HSCI2007

Proceedings of the
4th International Conference on

Hands-on Science

Development, Diversity and Inclusion in Science Education

July 23-27, 2007
Universidade dos Açores, Ponta Delgada, Portugal

The Hands-on Science Network

HSCI2007
Proceedings of the
4th International Conference on Hands-on Science
Development Diversity and Inclusion in Science Education
23rd - 27th July, 2007
Ponta Delgada, Açores, Portugal
ISBN 978-989-95336-1-5
Online available on http://www.hsci.info

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Edited by

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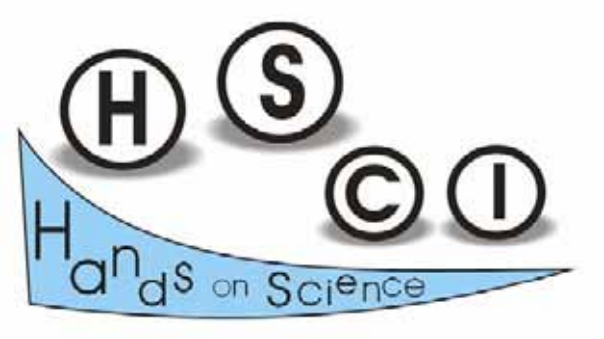

ISBN 978-989-95336-1-5

Printed by: Copissaurio Repro – Centro Imp. Unip. Lda. Campus de Gualtar, Reprografia Complexo II, 4710-057 Braga, Portugal
Number of copies: 200
First printing July 2007
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 4th 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 4th International Conference on Hands-on Science. Costa MF, Dorrío BV, Reis R (Eds.); 2007, July 23-27; University of Azores; Ponta Delgada, Portugal. 2007. Page numbers.

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The Organizers of the 4th International Conference on Hands-on Science acknowledge the sponsorship cooperation and support of:

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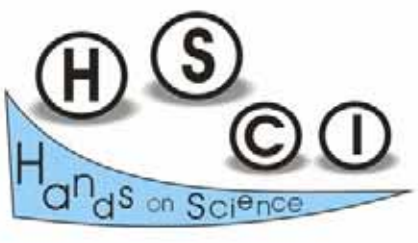

4th International Conference on Hands-on Science
Development, Diversity and Inclusion in Science Education
 ISBN 978-989-95336-1-5

FOREWORD

The quality of life and the levels of economical and social development are quite diverse in different continents, on each continent's trans-national region, country or even local community. Dramatic differences in social and economical development across the world extend to culture and education further conditioning the evolution of human condition and societies.

World' sustainable development strengthening the democracy and social cohesion in our societies with high levels of human development in respect to the United Nations chart of human rights requires a true inclusive globalization on our world. Not the ongoing so called *globalization* that only refer or is implemented in the sake of economics or the economic growth of major companies or multinational corporations, but on guaranteeing dignifying leaving conditions for every human being, focusing on human development and with true respect to each others' culture history and believes, respecting and growing with and from… *the difference*.

Science may and should have a major role in this process. Science education is fundamental to the development of Science and it also may and should lead to a better individual human' development.

Since 2003 the Hands-on Science Network is actively involved in the improvement of Science Education and scientific literacy promoting an enlarged use of hands-on experiments in the classroom under Aristotle's motto "*We learn how to do things by doing the things we are learning to do*". The improvement in the levels of quality and effectiveness in school science education can hardly be achieved without an effective change in the way science education is traditionally approached in our schools. The *method* that drives the pursuit of scientific knowledge should be the starting driving and guiding basis of all process of in-school teaching/learning of science. Leading the students to an active volunteer commitment in hands-on experimental activities: observing, analyzing critically, deducing, reasoning, defining, discussing, experimenting…

"making" (learning) science as a scientist do…

In the footsteps of our successful previous conferences HSCI'2004 in Ljubljana, HSCI'2005 in Crete, and HSCI'2006 at the University of Minho in Braga attended by over 600 participants from 43 countries on 5 continents, with 403 different interesting and meaningful presentations, I am sure this 2007 Conference will again provide the ideal environment for presentation and open friendly discussion of all kinds of ideas experiences and works related to Science Education. This year a special focus is given to difference diversity and inclusion in Science Education, but the almost one hundred communications will cover the wider variety of subjects and perspectives… aiming

… a better Science Education…

As Chair of the conference and Coordinator of the Hands-on Science Network it is my pleasure to welcome you in Ponta Delgada wishing you a wonderful stay in Azores!

Braga, July 2, 2007.

Manuel Filipe Pereira da Cunha Martins Costa
Chair

4th International Conference on Hands-on Science
Development, Diversity and Inclusion in Science Education
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Development, Diversity and Inclusion in Science Education
 ISBN 978-989-95336-1-5

Hands-on Science Network. Improving Science Education towards a Sustainable Development

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Abstract. The developmental needs of our modern societies demand a strong yet sustainable development of Science and its Technological applications. In most countries it is being registered a striving lack of scientists technicians and engineers but also, and probably most dramatically, science and technology teachers[1]. Driven by this fact science should and is gaining an increasing importance in school education. Hopefully also recognizing the importance of the study and training in Science in the building up of our youngsters' personality and abilities, both professional and social, changes in school curricula are being implemented in most countries being giving to Science a clearly higher importance.

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

This was the driven idea that leads to the establishment of the "Hands-on Science" Network back in 2003 with support of the European Commission under the Socrates Program. It was clearly confirmed along these years of exciting and rewarding work and will be the motto of the International Association "Hands-on Science Network" established in October 2006 and now open to a word wide enlarged membership.

Keywords. Hands-on Science, Network, Association.

1. Improving Science Education towards a Sustainable Development

Established in October 2003 in the frames of the Comenius 3 action of the Socrates program of the European Commission, the European Network "Hands-on Science" developed since then a vast range of activities towards a better Science Education in European Schools [2].

Our main goal is the promotion and development of Science Education and scientific literacy in Europe. We aim to generalise innovate and improve Science & Technology teaching at basic vocational training and secondary schools by hands-on experimental practice in the classroom. *Bringing hands-on active learning of Science into the classroom and into the soul and spirit of the school.*

The network, established now as an International Association, enrols as institutional or individual members, over two hundreds schools, several universities, national and international associations, governmental bodies, science centres and museums, NGO's and companies of practically all countries of the European Union and from all over the world.

About a thousand teachers and educators from kindergarten to high and vocational training schools including special education institutions and well over 20000 pupils are or had been directly and actively involved in our activities.

Several dozens of lectures, countless experimental activities in the classroom, experiments demonstrations plays festivals and science fairs were organised. Several science clubs were established are working actively and passionately… discovering Science.

Training seminars and courses for teachers and pupils had been developed at national and European level. Over four hundred pedagogical and scientific papers were published in conference proceedings and journals. Several books and experiments guides and support texts had been published in different languages. Multimedia CDROMs and DVDs were produced as well as fourteen websites in different languages:

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http://www.hsci.info/hsci_mt/,
http://www.clab.edc.uoc.gr/hsci/,
http://lsg.ucy.ac.cy/other/hsci/.

Most of the websites establish links to many other websites offering an enormous amount of resources (including remote laboratories like the site http://colos.fcu.um.es/rlab/) that can be used freely by teachers, students, and all interested persons in general.

Various press-conferences news and reports were organised disseminating the results of our work in our communities.

A major public relations campaign stating and illustrating the importance and the absolute need of a generalized use of practical hands-on experiments at the classroom as basis the education in Science at all school levels was developed aiming EU' schools, decision makers governments and politicians, universities, networks and national and transnational associations, science museums and other institutions involved with non-formal or informal education, the industry, local communities and the citizens in general.

Several successful Comenius 1 and Comenius 2 cooperation projects between dozens European schools and other institutions had been promoted in different subjects: robotics, renewable energies, optics, in-service science' teachers training, sociology and European identity, arts and science, and sustainable development. Other types of cooperation resulted also from the three Socrates/Comenius Contact Seminars we organized as part of our annual conferences in Ljubljana, Slovenia in 2004, in Crete in 2005 and in Braga in September 2006. The 2007' conference in Ponta Delgada, Azores, in this European year for "Equality" will focus on "Developed Diversity and Inclusion in Science Education.

Three international workshops were organized in Cologne, Malta and Bucharest to discuss issues of utmost importance as the Access of Women to Science, Scientific Literacy the Development of Europe and the Challenges of EU' Enlargement, and the increasing importance of Life Long Learning and Scientific Literacy in our Societies.

The "1st International Conference on Hands-on Science. Teaching and Learning Science in the XXI Century" held in 2004 in Ljubljana, was an excellent forum where 120 participants from 13 EU' countries presented 52 works and discussed the main aspects of modern Science Education establishing the basis for the work the network developed thereafter towards the generalization of hands-on experimental work in science education at our schools.

In Crete, July 2005, the HSCI2005 conference, "2nd International Conference on "Hands-on Science. Science in changing Education", gathered nearly 200 participants from 27 countries of the five continents that presented 81 communications discussing the changes education is facing these days in our schools. An interesting science fair was the preferred meeting point for informal contacts and friendly exchange of experiences and good practices.

In September 2006, 4 to 9, at the University of Minho in Braga, Portugal, our "3rd International Conference on Hands-on Science. Science Education and Sustainable Development", HSCI2006, proved the importance and prestige our organizations reached among the EU', and world's, educational and scientific community (a web search for the phrase 'Hands-on Science International Conference' gave more than 1 million hits most of them referring to our annual conferences and over 1/3 of all hits on hands-on science refer to activities of our network[3]).

Over 450 persons registered to the conference and the 314 effective participants from 41 countries presented 270 works, involving 432 co-authors, apart of 137 hands-on experiments presentations (many including several different experiments) at the 1st European Science Fair we organised from the 5 to the 8 of September that was visited, apart from the conference participants, by more than 500 students teachers and interested citizens in the most active and enthusiastic way.

In the overall over 790 scientists teachers students heads of school politicians ministers and other national and local governments representatives, NGO and media from 43 country (mostly from the EU) actively participated in our six major meetings presenting their ideas in 403 works, published and freely available in our websites in electronic format, and established a set of major recommendations and work' support material that, we truly believe, will positively influence the way Science Education is approached in our schools.

2. The future of Hands-on Science

With the active contribution of all network members and individuals and institutions committed to the improvement of science education, the Hands-on Science network will continue growing and contributing to the improvement of scientific literacy and to the quality of science education and thus to a sustainable development of our societies.

 ISBN 978-989-95336-1-5

The Hands-on Science Network[4] will be maintained in the form of an International Association (www.hsci.info) and will keep growing enlarging its membership and the impact of its activities and proposals in our schools and societies...

inducing a better science education ...
in favour of a sustainable development ...
… towards a brighter future of humankind ...

3. Conclusion

World' sustainable development both in economical and social terms strengthening the democracy and social cohesion in our societies with high levels of human development in respect to the United Nations chart of human rights should be a goal of all countries and of each one of us.

The importance of Science, both the pursuit of knowledge and the search for practical uses of scientific knowledge, is widely recognised at all levels in modern societies. A strong and enlarged scientific literacy is fundamental to the development of science and technology but also to a democratic citizenship.

4. Acknowledgements

As coordinator and chair of the Hands-on Science Network, the author would like to acknowledge the enthusiastic participation of all member of H-Sci in this effort of improvement of Science and Science Education.

5. References

[1] Report by the High Level Group on Increasing Human Resources for Science and Technology in Europe. European Commission, ISBN 92-894-8458-6 (2004).
[2] Manuel F. M. Costa, "Hands-on Science", Proceedings of the 1st International Conference on "Hands-on Science en Teaching and learning Science in the XXI Century", pp. 1-9 (2004).
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[4] www.hsci.info.

Results from an Undergraduate Test Teaching Course on Robotics to Primary Education Teacher – Students

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Abstract. In a previous work we have presented the design of an undergraduate course with the title 'Laboratory of Educational Robotics'. Its syllabus includes the assembly and (simple) programming of different modules towards the construction of a robot performing specified (simple) tasks. The course objectives include the familiarization with the notion of robots and the development of cognitive skills. The course was designed within the general context of increasing the Science and Technology Literacy, a crucial factor for the modern, technology based societies. In this work we present results obtained after a test teaching during the first semester of 2007 to undergraduate students of the Department for Primary Education of The University of Crete.

Keywords. Laboratory, Educational Robotics, Robolab, Primary Education.

1. Introduction

It is increasingly accepted that an effective Science and Technology Education may be achieved by an interdisciplinary teaching approach within a constructionismic context. In this sense, Educational Robotics is especially useful. On this basis we have presented in a previous work the design of an undergraduate course with the title 'Laboratory of Educational Robotics' [1]. Its syllabus includes the assembly and (simple) programming of different modules towards the construction of a robot performing specified (simple) tasks. The course objectives include the familiarization with the notion of robots and the development of cognitive skills. The course was designed within the general context of increasing the Science and Technology Literacy, a crucial factor for the modern, technology based societies. Pursuing the objective to construct (or assemble) a robot, students may develop complex cognitive and problem solving skills. They are also presented with real problem situations in which, trying e.g. to chose and manipulate the appropriate sensors or to incorporate movement to the robot, they are helped to a better understanding of basic

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concepts in Physics. In this work we present results from a first time test teaching of this designed course to the undergraduate students of the Department for Primary Education of The University of Crete.

2. Course Delivery

The course was included within the undergraduate program of courses at the spring semester of 2007 as an optional choice in the area of Informatics in Education of the Department for Primary Education of The University of Crete. Graduates of this Department are qualified to be appointed as teachers in the primary school. The course was delivered by the authors of this work. It addressed students on the 5th or greater semester. Most of the students addressed have already completed their basic courses in Science and in Methodology of Teaching. In their majority they are computer literate. In the announcement of the course it was stated that no formal prerequisite knowledge was demanded from those choosing to attend the course, although computer literacy extending to familiarization with simple computer programming would be an advantage. Due to its experimental teaching as a laboratory course and taking into account the available equipment (number of robot kits) the course was planned for 16 students at a maximum in one class. The course was chosen by 26 students. Instead of selecting between them, it was decided to enrol all the students, forming two separate classes in groups of 3 to 4 students instead of the 2 persons per group planned initially. This arrangement was made partly in order to compensate for possible drop-out that is significant in the Mathematics, Science and Technology area of the curriculum partly as a limitation imposed by the number of available robot kits. The drop-out rate was zero a fact we comment on later.

The course was delivered in intervals of three teaching hours per week for 13 weeks. Students however were free to use the laboratory for more hours, if they wanted to prepare or study for their assigned tasks. The equipment used was the LEGO© Mindstorms (see Figure 1) because their purchase was easier. They had the added advantage that the LEGO parts are familiar to most (almost all) of the students. There were two different versions of the robot processor units. The programming was made on PC's with Windows XP or Mac's with OS X using the Robolab© Software supplied by LEGO, an icon based programming language. The program was then transferred through the infrared link to the robot units.

