstrating simple experiments and toys.
g) Seeing paradoxes and tricks.
h) Watching films, video programs, TV programs, and computer programs.
i) Experiencing humour in science.
j) Visiting science museums and centres.

3. Interdisciplinary cognitive motivation techniques

a) Science for life (especially related to social issues - health, food, energy, and environment).
b) Applications of science knowledge in technology.
c) Use of ITC in science.
d) History related to science discoveries and scientists' lives.
e) Analysis of scientists' quotations.
f) Use of sci-fi literature and films.
g) Application of relation between science and art.
h) Use of philosophical aspects of science.

4. An example of cognitive motivation technique

In many fairytale books we can see illustrations of the evening sky showing a shining moon. In four different illustrations the moon was (displayed as the following):



Which picture correctly shows the moon in the evening sky after dusk in a temperate zone in the Northern Hemisphere?

The correct answer to task 1 is (C): If you are looking at the southern part of the sky and see the moon, the moon will illuminated from the right by the setting sun in the west.

5. Conclusions

It is necessary to use the following student's motivation ideas in science education:

(1) Individual motivation: Motivate each student according to their personal motivational spectrum.
(2) Variability: Use a variety of incentives to motivate all students.
(3) Adequacy: Pick appropriate incentives for each cognitive motivations teaching technique.
(4) Optimal proportion of motivation: Missing motivation as well as an over saturation of motivation can lead to a decrease of efficiency and interest of students. Optimal motivated behaviour illustrates a certain performance in satisfying the need. Necessary for reaching the optimal level of motivation energy.
(5) Formation of a spectrum of students' needs and the creation of an interest in science: From the motivational point of view, forming a spectrum of students' needs and the creation of an interest in science is a very important but also very difficult task for a teacher. It is possible to successfully develop the interest of talented students. In the case of untalented students, we try to at least create a positive attitude.
(6) The passage from external to internal motivation: The fundamental of this principle is the development of cognitive needs which are related to social and achievement

 ISBN 978-989-95095-3-5

needs. These cognitive needs form a bridge between internal and external motivation. We can involve a student with mathematical skills, and an interest in computers, in the solving of a numerical science problem, or in the computer modelling of an object or phenomenon. We can make the student, who is interested in history, more self-confident in science education by using his knowledge of inventions.

(7) The passage from the quantity of motivation to quality: If the student has already developed a positive attitude or even an interest in science, the quantity of his motivation changes into quality.

(8) Suppression of negative motivation: The principle here is part of the humanisation of teaching science and should be evident.

(9) Purposefulness, systematic, and connection to other elements of education: We must see teaching science as a complex system. Motivation of students, by itself, is not enough for success in teaching science. It is necessary to combine student motivation with other phases of teaching – approach, classroom atmosphere, student involvement and diagnostic measures.

(10) Interconnection with emotions and will**:** We should not forget the other parts of a student's personality, which is closely connected to the student's style of learning science.

6. References

[1] Atkinson, J. and Raynor, J.O. Motivation and achievement. New York, 1974.

[2] Maslow, A.H. Motivation and Personality. New York, 1954.

[3] Shayer, M. The Long-term effects of Cognitive Acceleration on pupils' Achievement. London, King's College London, 1996.

[4] Trna, J. Science Experiment in Science Teacher Training. In: Science and Technology Education in New Millenium. 3-rd IOSTE Symposium for Central and East European Countries. Prague, PERES Publishers, 201-206, 2000.

[5] Young, P.T. Motivation and Emotion. New York-London, 1961.

[6] Trna, J., Trnova, E. Cognitive Motivation in Science Teacher Training. In: Science and Technology Education for a Diverse Word – dilemmas, needs and partnership. 11th IOSTE Symposium for Central and East European Countries. (Lublin, Poland, July 25-30, 2004). Lublin: M. Curie-Sklodovska university press, 223-224, 2004.