Figure 1. Some of the equipment used

The teaching was organized as follows:

- During the first 3 weeks students were introduced to the concepts related to the robots and the robot programming. Examples of robots used already in different applications were given and students were encouraged to propose possible applications of robots in other areas also. During these same weeks the available equipment was available to the students. They were taught its use so as to become familiar with common techniques of robot programming.
- During these first 3 weeks all the students were in one class. During the next weeks, students were working in groups formed by them. Every group had its own Lego Mindstorms set to use throughout the course. Students were advised to assign between the members of every group the responsibilities for the design, for the assembly, for the programming, etc.
- During the next 4 weeks students were assigned the task of constructing a specific robot from the examples given on the manuals. The manuals were in English, a factor causing difficulties to the students. A clarifying explanation of the logic of the respective robot programs was demanded from the student as an indication of their understanding. Alternatively they could make their own programming to perform the same (or more) tasks. In parallel, students were introduced to design and assemble a robot of their own for a specific task, i.e. to construct a robot that could transfer objects from a place to another one. To make it more interesting a contest was setup where the student made robots will compete, in pairs, to clear their area of a number of ping-pong balls transferring them to the opponent's area.

 ISBN 978-989-95336-1-5

- The next 3 weeks were dedicated to the construction and testing of the robot. At the end the contest was made. During the same period, students were introduced to the concept of 'smart home' with the objective of study, design and implement, in a model way, a specific component of a 'smart home' The students were asked to identify such components and possible ways of introducing appropriately made robots. Students were encouraged to identify components of their own although, as a help, the following components were indicated and analyzed to some extend:
  - the operation of water heater and of central heating,
  - the interior – exterior house illumination in relation with the presence – absence of the residence or with other conditions,
  - the operation of the garage gate,
- The next 2 weeks were dedicated to the implementation and the presentation of the 'smart home' components that every group of the students had chosen.
- During all times of laboratory work a supervisor was always present to guide, during the first weeks, or to help and provide advice if asked, afterwards. Specific parts of the manuals. Referring to the assembly and some techniques on achieving specific results, were also translated into Greek and made available to the students.
- Students were also requested to submit a short weekly report (one per group) on their work.
- During the last week, through an anonymous questionnaire with open type questions students were asked to express their opinion on specific aspects of the course [2]. The remaining time after the completion of the questionnaire, was dedicated to a free brain storming type discussion commenting on the course experience.

3. Teachers' observations

All the students attended the course without any drop-out. This is a rather remarkable outcome for this type of course at the specific Department where the majority of students have a rather negative attitude towards Mathematics, Science and Technology. In previous courses, when the actual practice work (constructions, experimentation, field research …) commenced there was a significant drop-out rate (up to 50%). The remaining students however, all were achieving high marks. High marks, on the upper 25% range, were also achieved in this course.

None of the students had any previous experience with computer programming but they managed quite well using the supplied software with the (intuitive) icon based robot programming language. Quite often, however, the students had to work in the laboratory outside the teaching hours in order to get experience with the programming, a fact that added to their workload significantly. A rather worth noticing observation was that, mostly, students were trying to correct their programming or their assembling without resorting to the manuals (even if they were translated into Greek) but by trial and error techniques. This may be perceived as an indication of increased interest and self-esteem about their abilities to succeed on the subject. If their attempts failed, students were asking advice from the instructors quite often with humorous comments an indication of a friendly teaching environment.

The zero drop-out rate for this course despite the increased students' workload together with the high marks achieved may be perceived as a positive change of the students' attitudes towards Science and Technology. This explanation is further supported by the fact that the teaching proceedings of the course were known widely arousing the curiosity of other people (students, technicians, even outsiders) and many times there were outside observers during the teaching.

Work within the groups was mostly on an equal basis with peer discussions. Even at the 2 groups where there was an evident domination of activities by one of its members, all members were active. Sometimes discussions on what to do were lengthy and lead to disputes, especially during the first weeks. In three groups, the advice to assign responsibilities was taken literally and it seemed to be another source of dispute.

There was no apparent differentiation in task responsibilities between girls and boys. Girls were equally involved in constructions with gears, wheels, etc although this is considered, to some extent at least, a male occupation.

Judging from the results obtained at the end of the 7^{th}, 9^{th} and 11^{th} weeks, students had attained the objectives of the course at least at the group level. They assembled successfully and put into an efficient operation the robot under guidance (end of the 7^{th} week). They all succeeded to construct a robot of their own (with very little guidance) and participate to the contest (end of the 9^{th} week). On the final task requested, namely that of a component of a 'smart home', all groups made a rough analysis of one of the components indicated to them but at the end all groups choose to construct a rather

 ISBN 978-989-95336-1-5

simple household item – accessory (automatic light equipment, a toy activated when light or movement was detected, …) [3]. It seems that the time allotted to this activity was not sufficient, one or two more weeks were missing. However the main objective to detect application areas for a robot work and 'invent' an implementation was achieved by all groups more or less successfully. Their self esteem towards Science and Technology seems to have increased – all were keen to have their pictures and small videos from the contest published on the web site of the Department.

A 'by product' of the course was the experience from the attempt to form a Greek – English dictionary of terms related to robots and robot programming where someone was uploading a term and others (or the same person) were proposing translation and explanation. Links to relevant web sites was also indicated.

4. Students' questionnaire

From the 24 students (8 boys, 16 girls) registered to the course 22 (7 boys, 15 girls) answered questionnaires were received. The percentages boys – girls is the same to the percentages of male – female primary school teachers.

In the following we present the answers we received from the students. The answers are grouped. With the exceptions indicated, answers in the open type questions occurred more than once. Students included, mostly, more than one characteristic in their answers. The answers are still being analysed.

4-1. **Write briefly your impressions from the course.** Students found the course: interesting (very interesting, most interesting), creative, different from the courses they were used to, a nice experience, useful.

4-2. **What you think you will remember from this course 5 years from now**. Team work, a pleasant course, the construction, our efforts and time devoted to solve construction – programming problems, the contest, the new ideas (1 answer), nothing (1 answer).

4-3. **Write up to 2 of the best characteristics of the course.** Teamwork, useful, creative – intelligence – originality (in 18 out of the 22 questionnaires), pleasant, practice work

4-4. **Write the worst characteristics of the course**. A lot time (10 out of 22), not enough materials, no manuals in Greek, not detailed guidance (4 out of 22), sending reports every week was tiresome, 'no bad or worst characteristic, it simply requires more time than other courses' (1 answer).

4-5. **The guidance was sufficient?** (Yes/No). 22 out of 22 Yes.

4-6. **Write up to two of the best characteristics of the guidance**. Helpful remarks, always present, patience and Socratic Method, ideas.

4-7. **Write the worst characteristics of the guidance**. No detailed guidance (we had to complete the task ourselves), no praise on our efforts, left to follow wrong threads.

4-8. **Was there cooperation in the group?** (Yes/No). 20 Yes – 2 No.

4-9. **Write up to two of the best characteristic in your group**. Effectiveness, enthusiasm, teamwork, mutual assistance, understanding, none (in the 2 that said No to the previous question).

4-10. **Write the worst characteristics in your group**. None (7 out of the 22), disputes, trying to impose decisions, fixed responsibilities (in one case), many persons (in one case). No reply from one of the students who answered no cooperation while the second mentioned 'no teamwork-disputes-trying to impose decisions-no respect to other opinions'.

4-11. **What was missing from this course?** More detailed guidance, manuals in Greek, shortage for some materials, a more spacious laboratory, links with other departments teaching this course to exchange ideas (in 1 out of the 22).

4-12. **What was surplus in this course**? Nothing (in 9 out of the 22), the weekly reports, the demands to improve our artefacts, the theory (in 2 out of the 22).

4-13. **What issues should also cover this course.** None (in 7 out of the 22), more theory including the context and its role in pedagogy, use of other equipment also, smart home should be a common project for the whole class (in 2 out of the 22), 'Coffee, snacks (!)' (in 1 out of the 22).

4-14. **Would you recommend this course to your fellow-students?** (Yes/No). 22 Yes, 0 No

4-15. **Would you choose another course of a similar type?** (Yes/No). 21 Yes, 0 No, 1 no reply.

4-16. **Do you think you could teach such a subject in school?** (Yes/No). 15 Yes, 7 No

4-17. **Justify your previous answer**. Yes because: it is not so difficult – it is within the abilities of the students and mine (in 12 of the 15 yes). Yes provided there exist the

 ISBN 978-989-95336-1-5

infrastructure i.e. parts, equipment, computers, laboratory and time (in 3 of the 15 yes), Yes provided that there is adequate preparation and more training (in 1 of the 15 yes). No because: with the current situation in (Greek) schools there is no infrastructure, it is outside the culture, it is very demanding, it is time consuming, it is very difficult, I do not learned the programming.

4-18. **Add any other relevant comments you think appropriate**. (10 replies)
- amusing, interesting,
- I think you should have encouraged us more as it was totally unknown to us,
- at the beginning I was afraid but I do not regret choosing it – it was hard work but worthy,
- it was the most amusing course we had – in its negative are your criticism giving the impression you did not value our efforts,
- I liked the teaching approach, the friendly within the group and with the teachers – in general the nicer and most interesting seminar,
- it should have only two persons per group,
- next time more parts (in 3 of the 10 replies),
- constructive, original. Good to be introduced in schools,
- constructive and creative for school students who could learn in parallel Science, Mathematics and Information Technology.

5. Some Comments

We are still analyzing the test teaching of the course. However from the data already presented we may conclude:

- The course objectives have been met successfully. More specifically:
  - Students became familiar with the concept of robot and its possible uses.
  - Students learned the basic principles of assembling and programming a robot.
  - Students learned to locate areas where a robot may be used and plan appropriately such an implementation.
  - Students had the opportunity to develop problem solving skills. This is supported also from the, negative for some students, comments of them, that they missed detailed guidance or that they were left to follow wrong threads (see 4-7 above)
- On the management and delivery of the course problems were located. Although most of the problems were expected due to the initially planned test teaching on a small scale, they are taken into account. The problem of the limited number of parts has been already solved with the purchase of more kits on a variety of component parts. This will also solve the problem of group size limiting it to two students per group (or three, in exceptional circumstances). However, this will mean an increased teachers' workload and more laboratory work space. The manuals in Greek is also taken into account although we do not think it as serious problem – our observations showed that, even when there was a Greek translation of the manuals, the students preferred a trial and error approach or the teachers' advice. The problem of time needs some more thought. It may mean that students workload for the course is high, as the students have already indicated. However, we did not notice any group working in the Laboratory for more than three hours in excess of the three teaching hours per week. On the assumption that a couple of hours of home study per actual teaching hour is a normal situation for a University course this comment of the students may simply mean that they can do the homework necessary for the course only in the Laboratory [4]. This aspect needs more study as the obvious solution to lend the whole kit to the group may pose administration and logistics problems as is evident from Figure 2. This point is still under study.
- Another point from the students' comments is to find the appropriate balance between the theoretical context and the possible use of educational robotics within the school curricula and the level of detail for the guidance on the actual practice work. Our observations indicate also that a closer connection between the techniques used to assemble the robot they plan and the underlying Science concepts would also help. The demands on the students' artefacts should also be considered to be appropriate to the time available.
- Students liked the course. They judged it as interesting, creative, different (with a positive meaning) from other courses and as one student explicitly wrote 'it took us a lot of time but it was worthy'. Even some of the negative aspects they were provoked by the questionnaire's structure to write may be considered as positive remarks, for example the comments in 4-7 above
- From the data we have so far there is no indication of any differentiation between girls

 ISBN 978-989-95336-1-5

and boys, neither to their achievements or the marks obtained nor to their involvement as 'programmers' or constructors' or otherwise. The groups the students themselves had formed were included all girls or all boys as well as mixed groups with no apparent evidence of sex differentiation.

Figure 2. Overview of the workbench during a break of students' study

- The self-esteem of the students towards Science and Technology has increased, for example they feel confident that they could manage a similar teaching in school with themselves as teachers. This was also an explicit objective of the course and may explain, to some extent, the origin of the (negatively perceived) comment 'no praise on our efforts'.
- Another significant outcome is the students' comments that this course could be incorporated within the school activities. Even the negative answers (with three exceptions) accept this possibility on the fulfilment of some conditions. Although this cannot be considered as 'experts' opinion' it is noticeable moreover as the students who had attended the course had some school experience through their school practice courses.

In conclusion, we think that the test teaching was successful and we plan to include this course into the undergraduate curriculum on a regular basis.

6. Acknowledgements

We would like to thank our students Litsa, Athina, Amalia, Maria, Apostolis, Giorgos, Eleni, Marina, Spiros, Aristotelis, Giorgos, Dimitris, Katerina, Antelina, Dimitris, Stelios, Eugenia, Evi, Dionisia, Chrysanthi, Aggeliki, Kalliopi, Maria and Kalliopi. Their cooperation and the enthusiasm they showed during the whole course made our teaching a pleasant experience.

This work has been supported by the European Commission (project AESTIT - Contract 226381-CP-1-2005-1-GR-COMENIUS-C21). The views expressed here represent only the author of this work. Neither the Commission nor the author may be considered responsible for any use of the information contained here in.

7. References

[1] Simos Anagnostakis, P. G. Michaelides, 'Laboratory of Educational Robotics' - An undergraduate course for Primary Education Teacher - Students, HSci 2006 - 3rd International Conference on Hands-on Science, 4 - 9 September, 2006, Braga, Portugal, Proceedings published by University of Minho pp.329-335. http://www.hsci.info/hsci2006/index.html.

[2] The questionnaire was formally anonymous but due to the small number of students, an analysis of their answers could reveal the student (naturally, it was not made). However we believe that the students have responded sincerely. This is based to the good teachers - students relations and mutual confidence developed and the continuous encouragement of the students during the course to express their opinion, which they did, sometimes criticizing openly aspects of the course they considered as negative. Indirect similar evidence is from the fact that on similar other test teaching courses where a more thorough study was made there no indication of any bias was found.

[3] The constructed implementations included: a mechanism counting entries and exits to be used as a Gate counting persons in a place or as a post-box indicating new mail, a solar device following the sun to be used on household solar devices used in Greece to increase their efficiency, a toy producing soap bubbles activated by light or movement to be used with children, automatic irrigation control system to be used in watering flowers on the owners absence, a lighting device activated by detection of sound or movement to be used in corridors, outside of the house areas, etc.

 ISBN 978-989-95336-1-5

[4] Another possible explanation is that because of the course structure and the active students' involvement, necessary for a course aiming at the development of problem solving skills, the homework has actually to be done in time for the next teaching session, while in other courses this may be left at the end of the semester.

Electric Art

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Abstract. Electric Art is a challenging and practical application of electricity and creativity. Participants will be presented with a cross-curricular application of Physics and Art that uses recycled materials. Art from the global scrap heap is the focus of this endeavor. Workshop includes goals, lesson plans and grading rubrics. Participants will receive a packet containing necessary materials for implementation. Project uses readily available materials.

The primary goal of the science component is to allow students to apply what they have learned about electricity and wiring to a hands-on project. After learning lab safety, how to wire a circuit and make a switch, they get to create an art piece that lights up, has an object that spins, or makes noises. The students will draw an accurate schematic diagram and be able to follow it to wire their art piece. They will apply their knowledge of how to strip wire, attach switches, motors, buzzers, and lights in parallel and series. Additionally, they will learn simple structural engineering techniques in order to create a sturdy and reliable final product.

The primary goal of the art component of this project is to encourage creativity by using only "found" objects to create esthetic and interesting art objects. The artworks must contain the required electrical circuitry. The students are introduced to "found art" through a series of prints of both global found art and contemporary artists who work with found objects. Through directed discussions, they learn about the process of seeing and transforming ordinary objects and trash, into meaningful and esthetic works of art. The second art component is the practice of using sketching to plan their artwork. They need to understand simple schematic drawing, i.e. aerial view, side view, details, etc., to do their planning.

Keywords. Electricity, Physics, Found Art.

From Electromagnetism to Electrodynamics: Ampère's Demonstration of the Interaction between Current Carrying Wires

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Abstract. We present Oersted's discovery of the torque exerted by a current carrying wire upon a nearby magnet and his interpretation of this experiment. This opened the field of electromagnetism, describing the interaction between current carrying wires and magnets. We discuss Ampère's alternative interpretation and his experiment showing a force between a magnet and a current carrying spiral. This led him to try an interaction between two current carrying spirals, without any magnet. He was successful with this trial and this is one of the most important experiments in the history of electricity. This led him to the result that current carrying parallel wires attract (repel) one another when the currents flow along the same direction (in opposite directions). This new field of research describing the interaction between current carrying wires was called electrodynamics by Ampère. We show how to perform Ampère's crucial experiment with simple and cheap materials.

Keywords. Ampère, Electro-dynamics, History of Physics, Low Cost Materials.

1. Introduction

Until the beginning of the nineteenth century there were some separate branches of physics including gravitation, electricity and magnetism. They were represented by inverse square central forces. The force of gravitation, F_g, was proportional to the product of the two masses, m_1 and m_2, and inversely proportional to the square

 ISBN 978-989-95336-1-5

of the distance r between them. We can express this proportionality as

$$F_g \alpha \frac{m_1 m_2}{r^2}$$

This force was always attractive. The electrical force F_g was proportional to the product of the two charges, q_1 and q_2, falling also as the square of the distance. We can express this as

$$F_e \alpha \frac{q_1 q_2}{r^2}$$

This force was attractive if the two charges had opposite signs and repulsive if they had the same signs. The magnetic force F_m was proportional to the product of the two poles, p_1 and p_2, falling also as r^2. We can express this as

$$F_m \alpha \frac{p_1 p_2}{r^2}$$

This force was attractive if the two poles were of opposite types (a north and a south pole) and repulsive if they were of the same type (two north poles, or two south poles). Despite this mathematical similarity there were no known phenomena showing unambiguously a connection between these three branches of physics.

In 1800 Volta (1745-1827) invented the electric pile which allowed a source of constant current, [1]. This opened a new area of research and soon important new results were reported.

2. Oersted's discovery of electromagnetism and his interpretation of his findings

In 1820 Oersted (1777-1851) obtained for the first time a clear phenomenon showing an interaction between a current carrying wire and a magnet. In particular he showed that a current carrying wire exerted a torque upon a nearby magnet, deflecting it from its natural orientation along a magnetic meridian. He wrote a short report in Latin, *Experimenta circa effectum conflictus electrici in acum magneticam*, and sent it to learned societies and scholars on July 21, 1820. Here we quote from the English translation, [2], which has the following title: Experiments on the Effect of a Current of Electricity on the Magnetic Needle. Instead of "current of electricity," Oersted utilized the expression "conflict of electricity." This appears not only in the Latin title but also in his text, namely: "The opposite ends of the galvanic battery were joined by a metallic wire, which, for shortness sake, we shall call the *uniting conductor*, or the *uniting wire*. To the effect which takes place in this conductor and in the surrounding space, we shall give the name of the *conflict of electricity*."

Instead of adopting a more conventional view of a current as a stream of electric particles, Oersted thought that inside a current carrying wire there was a double flow of positive and negative electricity currents moving in opposite directions relative to the wire. This is evident from the explanation of his experiment, as we quote later on. These opposite charges would collide with one another and separate, all along a current carrying wire. This is the origin of the name *conflict* which he utilized.

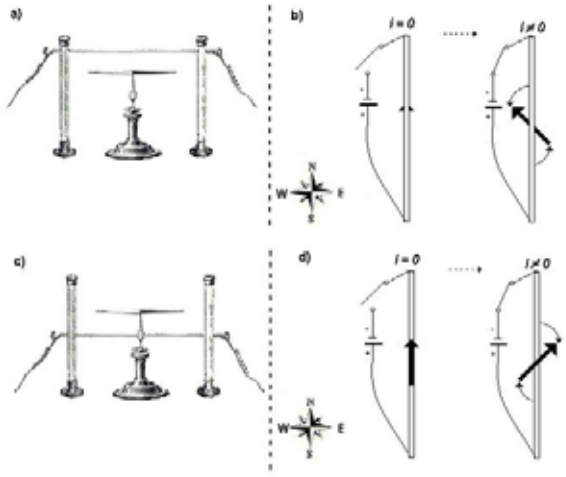

Figure 1. Deflection of a magnet in Oersted's experiment

The reason why he considered this conflict of electricity to happen not only inside the conductor but also in the "surrounding space," will become evident as a result of his fundamental finding, which he described as follows:

"Let the straight part of this wire be placed horizontally above the magnetic needle, properly suspended, and parallel to it. If necessary, the uniting wire is bent so as to assume a proper position for the experiment. Things being in this state, the needle will be moved, and the end of it next the negative side of the battery will go westward.

"If the distance of the uniting wire does not exceed three-quarters of an inch from the needle, the declination of the needle makes an angle of about 45º. If the distance is increased, the angle diminishes proportionally. The

 ISBN 978-989-95336-1-5

declination likewise varies with the power of the battery. (...)

"If the uniting wire be placed in a horizontal plane under the magnetic needle, all the effects are the same as when it is above the needle, only they are in an opposite direction, for the pole of the magnetic needle next the negative end of the battery declines to the east.

"That these facts may be the more easily retained, we may use this formula – the pole above which the negative electricity enters is turned to the west, under which, to the east."
This last sentence is illustrated in our Figure 1.

His interpretation of this fundamental discovery was expressed as follows:

"We may now make a few observations towards explaining these phenomena.

"The electric conflict acts only on the magnetic particles of matter. All non-magnetic bodies appear penetrable by the electric conflict, while magnetic bodies, or rather their magnetic particles, resist the passage of this conflict. Hence they can be moved by the impetus of the contending powers.

"It is sufficiently evident from the preceding facts that the electric conflict is not confined to the conductor, but dispersed pretty widely in the circumjacent space.

"From the preceding facts we may likewise infer that this conflict performs circles, for without this condition it seems impossible that the one part of the uniting wire, when placed below the magnetic pole, should drive it towards the east, and when placed above it towards the west, for it is the nature of a circle that the motions in opposite parts should have an opposite direction. Besides, a motion in circles, joined with a progressive motion, according to the length of the conductor, ought to form a conchoidal or spiral line, but this, unless I am mistaken, contributes nothing to explain the phenomena hitherto observed.

"All the effects on the north pole above-mentioned are easily understood by supposing that negative electricity moves in a spiral line bent towards the right, and propels the north pole, but does not act on the south pole. The effects on the south pole are explained in a similar manner, if we ascribe to positive electricity a contrary motion and power of acting on the south pole, but not upon the north. The agreement of this law with nature will be better seen by a repetition of the experiments than by a long explanation. The mode of judging of the experiments will be much facilitated if the course of the electricity currents in the uniting wire be pointed out by marks or figures.

"I shall merely add to the above that I have demonstrated in a book published five years ago that heat and light consist of the conflict of the electricity currents. From the observations now stated, we may conclude that a circular motion likewise occurs in these effects. This I think will contribute very much to illustrate the phenomena to which the appellation of polarization of light has been given."

3. Ampère's interpretation of Oersted's experiment

Oersted's experiment was presented and repeated at the French Academy of Sciences by Arago (1786-1853). Ampère (1775-1836) was fascinated by it and devoted himself to this subject during the following months. He did not accept Oersted's interpretation that something was circulating around the wire. Ampère preferred to interpret this experiment as indicating a direct interaction between currents. To this end he supposed that any magnet was composed of electric currents following closed curves perpendicular to its axis. In order to explain the magnetic properties of the Earth he also supposed that it had internal currents flowing from east to west in a direction perpendicular to the magnetic meridian.

He expressed his opposition to Oersted's interpretation in his main work, On the Mathematical Theory of Electrodynamic Phenomena, experimentally Deduced, published in 1826. Here we quote from the partial English translation of this work, [3, pp. 155-157].

"The new era in the history of science marked by the works of Newton, is not only the age of man's most important discovery in the causes of natural phenomena, it is also the age in which the human spirit has opened a new highway into the sciences which have natural phenomena as their object of study.

"Until Newton, the causes of natural phenomena had been sought almost exclusively in the impulsion of an unknown fluid which entrained particles of materials in the same direction as its own particles, wherever rotational motion occurred, and a vortex in the same direction was imagined.

"Newton taught us that motion of this kind, like all motions in nature, must be reducible by calculation to forces acting between two material particles along the straight line between them such that the action of one upon the other is equal and opposite to that which the latter has upon the former and, consequently, assuming the two particles to be permanently associated, that no motion whatsoever can result from their interaction. (...)

 ISBN 978-989-95336-1-5

"It does not appear that this approach, the only one which can lead to results which are free of all hypothesis, is preferred by physicists in the rest of Europe like it is by Frenchmen, the famous scientist who first saw the poles of a magnet transported by the action of a conductor in directions perpendicular to those of the wire, concluded that electrical matter revolved about it and pushed the poles along with it, just as Descartes made the 'matter of the vortices' revolve in the direction of planetary revolution. Guided by Newtonian philosophy, I have reduced the phenomenon observed by M. Oersted, as has been done for all similar natural phenomena, to forces acting along a straight line joining the two particles between which the actions are exerted, and if I have established that the same arrangement, or the same movement of electricity, which exists in the conductor is present also round the particles of the magnets, it is certainly not to explain their action by impulsion as with a vortex, but to calculate, according to my formula, the resultant forces acting between the particles of a magnet, and those of a conductor, or of another magnet, along the lines joining the particles in pairs which are considered to be interacting, and to show that the results of the calculation are completely verified by (1) the experiments of M. Pouillet and my own into the precise determination of the conditions which must exist for a moving conductor to remain in equilibrium when acted upon, whether by another conductor, or by a magnet, and (2) by the agreement between these results and the laws which Coulomb and M. Biot have deduced by their experiments, the former relating to the interaction of two magnets, and the latter to the interaction between a magnet and a conductor."

In order to test his ideas Ampère first tried to model a magnet pole by means of a metallic spiral, [4, pp. 235-246]. He placed the plane of this spiral along a vertical plane, with its axis coinciding with the north-south direction of a bar magnet suspended horizontally. The spiral was suspended from above in such a way that it could move or oscillate along the horizontal direction. When there was no current flowing along the spiral, there was no perceptible interaction between it and the nearby magnet. He then connected the spiral to a battery. When a constant current was flowing along the spiral it was attracted or repelled by the magnet, depending upon the direction of the current. In this way he could reproduce qualitatively the attraction and repulsion between two bar magnets depending upon their facing poles, but now with one of the magnets replaced by a current carrying spiral.

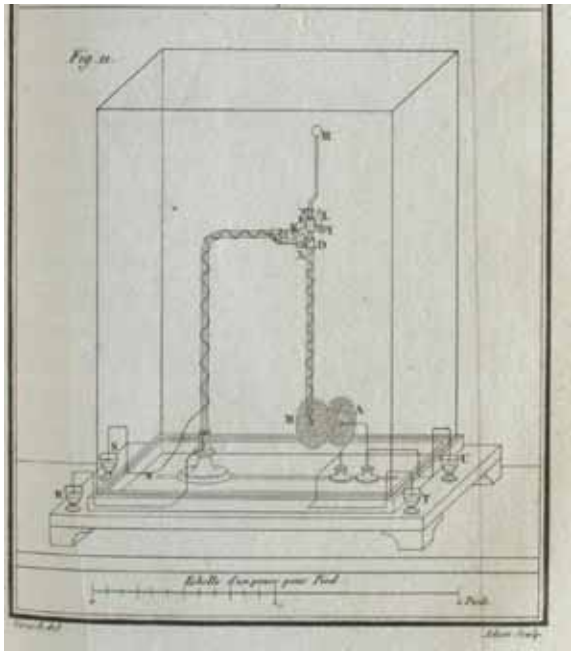

Figure 2. Ampère's crucial experiment showing for the first time the interaction between two current carrying circuits

In order to test his ideas Ampère first tried to model a magnet pole by means of a metallic spiral, [4, pp. 235-246]. He placed the plane of this spiral along a vertical plane, with its axis coinciding with the north-south direction of a bar magnet suspended horizontally. The spiral was suspended from above in such a way that it could move or oscillate along the horizontal direction. When there was no current flowing along the spiral, there was no perceptible interaction between it and the nearby magnet. He then connected the spiral to a battery. When a constant current was flowing along the spiral it was attracted or repelled by the magnet, depending upon the direction of the current. In this way he could reproduce qualitatively the attraction and repulsion between two bar magnets depending upon their facing poles, but now with one of the magnets replaced by a current carrying spiral.

Then it came a crucial moment. Ampère now replaced the magnet by another spiral. The two spirals were in parallel vertical planes facing one another, with collinear axes. There was no visible interaction between them when no current was flowing. When there was a constant current flowing along both spirals they attracted or repelled one another, depending upon the directions of the currents. It was in this way that he concluded for the first time that two parallel straight wires should attract (repel) one another if their currents were flowing along the same direction (in opposite directions), an arrangement

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which he presented in his first published paper about this subject, [5]. It is worth while quoting in full this crucial experiment of Ampère, performed and described in 1820, [6, pp. 152-154]:

"Now, if electric currents are the cause of the directive action of the earth, then electric currents could also cause the action of one magnet on another magnet, it therefore follows that a magnet could be regarded as an assembly of electric currents in planes perpendicular to its axis, their direction being such that the austral pole of the magnet, pointing north, is to the right of these currents since it is always to the left of a current placed outside the magnet, and which faces it in a parallel direction, or rather that these currents establish themselves first in the magnet along the shortest closed curves, whether from left to right, or from right to left, and the line perpendicular to the planes of these currents then becomes the axis of the magnet and its extremities make the two poles. Thus, at each pole the electric currents of which the magnet is composed are directed along closed concentric curves, I simulated this arrangement as much as possible by bending a conducting wire in a spiral: this spiral was made from brass wire terminating in two straight portions enclosed in glass tubes so as to eliminate contact and attach them to the two extremities of the battery.