WORKSHOP 2
Uses of Drama as a Teaching Strategy

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Abstract. In order to motivate the student to take on the sheer absorption of facts and theories, involved in science subjects, I will demonstrate how drama techniques can encourage students to be more engaged, inquisitive and involved.

Firstly I would take a current controversy, for example, how the advancement of genetic science has thrown up the issue of Designer Babies, and the possibility of parents choosing the sex and characteristics for their children. Or we could take the issue of employing atomic power to solve the fossil fuel crisis or the use of the MMR vaccine or the ongoing controversy as to the evolutionary origins of Homo sapiens â€“ indeed anything with an ethical dimension. I would then engage the group in the debate, recruiting advocates for and against. Thus exploring the possibility of how drama can encourage the students to learn the factual basis on which the debate needs to be informed. I would also explore and discuss a range of other drama techniques that can be exploited in the teaching of science. These would include:

1) Role-play by taking a historical or significant contemporary scientific figure, demonstrate that this does not involve acting skills on the part of the trainer so much as the representation of the arguments and points-of-view of this figure.
2) Hot-seating: this is an extension of role-play. It is also a skill that can be exercised by the students as well as the trainer within the context of the learning situation.
3) Simulation: this involves the structuring of a more concerted project, for example for a whole year group over an extended period. This could entail all the above techniques but would involve more detailed research, a wider engagement of skills and cross curriculum involvement (e.g. Art for graphics and displays, History for social and political background, Geography etc.).

The workshop will engage the participants practically, enabling them to exercise and practice these skills within the session, whilst also illustrating the techniques employed. Delegates will be provided with a simple hard copy of information and techniques used within the workshop.

 ISBN 978-989-95095-3-5

WORKSHOP 3
Building Images: Holography by Hand, Pictures Made with Pinhole Camera and Sum-of-Colors Ball

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Program:

1st Class (2 hours): Will be made a brief explanation about the process image formations and a brief discussion about technical details that refers to the photographic registration and the chemical process evolving. There is an activity out of the classroom to obtain pictures with pinhole camera in photographic paper. The workshop will be finalized with the revelation of the pictures made by every participant.

2nd Class (2 hours): Will be made a brief explanation about the formation process by pinhole camera, mirrors and lenses. Will be introduced, by simple demonstrations, the concept of diffraction and interference of waves, with images formation by holographic process. The workshop finalizes it with a construction of a simple hologram by hand, using only a piece of acrylic and compass.

3rdClass (2 hours): Beyond a brief explanation about the color theory, there will be a construction of a model that can be used in the optics classes, to teaching color theories, sum of colors and basic optics phenomena, as the natural selection of colors, transmission, reflection and absorption of color light by several materials of several colors.

WORKSHOP 4
Understanding the Human Body

M.I. Nogueira[1], R. Vasconcelos[1], M. Muramatsu[2] and C.C. Robillota[2]
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Abstract. This activity aims to illustrate and stimulate the exploration of the human body organization, using commercial and prepared models with recycled or low cost material, or using biscuit dough. Explore by the models the organs of sense and sensorial modalities, the body perception and its relation with the environment and with the processes of health and disease. Nutrition, oral health, reproduction and sexuality. Themes and strategies to put hearts and hands on education for health and understanding of inner and external world.

WORKSHOP 5
The Optics of Vision

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Abstract. The main objectives of this short course (three classes of 2 hours each), proposed for teachers of Physics, Biology and Science, are to introduce the optics of vision, through some examples of visual perception, and to discuss the most common visual defects and their corrections. It is expected that this short course can show how scientific knowledge is present in the daily life of everyone and well known phenomena can be used in the classroom to illustrate not so well known concepts.

In the first class, it will be presented vision and visual perception, a brief history of some models of vision, the eye, the visual information pathway and processing.

The second class will tackle the eye as a visual device and its optical characteristics, refraction and retinal image formation, visual defects and its corrections.

Some simple experiments and demonstrations shown will be mounted by the participants during the third class.