"Depending on the direction of the current, such a spiral is greatly attracted or repelled by the pole of a magnet which is presented with its axis perpendicular to the plane of the spiral, according as the current of the spiral and of the magnet flow in the same or opposite directions. In replacing the magnet by another spiral with its current in the same direction, the same attractions and repulsions occur, it is in this way that I discovered that two electric currents attract each other when they flow in the same direction and repel each other in the other case."

Figure 2 presents Ampère's apparatus to show this effect. It might at first appear that Ampère's experiment with the two spirals was a necessary consequence of Oersted's discovery. That this was not the case was shown by Arago and Ampère, [7, pp. 23 and 195-196]. They pointed out that a magnet exerts forces upon a piece of soft iron but two pieces of soft iron are without effect upon each other. Only experiments could decide if two current carrying conductors would or not exert forces upon each other. The experiment with the two current carrying spirals was performed by Ampère in September 1820, thus confirming his expectation. It opened up a new area of physics, namely, the interaction between current carrying wires without the presence of any magnet. Oersted's discovery, describing the interactions between a current carrying wire and a magnet, was called sometimes as an *electromagnetic* phenomenon. In order to distinguish the new class of phenomena from those analogous to Oersted's discovery, Ampère created two new names, *electrostatics* and *electrodynamics*. To the first class we should include the attractions and repulsions of charges at rest, while the second class should include specially the attractions and repulsions between current carrying wires, [8] and [9, p. 78]:

"The name *electro-magnetic*, given to the phenomena produced by the conducting wires of Volta's pile, could only conveniently describe these phenomena at the time in which there were only known between these phenomena those which Mr. Oersted discovered between an electric current and a magnet. I believe that I should utilize the denomination *electro-dynamic*, to join in a single common name all these phenomena, and specially to designate the phenomena which I observed between two voltaic conductors. It expresses the characteristic property of these phenomena, namely, to be produced by electricity in motion, while the electrical attractions and repulsions known for a very long time are the *electro-static* phenomena produced by the unequal distribution of electricity at rest upon the bodies in which these phenomena are observed."

In the following Section we show how reproduce Ampère's crucial experiment with low cost material.

4. Reproducing Ampère's crucial experiment with low-cost materials

In order to perform experiments analogous to those of Ampère we need essentially the following material: two small cylindrical magnets, 4 D size batteries (alkaline 1.5 V piles), two metallic spirals, two switches and connecting wires. At least one of the magnets should be suspended by a string, like a pendulum, with its north-south axis horizontal. Two batteries connected in series will be the power supply for the current to flow in each spiral. The circuit connecting the extremities of the batteries to each spiral can be made of common copper wire or aluminum strips fixed over a wood board 20 cm × 20 cm. Each circuit should have a switch which will be normally open to prevent the quick loss of energy from the batteries.

The most unusual part of the apparatus is the spiral. We made it with AWG 26 insulated copper wire, easily available from electric shops. We fixed loosely a nail upon a wood board, so that we could remove it easily with our hands when necessary. Each spiral utilized approximately 2

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m of wire. We fixed one of its extremities at the board with a tape distant 15 cm from the nail. The wire was wound around the nail making a plane spiral. Each spiral consisted of some 30 turns, with the largest turn having a diameter of around 3 cm. After the last turn there remained an extra 15 cm of wire at the other extremity, Figure 3. We removed the nail from the board and fixed the spiral in a planar shape with some glue. To this end we also utilized three radial extra wires leaving from the center of the spiral, reaching the largest turn, returning to the center of the spiral at its other side and making an angle of 120º between them. We wound the two extremities of the spiral containing 15 cm of straight wire in such a way that it remained only 2 cm of each side. We put these extremities on fire to remove the electrical insulation. In its final shape the spiral would be in a vertical plane, with the wound wires descending vertically from the center of the spiral and the two bare extremities pointing laterally to the left and to the right into the same plane of the spiral, Figure 3.

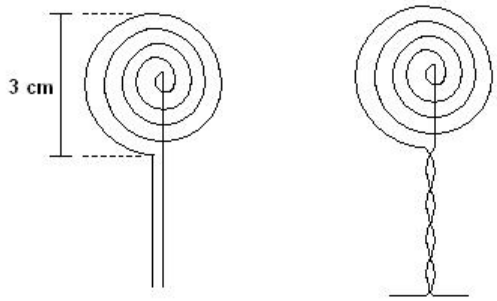

Figure 3. A typical spiral utilizes 2 m of wire, has 30 turns with largest diameter of 3 cm and two legs of 15 cm. The legs are wound together except at their extremities, which are uninsulated and bent to opposite sides

The photos illustrating this procedure are presented in Figure 4.

Figure 4. Procedure to make the spiral and its final shape

We hung each spiral in a vertical plane utilizing a string connected to a higher support in such a loose way that the spiral could oscillate around this support like a pendulum. Finally we connected the two batteries in series with a switch and with the two bare extremities of the spiral. The photos of two of these circuits facing one another with and without batteries are presented in Figures 5 and 6.

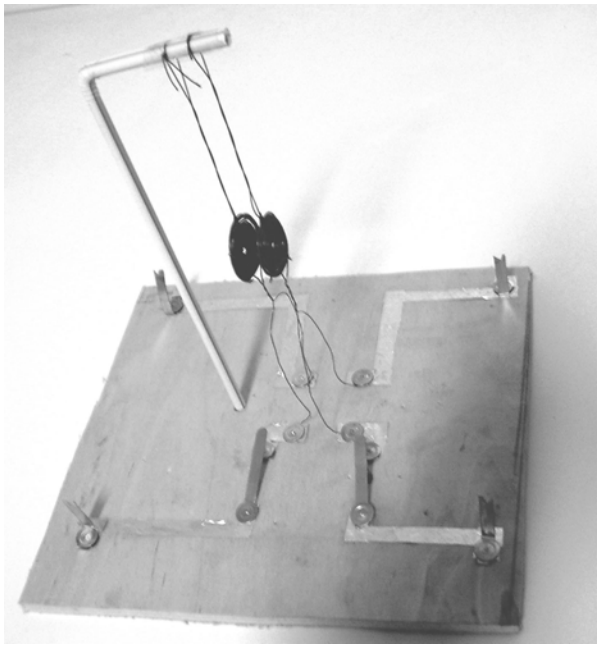

Figure 5. Final apparatus without batteries

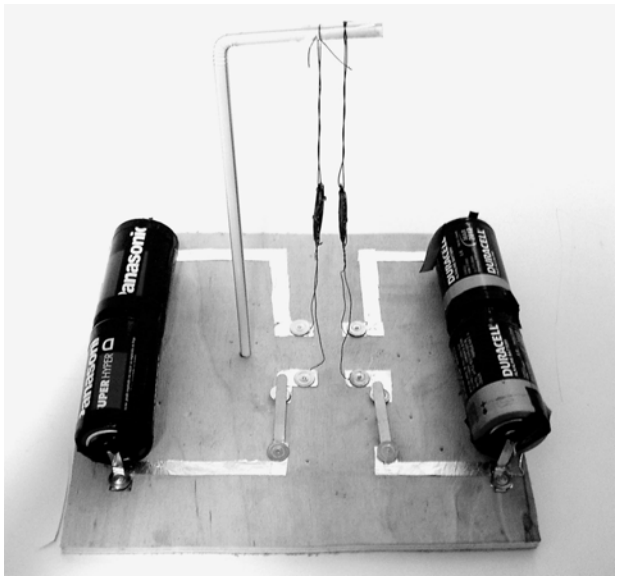

Figure 6. Final apparatus with batteries

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5. Experiments

With this apparatus it is possible to illustrate easily three classes of phenomena, namely, magnetic, electromagnetic and electrodynamic.

A magnetic phenomenon is characterized by the interaction of two magnets. This can be shown by hanging one cylindrical magnet like a pendulum with its north-south axis along a horizontal direction. We hold another cylindrical magnet in our hand with its north-south axis collinear with the first magnet. By presenting it to the pendular magnet it is easy to see this last magnet being attracted or repelled by the magnet in our hand depending upon the facing poles, Figure 7.

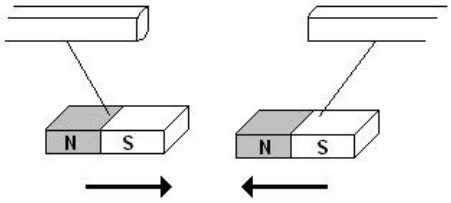

Figure 7. Two collinear magnets attracting one another

An electromagnetic phenomenon is characterized by an interaction between a current carrying wire and a magnet. This can be illustrated with our apparatus by mounting one spiral circuit with batteries and switch. We hold a cylindrical magnet in our hand with its north-south axis collinear with the spiral axis. When the switch is open there is no interaction between them. By closing the switch a constant current flows along the spiral. In this case it can be observed its attraction or repulsion by the magnet depending upon the direction of the current and upon which pole is closest to the spiral, Figure 8. An attraction in one configuration can be transformed into a repulsion by reversing the orientation of the pair of batteries, or by reversing the polarity of the magnet. By reversing both there will remain an attraction between the magnet and the spiral. The main difference between this experience of Ampère and that of Oersted is that now we are observing attractions and repulsions between the magnet and the current carrying spiral, while in Oersted's experiment he observed a deflection of a magnetic due to a torque exerted by a nearby current carrying wire.

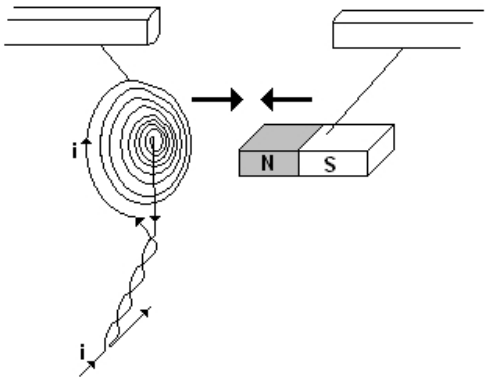

Figure 8. A spiral with its plane orthogonal to the north-south axis of a magnet, with its axis collinear with that of the magnet. There is an attraction between the magnet and the spiral depending upon the direction of the current in the spiral and the orientation of the poles of the magnet. The closing circuit of the spiral is not shown

An electrodynamic phenomenon is characterized by an interaction between two current carrying wires. This is illustrated with our apparatus in Figure 6. When one or two switches are open no interaction is observed between the spirals. When both switches are closed there is a visible attraction or repulsion between both spirals depending upon the directions of the currents, Figure 9. An attraction in one configuration can be reversed to a repulsion by changing the direction of only one current (this can be easily achieved by reversing the orientation of one pair of batteries). On the other hand, an attraction will remain by reversing the orientation of both pairs of batteries. In this way it is easily verified that currents flowing along the same direction attract one another while currents flowing in opposite directions repel one another.

Two batteries connected in series produce a voltage of 3 V between their terminals. With an amperimeter we measured the typical current in our circuit, of the order of 1.3 A. This means that the total resistance of each circuit had a value of some 2.3 Ω. With these small currents we could easily observe two spirals which were initially separated by 1 cm attract one another and remain in touch after that. The advantage of this didactic apparatus is evident when we compare it with a real reproduction of Ampère's original experiment, [10]. In this case it was only possible to see two straight wires touching one another for high currents of the order of 30 amperes.

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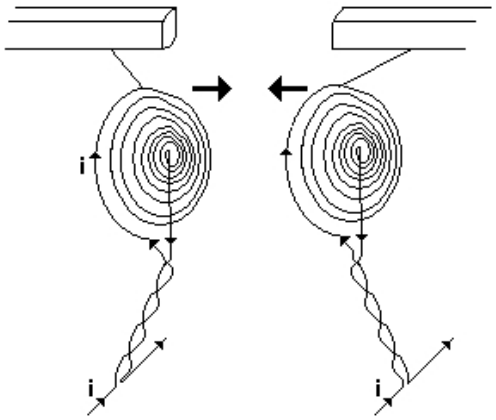

Figure 9. Two spirals with their planes parallel to one another and collinear axes. There is an attraction between them when both currents flow along the same directions

6. Acknowledgements

JPMCC wishes to thank Funcamp-Unicamp for financial support.

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The Educational Role of Play at the Teaching of Physics

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Abstract. Whether you consider it as an activity, or as an object in the form of a toy, playing vindicates a great importance in the harmonious development of the child's physic and an important role in the understanding of the rules of nature. It is by means of the magic world of playing that basic rules and principles of Physics find a way to give logical answers to questions about life. Under certain circumstances, play can turn into a wonderful teaching aid and a dynamic tool in the teaching of Physics, provided that the teacher uses it correctly in the classroom. Almost all the topics of Physics can be taught experimentally or theoretically throughout ''playing'', whether it means the use of toys, or an activity with the participation of the students. Watches with salted water instead of battery, solar helicopters, leaking bottles carrying water, lamps which switch on without electricity, balls carried away without any support, under water fire, plays with static electricity are only some of the experiments with …playful mood which can contribute to the understanding of the laws of Physics as well as to the development of positive feelings towards the Physics' lessons. In order to use in its greater extent this teaching method, the teacher has to take into consideration some parameters. The lecture refers to the pedagogic and didactic dimension of play in Physics. In addition, it is out to show the way (throughout selected references such as photos and short

 ISBN 978-989-95336-1-5

videos showing the application of play-experiments in teaching practice) with which somebody can take Physics seriously by playing with them.

Colors and sounds consist two of the very first stimuli that a baby has in his life adventure. These stimuli most of the times come from a toy which is put near the baby's cradle. As the baby grows up, his exploration of the world takes place also through toys, which will sharpen his senses and offer him new experiences and knowledge. And when time has come for the logic to start asking thousands of ''whys'' about the incomprehensible to the uneducated young brain miracles of everyday life, play has enough answers to provide.

We have to accept that the more we use teaching aids into the classroom to analyse an idea, the more we transform the conceptual language of symbols into the material world of objects, and the better we can explain this idea to the students.

Figure 1

Figure 2

Figure 3

Figure 4

Furthermore, pedagogic has proved that learning is easier when the subject of instruction is enjoyable and attracts the inherent human curiosity. Consequently, teaching aid and attraction of curiosity are two of the targets that teacher of nowadays has to achieve, as by means of them the implementation of Physics in everyday life is easier to be presented, the interest of the students is kindled and their mental and physical functions are activated. Whether you consider it as an activity, or as an object in the form of a toy, play disposes of the latter characteristics and can be used as a brilliant teaching method. We also have to stress that the term ''play'' in the teaching process does not necessarily mean a material object. It can insinuate a laboratories procedure, a riddle, an enigma, in other words, a wilful provocation from the teacher's part. For example, if, during the lesson of combustion, the teacher asks the students how they can plunge a burning candle to the bottom of a water-dish without extinguishing it, then he automatically introduces the play into the teaching procedure.

The advantages of teaching through play are many. First of all, the practical aspect of teaching trough play is that it is cheaper, safer, and easy to use, it needs short time of experimental procedures and gives the opportunity to the teacher to use a laboratory with many devices. Some empty refresher cans, rulers and plastic bags, are enough to ''produce'' a laboratory in order to present an interest experiment of static electricity, in which we encourage the students to make the can move with the ruler but without touching it (Figure 1).

Secondly, by means of simple devices of everyday life or play, the student can more easily understand abstract notions or ideas which are undetectable with his senses. It is hard enough to make a student understand the idea of atmospheric pressure, as long as he does not feel its weight on his back. Nevertheless, with two plastic cups strongly tied, or with the scratching of a metal box containing some boiled water by plunging it quickly and upside-down in a water-dish, this can be shown in an extremely impressive way (Figure2). Staying In the unit of atmospheric pressure, we can also play with the curiosity of the students by asking them: "can we take away water in a leaking bottle?'' (Figure 3). Another way is starting the lesson by putting in front of the class a bottle of water without its screw-top and a small empty cup near it. Afterwards, we can provoke the curiosity of the class by asking who can turn upside down the bottle and hold it in that position for over than 30 seconds without pouring its content. (Figure 4)

There are some ideas in Physics that are difficult to be taught experimentally. Nevertheless, they could easily be presented with the help of a play. Some ordinary examples: how can we show that evaporation is a procedure which absorbs heat? Let us show it by means of the glass duck with its head covered with a wet cloth (Figure 5). As the water evaporates from its head, and as evaporation absorbs heat and its head becomes colder, the gas that is inside its glass body comes up, as the lighter gas and the change of the pressure between the two parts of its body. This makes

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the head heavier and it produces its funny movement (Figure 5). The ''actinometer'' crookes (Figure 6) helps students to understand the different absorption of radiation from dark objects, although the whole explication of the experiment is complicated.

Figure 5

Figure 6

Figure 7

Figure 8

Play may help the student understand how tightly Physics are connected with our lives, as many of them consist of miniatures of wider applications of Physics in everyday life. As we cannot bring a solar heater into the classroom, the conversion of solar energy into electric power and the use of……..can be shown with the help of some toys, like small cars, helicopters, etc (Figure7) actually, energy transformation is a topic which can be easily taught through a great number of devices and plays, as it is hard to find any toy which does not content in its function, some energy transformations (Figure8).

In addition to these, another important aspect of the role of play to the teaching practice is the activation of students' mental world. The sounds, the movements of the objects as well as students' challenge by the appropriate question from the teacher's part, can provoke various emotions like admiration, curiosity, ebullience, surprise, etc. Although ''emotional activation'' of a classroom should not be an end in itself for the teacher, it is a very good means of making the students remember some notions of Physics and forming a positive attitude towards the lesson. One of the best experiments of physics is gas ionization in a fluorescent lamp, without having an electrical source. As it is a truly ''magical'' experiment it is better to be done in a ''magical'' way for the first time, this means by approaching a fluorescent lamp to a decorative lamp of gas evacuation, covered with a cloth. The light of the lamp will surely provoke the surprise of the students and possible…applause (Figure9). Another impressive experiment is the transport of a ping-pong ball with the air stream of a hairdryer (Figure10), an application of Bernoulli rule that students are possible to repeat at their homes the same day.

Figure 9

Figure 10

Figure 11

Figure 12

The teacher is able, by changing a little bit the orthodox method of making an experiment, to transform a boring procedure to an enjoyable experience for the students. For example, we can put some students to make a queue, holding each other. The first one will touch the one terminal of the electrostatic Wimsurth machine. Then, the last student of the queue will shake hands with a classmate who did not participate in the experiment (Figure11). The skill of the teacher to be able to attract the attention of his students by questions or bets which can kindle their curiosity plays an important role in the teaching process. A water basin, an empty glass, a paper and the question ''who can plunge the paper into the water without wetting it?'' (Figure 12). Students will not stay indifferent before such a challenge. There is also a device put on the market with the commercial name ''lovemeter'' (Figure 13). It shows how hot somebody is by touching it and its function is based on the thermal expansion of gases. This device is sure

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to create a positive attitude to the students towards the topic of heat.

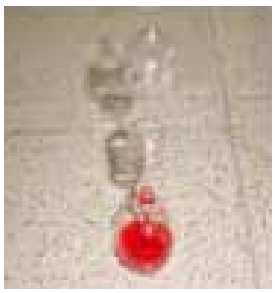

Figure 13

Figure 14

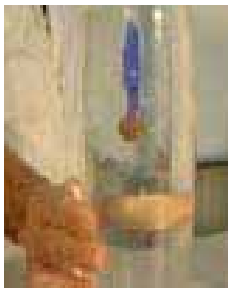

Figure 15

Figure 16

Furthermore, the teacher can divide the students to small groups and give them a further motivation: the construction of devices or toys which they will present in the classroom. They can very easily construct digital watches which, instead of typical batteries, will have two piles of copper-zinc stuck into a lemon, orange, or salted water (Figure 14). This is a team game too. Students can also, at a low cost, construct the ''Cartesian diver'' (Figure 15), or solar cars from old, destroyed toys. It would be good if the best constructions received a symbolic award. After all, students could even turn to modelism, as far as their construction has a direct connection with Physics like, for example, the helicopter of the picture which runs on a thermoelectric pile (Figure 16).

Unless the use of play as a teaching method is abused, only advantages have it to offer. What the teacher has to bare in mind is to keep the balance between the game and the lesson, without allowing the latter losing its strict structure. And, if possible, to make his students understand that even when playing, we have to take physics really seriously.

Keywords. Teaching, Physics, Play, Educational.

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Hands on Experiments with Light

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Abstract. "Hands on Science Romania" network and Center for Science Education and Training CSET, coordinated by Mr. dr. Dan Sporea, INFLPR Bucharest, received recently some OSA (Optical Society of America) kits - Optics Discovery Kit, in the frame of Photonics project, in partnership with New England Board of Higher Education (NEBHE), USA. Project Principal Investigator is Fenna Hanes (NEBHE). Co-principal Investigators are Professor Judy Donnelly (Three Rivers Community College), Dean Nicholas Massa (CCSU), and Marijke Kehrhahn (University of Connecticut). Also, Vernier Software & Technology, USA donated sensors for physics lab.
National Vocational College "Nicolae Titulescu", Slatina, Olt, Romania is an associated member of the "Hands on Science" network coordinated by Mr. Manuel Costa from 2004. As a reward of

 ISBN 978-989-95336-1-5

our participation in HSCI, we received two training kits for mechanics, an OSA kit and Vernier sensors of motion, force and temperature. The paper presents some hand-on experiments with this equipment, in the Photonics project.

Keywords. Science, Physics, Optics, Experiment.

1. Introduction

Photonics is the practical application of light and optics. It is an enabling technology that integrates lasers, optics and electronics to develop applications in industries such as telecommunications, information technology, entertainment and displays, lighting, consumer products, precision manufacturing, biology and medicine, environmental sensing, homeland security and defense, astronomy and aerospace, and research. In this twelve-week online course educators learn about the science and technology of photonics through reading, problem solving, hands-on activities and discussion with peers. The overarching theme of the course is "How can I teach optics/photonics to my own students with the resources I have at hand?" The course have 6 optics/photonics units plus a "get acquainted" week and a summary week. Instructors: Professor Judy Donnelly (Three Rivers Community College, Norwich, CT, USA) and Donna Goyette (H.H. Ellis Technical High School in Danielson, CT, USA).

I will present you some hand-on experiments with OSA (Optical Society of America) kits - Optics Discovery Kit, in the Photonics project.

2. Exploring Light Spectra

Objective: the study of spectra for different sources of light (candle, incandescent bulb with various colored filters, Laser pointer, LED on electronic equipment, fluorescent bulbs, LCD monitor, and Sun light).
Materials: OSA Kit 500 lines/mm grating, a "toilet paper tube spectrometer", a cardboard box with slit.

First, I saw spectra using just an OSA Kit 500 lines/mm grating alone, second I used a "toilet paper tube spectrometer" (Figure 1) to block out the stray light from other sources in the room. Also, in the room was complete dark.

Third, I used an improve spectroscope (digital camera + diffraction grating) and a cardboard box 40 cm x 40 cm in size to block out the light source except for a 1 mm x 5 cm slit. Putting a slit in front of the light source helps a lot.

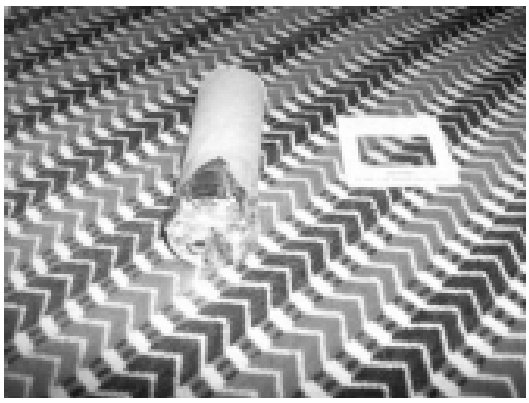

Figure 1. "Toilet paper tube spectrometer"

Let's see the photo's of a candle flame spectrum, as seen looking through the 500 lines/mm grating (Figure 2):

Figure 2. A candle flame spectrum

The brightest flame image is the undiffracted light (zero order) from the flame itself. I saw two orders of diffraction, the second very faint. Next photo shows the same candle, this time with cardboard box blocking the flame except for a narrow slit. The individual colors in each order show much clearly (Figure 3).

I repeated the experiment with an incandescent clear bulb, with a soft white fluorescent bulb and with my TFT LCD computer monitor. For candle and bulbs, I obtained a rainbow continuous spectrum. For LCD monitor, I got next colors starting with the color closest to the slit: violet-blue, sky-blue, green, faint red and bright-red. I remarked that the spectral lines are colored images of the slit, which is an irregular slit.

For LED I saw one order of diffraction each side of the central undiffracted light, but the overlapping was almost complete because I saw only irisations.

For laser pointer was only one color: red. I shined the laser on a piece of white paper and I

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looked at the light reflected from the paper. Still, I couldn't make a good picture. I don't know why. I saw the spectrum of sunlight ("Roy-G-Biv") focalized on a piece of white paper.

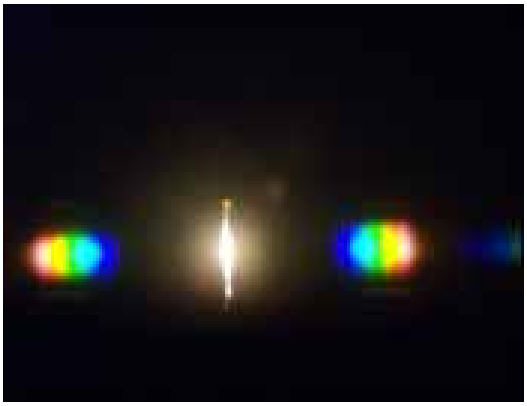

Figure 3. A candle flame spectrum with cardboard box blocking the flame except for a narrow slit

For the incandescent clear bulb, I used also color filters. Here are my observations:

1) Yellow filter – removes violet and most of blue, allows through red, orange, yellow, green and a little blue
2) Red filter – removes all colors except red
3) Blue filter – removes orange, yellow and red, allows through violet, blue, and green
4) Green filter – removes violet, orange and yellow, allows through a little blue, a lot of green, and a little red

To see all my pictures with beautiful colored spectra, you can visit my web site [1].

After this lab, I can't tell what colors are in a light source by looking at it with my unaided eye. LCD monitor surprised me. I am sure now that all white lights have the same colors spectrum, depending on the substance of the source. This experiment was used for the study of continuous emission spectra, but can be improved for the band and lines emission spectra and absorption spectra.

3. The Color Spectrum

Objective: to create a model of the infrared, visible, and ultraviolet portions of the electromagnetic spectrum
Materials: Meter stick or metric ruler (marked in millimeters), scissors, scotch tape, several pieces of paper in the following colors: red, orange, yellow, green, blue, violet, white, and black (paper will be cut into 1-inch-wide strips), black marker, prism, flashlight (optional), a copy of The Color Spectrum: How Does It Work? Data Sheet for each student [2].
Procedure: The scale that will be used to build their model of the spectrum is 1 nanometer equals 1 millimeter. So if a wavelength is X nanometers, the model for that wavelength should measure X millimeters. Students will need to show the work they've done on their calculations in the space provided on the data sheet. The class is divided into small groups of two or four. Work together as a class on the metric conversion calculation for red light. Red paper will be used for the wavelength of red light, orange paper for orange light, and so on. White paper will represent infrared, and black paper will represent ultraviolet (Figure 4). After groups have completed their model spectrum, they will shine white light through a prism in order to see the visible spectrum they have just modeled.

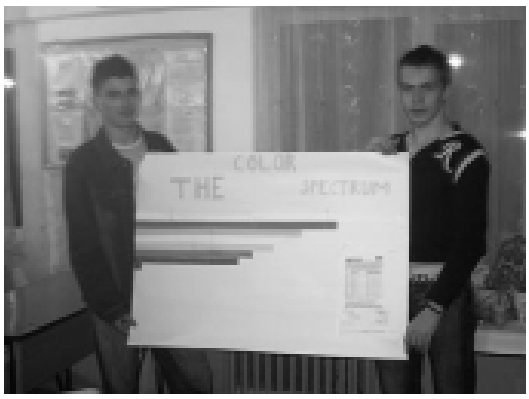

Figure 4. A model of the IR, VIS, and UV portions of the electromagnetic spectrum created by two 16 years old students

4. Pinhole Camera

Objective: the study of the image formed by a pinhole camera
Materials: Large carton or box with the bottom removed, Aluminum foil, needle, tape
Procedure: Cut a hole of approximately 5 cm square in the center of one end of the box. Tape an aluminum foil with a pinhole over the hole in the box, centering the pinhole. Aim the pinhole toward a light source and look up through the open bottom of the box to observe the image on the end opposite the pinhole. Like a lens, the pinhole can form an image on a screen. The rays from the bottom of the lamp do not overlap the rays from the top because of the small size of the pinhole (Figure 5).