WORSHOP 6
Experiências de Mecânica com Materiais de Baixo Custo

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Abstract. Os participantes realizarão algumas experiências importantes de mecânica clássica ligadas ao equilíbrio e movimento de corpos. Em

 ISBN 978-989-95095-3-5

particular, vão encontrar os quatro pontos notáveis de um triângulo e vão obter os centros de gravidade de diversas figuras planas utilizando três procedimentos experimentais diferentes. Serão discutidos os equilíbrios estável, indiferente e instável. Serão discutidos aspectos sobre a vida e a obra de Arquimedes. Todas as experiências serão realizadas com materiais de baixo custo. Ao final do curso os participantes ficarão com os instrumentos e materiais construídos no curso.

WORKSHOP 7
Hands-on Batteries

D. Martins Morato, G. Rodrigues do Rego Barros, R. Rodrigues de Almeida, L.A. da Silva, V. Bezerra de Moraes and J. Tavares Cruz Oliveira
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Abstract. Electric batteries are well-known in our world, but the most number of people don't know how they work. That's why, this Project has as a goal to motivate the students to have an investigation attitude. It will be stimulated during hands-on activities, and it will be built batteries and piles made of fruits, vegetables and different metal plates. The construction of these "galvanic cells" will provoke the group to ask questions about the workshop subject. Among these questions we can cite: Where come the pile energy from? How does the battery behave when they are associated in serial or parallel? Why some fruits are better to build piles than others? These questions will make the students develop a searcher posture.

WORKSHOP 8
Archaeological Learning in Stones of a Remote Past

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Abstract. This activity is related on Archaeology. The methodology used is the discussion, the study and of replicas, restoration of one of the techniques used to manufacture of instruments in rock. Using an interactive relationship with the public, we seek to expand the horizons on the information acquired for them about Brazilian pre-historic populations, in techniques archaeological analysis and the value of the information acquired by the archaeologists. We try, through of experiments, rise the interest of the public about human pre-historic investigation, the knowledgement and the act of acquiring knowledge about the preservation of the places that keep evidences.

WORKSHOP 9
Mathematics as Hands-on Learning

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Abstract. Frequently, Mathematics is considered as a theoretical discipline, where students simply apply ready-made techniques. However, as shown different practices for almost 20 years, their teaching may be also conceived in an experimental research perspective, including successive phases of observation, conjecture and test. This workshop will present examples of this approach, using interdisciplinary contexts or situations that involve abstract mathematical concepts of geometry, arithmetic, and analysis for students from 11 to 18 years. In a collective reflection, we will analyse the advantages and

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limitations of this method, and understand why it is so uncommon in mathematical formal education, when it is very present in science museums or exhibitions.

WORKSHOP 10
Use of the Solar Energy for Cooking Foods. Studies and Optimization of the Solar Stoves

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Abstract. Many countries suffer with high fuel prices and with the intensively decimating green area, when they could enjoy a huge source solar. But many people don´t know that the Sun can be used to cook food. As we know that the building of solar stoves are economic and easy. This project has the purpose to build solar stoves, to observe its working, to use them to cook food, to measure the cooking time and to compare it with conventional stoves and improve their working as we investigate evident or elusive which affects their development. After all, How to use the solar stoves daily, and which ones to use?

Studying Emission Behaviour of Trace Metals in Energy Production Process through Correlation Matrix Technique

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Abstract. Deposition of trace metals in areas surrounding emission sources has reached levels that in certain regions have exceeded the maximum-permissible values. The main objective of this work is to teach students that investigating correlation between various trace metals emitted from stationary and anthropogenic sources, one can find out different solid sorbents need to be used for retaining harmful trace metals .The highly correlated variables are arranged in groups On the basis of correlated group variables we have examined energy production processes dangerous to environment and human health in terms of trace metal emission

Keywords. Trace Metals, Stationary Source, Anthropogenic Source, Correlation Coefficient Matrix.

 ISBN 978-989-95095-3-5

AUTHOR INDEX

 ISBN 978-989-95095-3-5

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