Because the pinhole is small, exposure times are very long compared to those with a lens. The height of the image (hi) is calculated by similar triangles (Figure 6):

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(hi/ho)=(di/do)

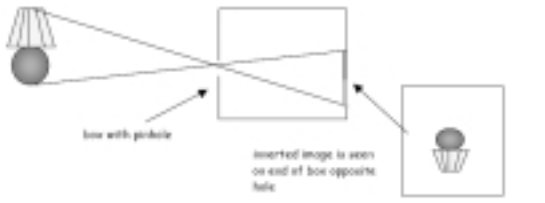

Figure 5. The pinhole camera viewer (Copyright Project PHOTON. © New England Board of Higher Education, 2005. Used with permission)

Figure 6. A Pinhole Camera made by two 16 years old students

5. Refraction

Objectives: demonstrate Snell's law of refraction, experimentally determine the index of refraction of gelatin, plastic and glass
Materials: gelatin, laser pointer, protractor, a piece of white paper, a piece of plastic and another of glass
Procedure: The heaviest but funniest thing to do is to make the block of gelatin. The object is to have a rectangle of gelatin about at least 2 cm thick and 4-5 cm square. The length is not too important, but the edges that light will travel through need to be very straight and flat, if you are not a patient man, use a piece of plastic or glass. We will need a piece of paper with optical axis, the normal and three angles of incidence of 30, 45 and 60 degrees drawn with a pencil (Figure7).

The laser must be directed so that the beam enters the gelatin at (above) the point where the normal line meets the surface, and we must note the point where the refracted beam exits on the other side, measured the angles of incidence and refraction, using the protractor from the normal line. I used Snell's Law to calculate gelatin's index of refraction of gelatin, plastic and glass.

Additional, you can make a gelatin "prism" (triangle) and see how some incident angles lead to total internal reflection at the opposite side, an optical "fiber"(Figure 8) or lens shapes.

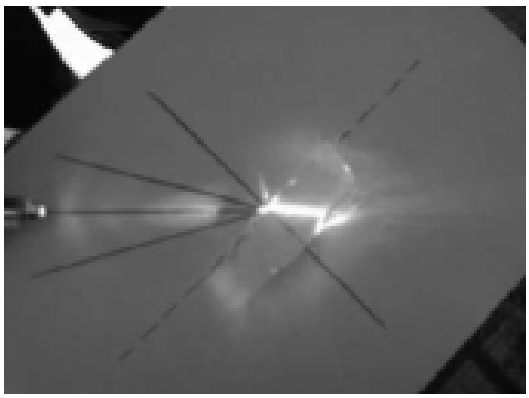

Figure 7. Experimentally determine the index of refraction of gelatin

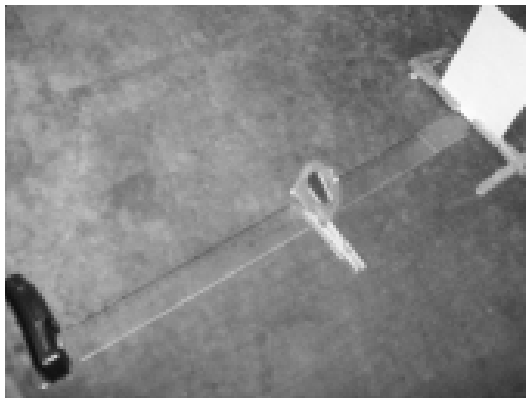

Figure 8. Total internal in a gelatin optical "fiber"

6. The Thin Lens Equation

Objective: To measure and observe image location, size and type for a converging lens
Materials: small flashlight, the larger converging lenses from the OSA kit (labeled A), a small piece of aluminum foil, clothespins, card for screen, three rulers
Procedure: The object was a small narrow triangle of aluminum foil taped to the center of the front of the flashlight, small enough so that light can shine around it on all sides. With object 30cm from the lens, I moved the screen back and forth until a clear image was formed (Figure 9).

The image was 12.5cm to the right of the lens, inverted and smaller than the object. Using the thin lens equation f=12, 52 cm.

I calculated also the magnification

M=-21, 5/30=-0, 71.

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I tried a few different object distances and calculate an average focal length from all my measurements f=12, 5 cm.

Figure 9. Experimental device

If the object distance is 50cm to the left of the lens, using the thin lens equation I found that

$$di = 16.67cm$$

After I performed the experiment with the object set at 50cm to the left of the lens, I measured an image distance of 16.5 cm, close enough to my prediction.

7. The Diffraction Grating

Objective: To determine the wavelength of diffracted light, by means of a transmission grating.
Materials: Laser, Diffraction Grating from OSA kit, a wall for the viewing screen
Procedure: for a distance from the screen of x=1m I was able to see only the 1st order maximum, and for x=20cm I was able to observe 2 orders of diffraction (Figure 10), the second order only to the right side of the zero-order maximum. Formula used for i=0:

$$m \lambda = d \sin \theta$$
$$tg \theta = y/x.$$

In the first case, I obtained λ=662nm, and in the second λ=654,5nm. My red laser pointer was an old toy laser and I couldn't see the label. But, knowing that the wavelength of such a laser is typically 650 or 670 nm, and using the average wavelength of this range (660 nm), my percent error was -0.84%.

The percent error for x=1 m was -0.30%.

Figure 10. Diffraction pattern for x=20 cm

8. The Air Wedge

Objectives: the study of interference fringes for an air wedge and the measurement of the thickness of hair
Materials: laser pointer, rule, two microscope slides
Procedure: I thoroughly cleaned two microscope slides and pushed them together, squishing out the air between. I looked at the light reflected from the slides: sun light, incandescent light bulb, and laser light (the picture was not good). To make a monochromatic source of light, I wrapped a mirror with wax paper and illuminate it with the laser beam. I counted the number of fringes per 0.5 cm at several locations, because was very, very hard and I multiplied by the total length 7.5 cm. Also, my wrapped mirror didn't illuminate the whole length of the glass plates, but only a little area. In order to make a better counting, I marked the wax paper in 1 cm increments with a pencil. I found m=34 fringes/cm x 7.5 cm=255 fringes. I used a magnifying lens and my husband's hair (dark-haired). Unfortunately, I couldn't make a good photo.

The thickness of hair measured by my air wedge was t=m8/2=(255 x 660 nm)/2=84,15 6m, which is reasonable, I think.

To see my pictures with interference fringes, you can visit my web site [1].

9. Diameter of a Hair

Objective: Measuring the Diameter of a Hair by Diffraction
Materials: Laser Pointer, ruler, 2 clothes pins
Procedure: I set up this experiment with my students. The experimental device is shown below (Figure 11):

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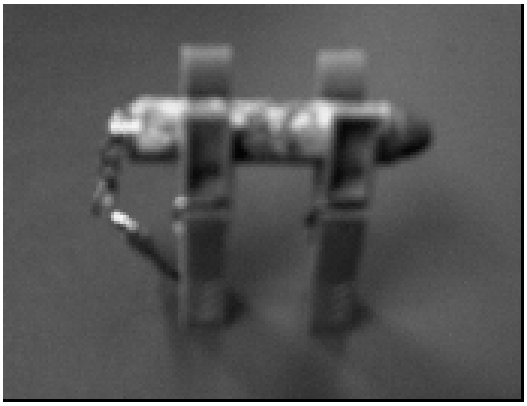

Figure 11. **Experimental device**

My students taped a piece of their hair across the output aperture of a red laser. The laser light diffracted around the hair and a pattern of light and dark spots were formed on a distant screen. We used for the diameter of the hair

$$d = m\lambda x/y$$

We measured the distance from the laser to the screen x= 2,38m and for m=1, we found y=2 cm, so d = 78,54 6m.

10. Polarization of Light

Objective: exploring polarization
Materials: two pieces of polarizing plastic from the OSA Optics Discovery kit, bowl of water, transparent plastic objects: ruler, protractor, comb, etc.
Procedure: "Natural" or randomly polarized light has light waves that vibrate in all directions, and the vibration directions vary randomly in time. When randomly polarized (natural) light is passed through an optical element known as a linear polarizer, one component of the electric field vector is absorbed, resulting in light that is strongly polarized in one direction.

To determine the transmission axis of the polarizer, you need to view the glare or shine from surface such as glass, water or ice through one of the polarizing filters. While looking through the polarizer, rotate it and notice that the reflected light becomes dimmer and brighter. When you can see the reflection at its brightest, the transmission axis of the polarizer is horizontal. I set up this experiment with my students. We marked the polarizer with a piece of tape to know which direction is the transmission axis. We repeated with the other polarizer. The light is partially dimmed by the parallel polarizers (Figure 12) and completely blocked when they are "crossed" or held with transmission axes perpendicular (Figure 13).

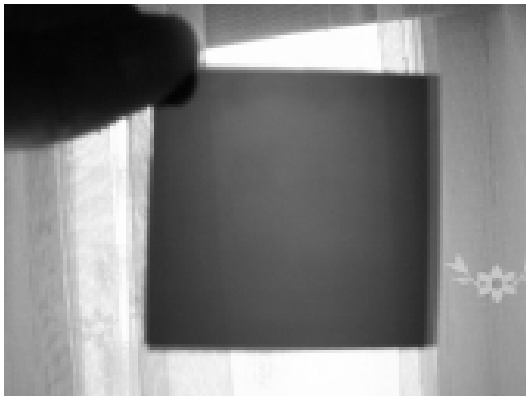

Figure 12. **Two parallel polarizers**

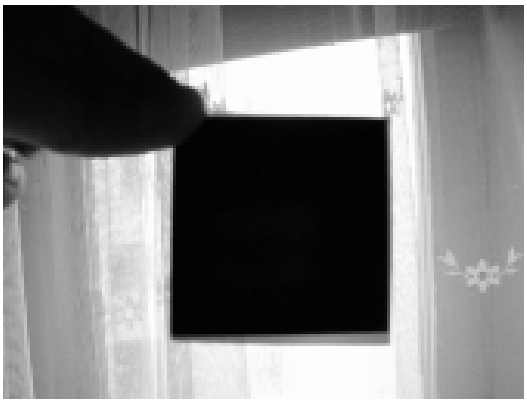

Figure 13. **Two crossed polarizers**

When we place a transparent set square between the crossed polarizers, the plastic changes the plane of polarization an amount depending on the thickness of the square. The effect is wavelength dependent, producing beautiful clear colors (Figure 14).

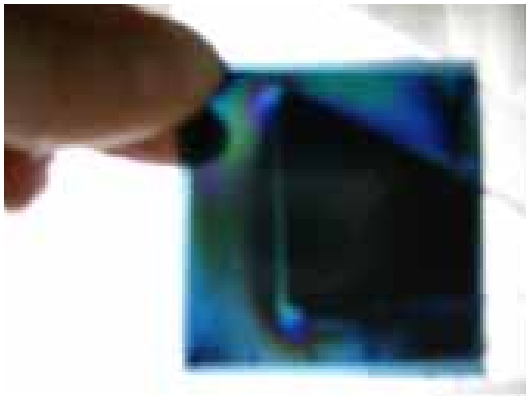

Figure 14. **A set square between the crossed polarizers**

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11. Graph Matching

Objectives: Analyze the motion of a student walking across the room, predict, sketch, and test position and velocity vs. time kinematics graphs.
Materials: Vernier Motion Detector, computer, meter stick, masking tape
Procedure: I set up this experiment with my students from 9th R2 grade.

We placed the Motion Detector so that it points toward an open space at least 4 m long. We used short strips of masking tape on the floor to mark the 1 m, 2 m, and 3 m positions from the Motion Detector. Using LoggerLite program, a student walk away from the detector with constant velocity and another click on "Collect" button.

The program sketch in the same time graphs d=f(t), v=f(t) si a=f(t). You can open the experiment file "01 Graph Matching." Some position and velocity vs. time graphs will appear.

You can describe how you would walk to produce this target graph, and then test your prediction.

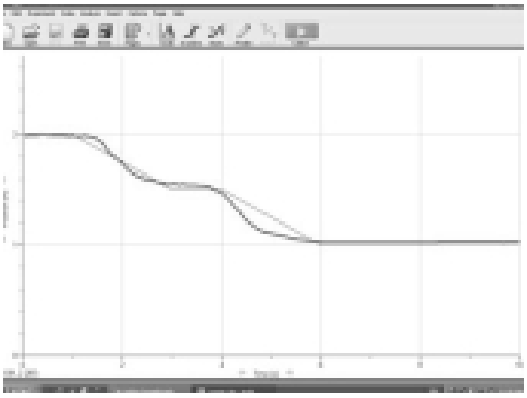

Figure 15. An example of d=f(t) graph obtained with Vernier Motion Detector

12. Simple Harmonic Motion

Objectives: measure the position and velocity as a function of time for an oscillating mass and spring system, determine the amplitude, period, and the frequency of the observed simple harmonic motion using the Vernier Motion Detector
Materials: spring, computer, Vernier Motion Detector, rods, ring stand, clamps
Procedure: I set up this experiment with my students (Figure 16).

First we established A=2cm and we collected data for a mass of m=150g, 200g si 250g hanged from a spring. After 10 s, data collection will stop. The position graph should show a clean sinusoidal curve. If it has flat regions or spikes, reposition the Motion Detector and try again. Using the position graph, we measured the period, T, of the motion and we calculated the frequency, f (f = 1/T).

Figure 16. Simple Harmonic Motion Experiment

13. Conclusions

We will use the results of students' work (devices manufactured by students, web sites, papers, paintings, projects, experimental movies, photos, etc.) like didactic material for classes of Physics, Computer Science, Mathematics, Biology and Chemistry so they be more attracted and interested to understand Science.

We enjoy very much to work in "Hands on Science".

14. Acknowledgements

I would like to thank Ms. Fenna Hanes - Principal Investigator, Judith Donnelly, Donna Goyette and Mr. Nicholas Massa - Co-Principal Investigators New England Board of Higher Education (NEBHE) [3], USA, the "Hands on Science" network coordinator Manuel Felipe Costa and the "Hands on Science Romania" and Center for Science Education and Training CSET [4] national coordinator Dr. Dan Sporea for their support and encouragements.

Also, I would like to thank Vernier Software & Technology [5], USA for their generous donations.

15. References

[1] http://www.geocities.com/physicsexperiments [04/27/2007]
[2] http://school.discovery.com/lessonplans/programs/colorspectrum/ [04/27/2007]
[3] www.nebhe.org [04/27/2007]
[4] www.inflpr.ro [04/27/2007]
[5] www.vernier.com [04/27/2007]

 ISBN 978-989-95336-1-5

Few Problems for Gases' Laws

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Abstract. In physics, certain properties of matter are measured and the results examined to see if there is any mathematical relationship between them. It is important to grasp the true meaning of the equations we find in a physics book. They do not tell us what things are in them, but are simply a convenient way of expressing the laws governing their behavior.

Keywords. Mathematics, Physics.

Vision: An Interdisciplinary View

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Abstract. With the objective of leaving the traditional lessons behind, in this work we present an approach of the vision from an interdisciplinary perspective, hands-on, or either active approach, where the participant expresses himself, executes tasks (eventually proposals by himself) and changes ideas with the group's colleagues and the teacher.

On the hands-on perspective the participation of the student is essential. This participation can be by making questions, suggestions, critical, etc. Under these circumstances, it is practically impossible confine the scope from the questions to an only one discipline, the physics for instance. After all, the real life is interdisciplinary. The basic interdisciplinary approach combines different fields of science.

Through an interdisciplinary, significant, active methodology, and using a hands-on approach, we work with the vision in a physics class not only like a two lens optical system. The vision is also considerate from the morphologic point of view, using concepts of biology.

The biological functions of diverse parts of the eye are highlighted, such as the optical nerve, the blind point, the function of the rods and cones, and so on. The physics reappear, but inside a new peculiar scene. For example, the perception from the colors by human eyes is investigating and a parallel with the perception of some animals is made.

The authenticity of these activities with processes of investigation on which the students do take part from investigation can be seen when we find out that two classes with the same subject to two different groups are never equals.

If we change the talkers, we will change the reactions, questions, perceptions. Even so, the "core" from activity is the same, once the fundamental aspects of the human eye always appear, in a way or another.

Keywords. Interdisciplinary, Vision, Education, Hands-on.

1. Introduction

Inside an interdisciplinary, active and hand-on perspective, we present a boarding on the sense of vision. Our activities were developed to use with continued education of teachers and teacher education undergraduate students. This new boarding contemplates necessity to move paradigms in current academic education, once the process of making pedagogical decisions is focused. In the Cartesian-Newtonian paradigm that favored materialism, rationalism and a fragmented vision of the world and of the sciences [1, 2]. Education/learning cannot be treated just like a transmission of scientific knowledge, in a broken way, through activities whose learning neither stay nor represents a constructed knowledge. Education must stimulate the student to search, going far beyond the four walls of the classroom. The research is necessary. Mainly, because the world changes very quickly and, the people who lives in it, must be prepared for these changes.

The majority of the graduation courses do not prioritize a reflexive and consistent formation. The courses are disarticulated, there are not exchanges between the diverse areas of the knowledge. We must show to the student how the reality around them is and which relations exist between them, the other creatures, the work and the world. It is necessary to show in the classes that there is a net of relations between all the creatures and the environment. Everything becomes related and everything is in connection.

In this direction, this work considers a boarding where it is considered in special the participation of the student, through questions, suggestions, critical, etc., investing in the holistic vision, by which the academic study is carried out analyzing the whole context, practically being impossible to restrict the scope of the

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questionings to an only one disciplines, physics, for example.

2. Methodology

To avoid an education were the teacher presents the contents in order to fulfill the program, we emphasize the construction of scientific meaning for the students by adopting interdisciplinary, active and hands-on activities.

This work is part of an extension project that aims at the continued education of teachers of high school in the sciences area. Our work group is teachers of Physics, Chemistry, Biology, Mathematics and Computation. Always working in an interdisciplinary, active and hands-on perspective, workshops in science have been created. In Figure 1 we can observe the work group in a workshop with undergraduate students. Taking into account the new curricular guidelines of the Ministry of Education and Culture, some areas of interest were chosen by the high school teachers who participate of the workshops. To this work we are going to present some activities on vision developed for the five senses workshop.

Figure 1. Our work group working interdisciplinarly with undergraduate students

The high school teachers interacted with playful materials, potentially significant objects that could generate discussions at theoretical, practical and interdisciplinary levels. The texts and the activities were developed based on the methodology of active learning. According to the active learning methodology students will discover new phenomena and concepts on their own, link them to previous knowledge, reflect and generalize to acquire conceptual and significant understanding [3-5].

3. The sense study

Always working inside of a perspective interdisciplinary, active and hands-on, we choose the study of the sense for this work. In special we choose the study of vision. Some equipment had been mounted by the participants during the course, well to the taste of the hands-on philosophy. The sense activities had been presented as in an interdisciplinary workshop offered in continued education of teachers, as in mini courses offered to graduation students.

4. The vision

Inside an interdisciplinary study on the five senses, the sense of vision is presented taking in account aspects not only of the physics.

The study of the sense of vision it is initiated with a holistic activity that consists of mounting an eye with a glass globe a lens of increase and a lantern (Figure 2). The students in this stage visualize the formation of an image in the posterior part of the glass globe.

The students start to make analogy with the real eye, observing as the image is formed.

Figure 2. Material used for a model of the eye construction

In the follow a model of the human eye is presented, in its morphologic aspect, well to the taste of Biology (Figure 3). The model is compared with the previously mounted globe. The anatomical parts are described and its functions are specified. In this point the eye is perceived not only as an optic system with two “lenses”, but also as a detector. The functions of the retina, blind point, optic nerve, pupil, cones and rods are argued.

After the presentation of the morphologic model, some optic illusions are presented. The

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paper of our brain in the interpretation of what we see is pointing out. It is possible to find diverse websites (some optics illusions can be seen, for example, in [6, 7]) that explore diverse types of "tricks" to deceive our brain (Figure 4). We can explore, for example, the 3 dimensions vision through images with different colors, showing images in a retro projector and distributing special eyeglasses with lenses of two colors. Defects on vision were explored too. In Figure 5, we can see an image with a test of color-blindness.

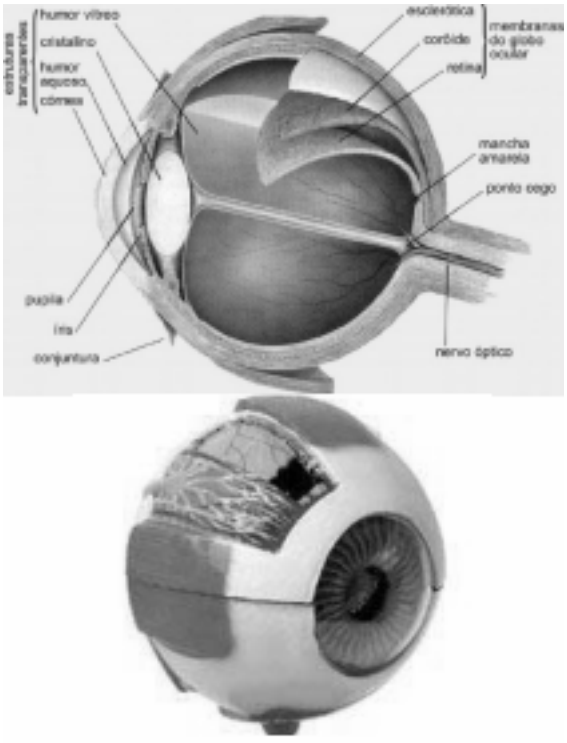

Figure 3. Model of the human eye

In another activity, we made an ocular globe with a sphere of expanded polystyrene, an entrance hole in the place of the iris and another one in the exit, in the retina's place. In the exit hole the student must place his eye and observe the image formed. We use lenses calculated for a normal vision, hyperemia and myopia. We can use "corrective glasses" to put in focus the image of a hyperemic or myopic eye.

In this activity we discuss, in an image's formation perspective, the focus of the lenses, and the common defects of vision. In Figure 6 we show to some images formed with (a) lens for normal vision, (b) hyperopic vision, (c) position of the hyperopic image, moving the plate behind the retina, and (d) image corrected with an adequate lens.

In Figure 7 we can observe the students during the activity. The hyperopic image is being corrected for the lens put in front of the eye and the students can observe it in the posterior part, in the plate placed in the position of the retina. We can see the eye in Figure 8. In this, a second lens is putting in front of the eye to correct hyperemia.

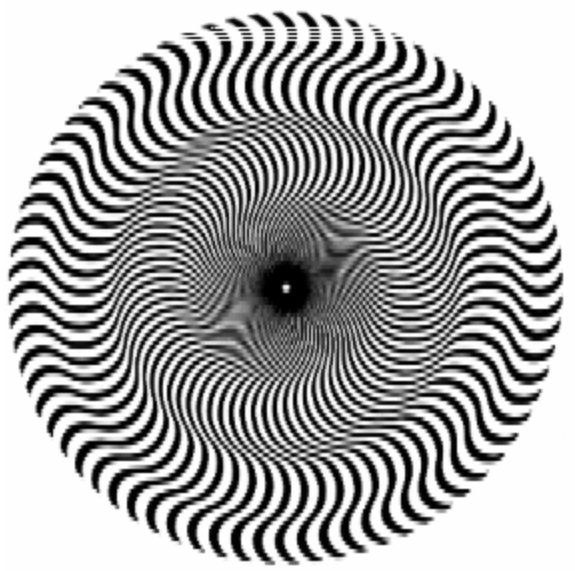

Figure 4. Example of optical illusion. Moving the head, you will have the sensation that the image is moving constantly [6]

Figure 5. Image with a test of color-blindness

Coming back again to the morphology of the eye, it is argued the paper of the cones and rods. The Physics reappears, but in a peculiar scene. For example, the perception of the colors for the human eye is investigated, and compared with the perception of some animals.

In the study of colors we use an over head projector with plates to support color filters and diffraction gratings, as we can see in Figure 9. We can obtain the filters by printing the colors desired in transparencies. The diffraction gratings can be obtained cutting a recordable compact disc without the protection film.

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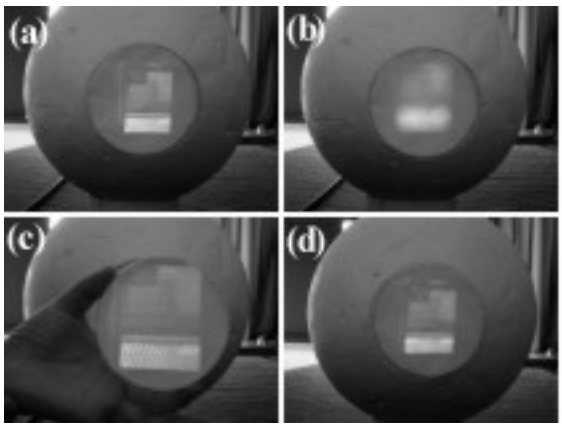

Figure 6. Images formed for (a) the normal eye, (b) hyperopic eye, (c) position of the hyperopic image, behind the retina, and (d) image corrected with an adequate lens

Figure 7. Students using the eye to observe images and to correct defects of vision with lenses

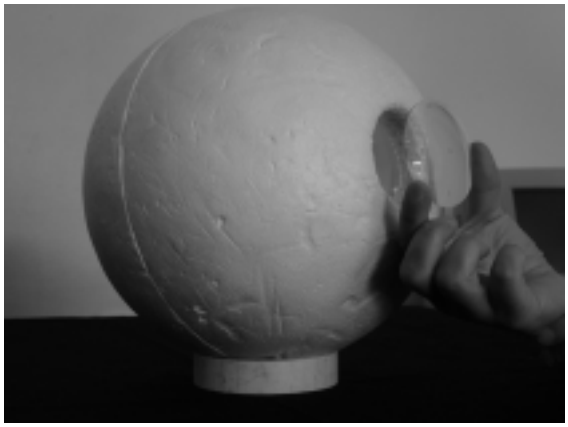

Figure 8. Eye with a correcting lens

Using this apparatus, that can easily be constructed in classroom of high school, we can explore the electromagnetic spectrum, the function of the color filters and the composition of colors. The detectors of our eyes, rods and cones, are also studied in terms of its sensitivities. The addition of the signal received for each sensor is described. We discuss what happens when one of the sensors presents defect, causing color-blindness. Also the animals´ vision is presented, comparing it with ours. In Figure 10 we can see the student's activity using composition of colors.

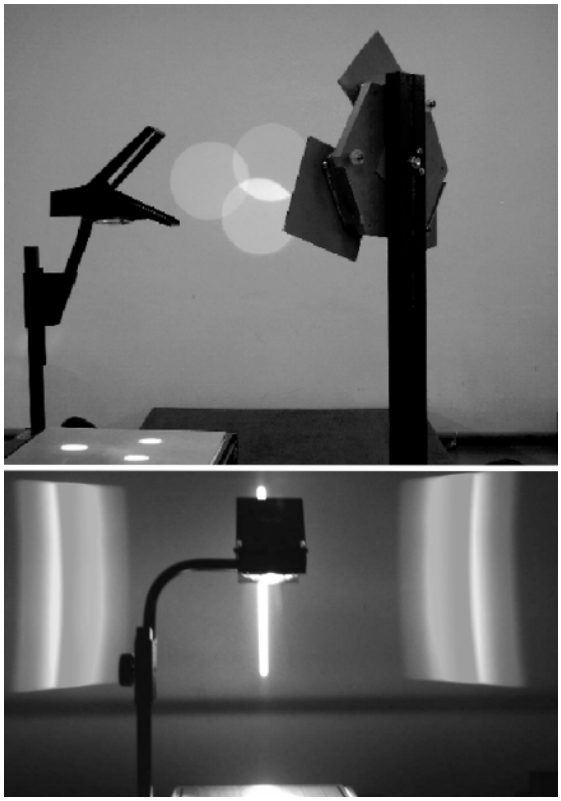

Figure 9. Apparatus used for the study of colors

To explore the electromagnetic spectrum, the students mount a spectrograph, as we can see in Figure 11. Pieces of recordable compact discs without the film mounted in a cardboard box are used. The students mount the box, the slit and the "diffraction grating".

Some characteristics of the electromagnetic waves are presented. When observing the spectrum obtained with the aid of the over head projector, the students back to analyze the colors. We can see in Figure 12, activities with electromagnetic waves.

5. Analysis and discussion

The philosophy of our work is interdisciplinary, active and hands-on. All proposals activities contemplate this philosophy. When we work with the sense of vision, beyond the physical and biological aspects, we emphasize the existent chemical reactions in the exchanges of information in our biological

 ISBN 978-989-95336-1-5

sensors. The mathematics is present when working with the images and the composition of colors. The use of computer in classroom also is stimulated, with the use of diverse programs in Java.

Figure 10. Activity of composition of colors

Figure 11. Activity with the spectrograph

6. Conclusion

With ours activities we hope enable students to learn more about science. To obtain success we used an interdisciplinary, active and hands-on methodology. The results observed with the answer of the students were very good. The activities developed for the study of vision is friendly and ease to use. This kind of activities awakes in the high school teacher the creativity and the desire of work in their class in an interdisciplinary, active and hands-on way. In the workshop to continued education of teachers, they presented activities developed in this philosophy.

Figure 12. Activity with electromagnetic waves

7. Acknowledgements

The authors would like to thank FINEP and UCS for financial support, the students who participated at the workshops and the high school teachers who did the workshop and brought valuable contributions for the enhancement of the work developed.

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4th International Conference on Hands-on Science
Development, Diversity and Inclusion in Science Education
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Production of Experiment about Energy Conservation into Teacher Education Undergraduate Course in Physics of the Federal University of Itajubá

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Abstract. In the Learning Practices IV course (FIS461), from teacher education undergraduate in Physics of the Federal University of Itajubá (UNIFEI), Brazil, we work with the concept of energy conservation within an historic approach giving emphasis to their several forms, sources and also with the fundamentals energies from the point of view of the theories of Physics. To introduce each topic a conceptual and qualitative argument is made. After that, the students develop new activities such as seminars about the several sources of energy. To conclude, they work out and develop experiments on the subjects learned, more exactly the energy conservation is investigated. The goal of the students is to design and to assemble the chosen experiments in order to promote the experimental Physics and to improve the scientific education at the Brazilians High School. Those are user-friendly assembled experiment and are built up with recycled material or cheap materials. A schedule is developed to each experiment in order to guide the teachers and the students from High School to set up and carry out the activity. With those experiments we intent to provoke and develop the use of classroom experiments. In this way we expect that the Brazilians High School students are going to "do" science rather than merely being "exposed" to it. It is fundamental that the experimental set up must be made by the High School students, this will provide a full control of all detail. The students will be completely familiar with the experimental set up and will carry out a better understanding about the experiment itself and about the physical concepts involved. In this work we present few examples of experiences, developed by the students of Learning Practices IV course, such as collision, domino effect, yoyo of bottle and water wheel. We argue and we evaluate these works 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. Education, Physics, Energy Conservation.

1. Introduction

Teacher education undergraduate course in Physics, of the Federal University of Itajubá, was created in the year of 2001, with the first group entering in the following year. It has for objectives: to form Physics' teachers, who can as act in High School as continue its studies in programs of Msc and PhD, to support collaborations existent and to make possible new collaborations with diverse research's groups in Education and Physics´ Education, as in the proper institution as witch others institutions, through activities like probation and scientific initiation, to narrow the bows of the University to the schools of average education by means of activities of period of training and scientific initiation program, to promote the dissemination of distance education for all the country, to foment activities of scientific divulgation, to form qualified people to act in sciences museums, and to insert students in extension activities in order to contribute into processes of social inclusion already in progress.

The Learning Practices IV course has as objective to give to the students a conceptual and quantitative vision on energy, stimulating it to present it subjects related with the subject as well as elaborating and mounting an experiment involving the apprehended concepts of energy. The boarded strategies are: formal lessons, seminaries presented by the students and elaboration and assembly of experiments involving Conservation of Energy.

The following concepts had been boarded in the formal lessons: History of the Energy, the diverse forms of energy, sources of energy: renewed energies, basic energies from the point of view of Physics, and the theories of Physics and energy. In the seminaries the students had presented the following energy sources: Aeolian, Biomass, Hydroelectric, Nuclear, Solar and Thermal. Some of the experiments presented for the students on Conservation of Energy form were: Collision, Domino Effect, Yoyo of Bottle and Water Wheel.

2. Experiments

The experiments planned and mounted for the students of the course, aim at the promotion of experimental education in Physics in order to improve the scientific education in the Brazilian

 ISBN 978-989-95336-1-5

schools of High School. These are experiences of easy assembly and composed by recycled materials, or cheap materials, and all of them have a script that guides the teachers and students of High School in the assembly and posterior accomplishment of the activity.

The objective of the practical experiences is to foment and to develop the use of experiments in classroom, with that purpose of take the students of High School to "make" science instead of only to be "displayed" to it. To this happen the assembly of the experiences should be made by the proper High School students. This will promote the complete familiarization of the experimental apparatus and will provide the domain of all experimental aspects causing a better agreement of the experience itself and also of the boarded concepts in it.

3. Scripts of the Experiences

To follow we present scripts elaborated for the students

3.1 Collision

Federal University of Itajubá
Learning Practices course IV (FIS461)
Experience: Conservation of energy
Objective: The objective of this experiment is to show the transformation of the gravitational potential energy in kinetic energy, illustrating the conservation of the energy mechanics.

Used Material

• Plastic Cup
• 2 plastic cover from 2000 ml or 600 ml bottle
• 2 rulers of 30 cm
• Adhesive Ribbon
• Supports (book, notebook, pencil, etc.)
• 1 small ball

Experimental Procedure

• Cut a square of approximately 3 cm width for 6 cm height next to the edge of the plastic cup.
• Fix the plastic covers with adhesive ribbon in the extremities of one ruler, in way that are lined up.
• Fix the plastic covers to another ruler, horizontally, on the other face of the plastic cover. This junction of the two rulers, separate for the plastic cover, is seemed like a narrow channel.
• To prevent the small ball to open the two rulers when rolling in the narrow channel, pass an adhesive ribbon in the low part of the narrow channel, in such way that the rulers cannot be opened.
• Raise the ruler's extremity using a book as support.

• Place the small ball in the ridge of the ruler, from the upper part of the support.
• Liberate the small ball and observe the cup.
• Repeat the procedure using different supports, with different heights.
• Observe the reactions of the cup.

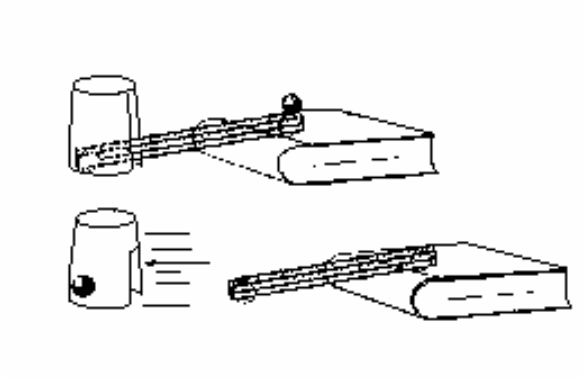

Figure 1. Illustration of the experiment

Cost of the Experience

• Plastic Cup: recycled
• Plastic cover: it can be recycled by 2000 ml or 600 ml bottle
• Rulers: 0,15 euros
• Small ball: 0,15 euros
• Adhesive Ribbon
• Adhesive Ribbon: 0,50 euros

Explanation of as the energy conservation occurs

The idea of the experiment is to show that how higher the gravitational potencia1 energy of the object at the beginning of the fall movement, greater will be its kinetic energy in the end of the fall. The amount of kinetic energy could be evaluated through a mechanism of to stop the movement of the object in fall.

In this experiment, a small ball in fall in an inclined plan transfers its mechanics energy to a cup. When initiating the movement, the small ball transforms its gravitational potential energy into kinetic energy. During the movement occur reduction of the gravitational potential energy and increase of the kinetic energy. Due to mechanics energy conservation, into the end of the plan, all gravitational potential energy transforms into kinetic energy. After that, the small ball does enter in contact with the cup and the kinetic energy is all transformed into other

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forms of energy. For example, in thermal and sonorous energy of the noise that the cup makes. The cup wastes the kinetic energy that received from the small ball, but in this case the value of these forms of energy is negligible.

The friction over the cup is practically constant and the cup needs a fixed amount of kinetic energy to win a distance fixed. Therefore, if the cup dislocates more, this means that it received a bigger amount of kinetic energy.

What we observe is that: the higher is the extremity of the system of rulers where the small ball is released, more gravitational potential energy the small ball will have. Therefore the potential energy is function of the height. The small ball acquires more kinetic energy when rolling from the inclined plan. This implies bigger energy transference for the cup, which covers more horizontal distances until stopping, due to the friction with the surface.

Integrant
Denis Marcel Gouveia de Souza
Thiago Amaro Vicente
Guillermo Colaneri

3.2 Domino Effect

EXPERIMENT - ENERGY CONSERVATION

Objective: The objective of this experiment is to show the transformation of Gravitational Potential Energy in Kinetic Energy, illustrating the Conservation of the Mechanics Energy.

Context

The principle of the Conservation of the Energy says that “the energy can be transformed or be transferred, but never created or destroyed”.

In a determined mechanical system, where we don’t have energies related to electromagnetic or thermal phenomena, we can say that the total energy of the system is purely mechanics. In this way, the Principle of the Conservation of the Energy implies the conservation of the mechanics energy. This, in turn, is the sum of amounts of potential energy and kinetic energy. Although the energy mechanics is always constant, the amount of each one of its components can suffer variation, in such way that the total energy remains constant.

In this experiment we can identify a transformation of a kind of energy in another. Initially an object possesses gravitational energy, which is the energy of interaction between the mass of the object with the mass of the earth. This energy is stored in the system earth-object. The energy goes diminishing with the object and the earth approach. The gravitational potential energy of an object, which is directly proportional to the product of its mass, the acceleration of the gravity (g) and its vertical distance in relation to a control point, transforms into energy of the object, that is associated with its movement. The kinetic energy is directly proportional to the mass and the square of the speed of the object.

Idea of the Experiment

The idea of the experiment is to show that gravitational potential energy can be transformed into kinetic energy and the transference through mechanical shocks causing the movement and fall of the bodies placed in the end of the stretch.

Item	Comments
3 sulfite paper	We use any paper
Wire	25 cm
Shoe box	With fixed cover
Compact disc Cd (1)	We use scratched Cd
Ball of glass (2)	Marbles
Recycled cup	

Table 1. Material

Assembly

• Cut the sulfite paper in the middle.
• Make two opposites lined cuts in the compact disc, and use one half sulfite paper to make two shovels that will be fixed with adhesive ribbon in the cuts of the compact disc.
• With one half sulfite paper make a pipe with equal diameter of the center of the compact disc. Pass the pipe through the center and introduce the wire in the pipe. Attach the wire extremities in the center of the box, in way that is perpendicular with the cover.
• With another half sulfite paper, mount a narrow channel, folding it the middle and arresting it with the adhesive ribbon. Make two of these narrow channels.
• Arrest the box cover with adhesive ribbon, in way that this is in a position of 135 degree with regard to the box.
• Fix the narrow channel in the cover, in way that its inferior extremity is in the same direction of one of the compact disc shovels.
• Make a hole in the box, making possible the entrance of the narrow channel with a small inclination in relation to the other shovel.
• Make a support to the narrow channel with another half sulfite paper, folds in four parts to become firm.

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• Place the second narrow channel in this hole and equilibrate it to another extremity of the remaining shovel, in way to guarantee that the small ball can stop between the narrow channel and the shovel. Also place the support made from the paper to better equilibrate the small ball.
• Fix the opening of the recycled cup in the extremity of the narrow channel that was out of the box.
• Mount a line of domino in front of the cup.
• Liberate another small ball in the upper part of the initial narrow channel and observes the fall of domino.

Commentaries

If there is failure in the experiment, verify the following aspects:

• Position of the narrow channels
• Disposal of the compact disc in the pipe
• Distance of domino to the cup

Comments

- Project of assembly of experiment with material of low cost.
- All material used it was recycled, not demanding cost to the experiment.

Team Cristina Macedo
Keli Ribeiro
Willy J.P. Araújo

3.3. Yoyo of Bottle

FEDERAL UNIVERSITY OF ITAJUBÁ
Learning Practices Course IV

2° Semestre/2006

EXPERIENCE: Yoyo of Bottle
PRINCIPLE OF THE ENERGY CONSERVATION

Objective:

To construct a yoyo of bottle.
To verify the energy conservation mechanics.

Used material

• Small empty tin powder milk (or similar) with cover,
• Small ice cream stick,
• Rubber band (Elastic),
• Electric cell (discharged),
• Nail,
• Hammer,
• Ribbon crepe,
• String.

Experimental procedure

PART A: COSTRUCTION OF YOYO OF BOTTLE

Use the ribbon crepe to fix the electric cell in the rubber band. Make two small holes with a nail, one in the middle of the tin base and another one in the middle of the cover. It is important that it is exactly in these points. For this, trace successive straight lines in diametrical opposing points with a ruler, the intercession of these straight lines will be approximately the center of the tin. It is advisable that the rubber band be from circular type and that its maximum strength be 0.1 cm bigger that the length of the tin, to facilitate the disposal and centralization of the electric cell in the tin. Fix the rubber band inside the tin in this way: fasten a string piece in two symmetrical points of rubber band and pulls one of them outside of tin for the hole made in the base, fixing it in a ice cream stick (the rubber band must be strained inside of the tin), straining the rubber band, make the same on the opposing side to fix it in the hole of the cover. Close the cover and the assembly is ready (see figure below). With the closed and lying tin two branches of rubber band are formed: the above branch must be in the horizontal line, the lower branch, that has the weight in the middle, forms a well open V.

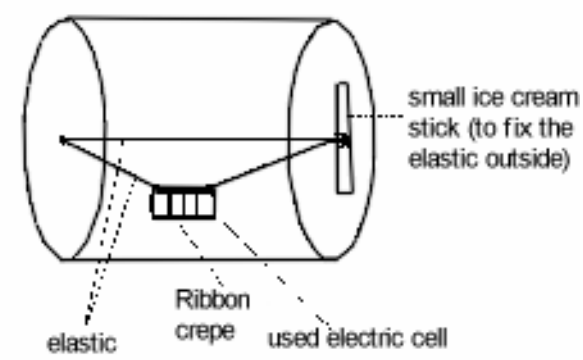

Figure 2. Yoyo of Bottle

Obs.: It is important that the stick stay fixed to the tin (does not have to slide when it rolls) and that the suspend weight does not touch the tin when it is lying. If this happen, reduce the length of the rubber band (it is enough to give one or more knots in the tips) or substitutes it for a smaller one, therefore the device will move only with the suspended weight.

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PART B: FUNCTIONING

Place the lying tin in a horizontal floor. It is important that the table or place be well polishing and is leveled to not appear undesirable accelerations. For leveling test proceed as to want, using, for example, a body of test. Mark the initial position. Give a moderate impulse to it, making it to roll in front, without sliding.

Theoretical information

The whole energy always conserves. It was not verified until today no experiment where has no conserved energy, it changed itself into many types, but the sum of each one of its divisions will give a constant. It is a physical law of maximum importance in the physics.

When dissipative forces, as friction force, are not considered in the system, we have the conservation of a special type of energy, called mechanics energy, in case that these dissipative forces exist, this kind of energy do not conserve, being itself part of the total energy transformed into sonorous, thermal, luminous energy, etc.

The mechanics energy is composed basically for potential energies (elastic, gravitational) due to the rubber band strength or the body position, respectively, and kinetic, due to the body or system movement.

In a system with this kind of energy, it must never create energy, but yes, transform the initial energy into other possible kind, some times being this transformation simple or other times being complex, but in the end, it will have exactly the initial value.

Interpretation of the results

- Give an impulse in the tin. It comes back to the same in local were it left?
- There have dissipative forces acting on the system? If they exist, which will be its relation with the arrival point of the tin?
- Which is the importance of the test table or place to be leveled?
- Describe what happens with the rubber band and the electric cell after the impulse given to the tin.
- Why the tin stops for an instant and later it returns in opposed direction, not stopping in the starting point?
- Consider the member of the team that gave small force in the tin. Did him do work on the tin? Why?
- If the can did not have a system with rubber band and electric cell, what would the team wait to happing with the tin?
- There is external forces acting in the system when this is in movement?

Reference

Caspar, Alberto. Experiences of Sciences for basic education. Ed. Ática, págs.213, 214.

Cost

• We utilize in this experience a clothes rubber band, being its cost of approximately 0,20 euros.
• The tin and the ice cream stick can be used.
• The electric cell is also used.
• The total cost (approached) is 0,20 euros.

Team: Andres Ribeiro de Souza
Jonas Peter Pereira
Thieny de Cássio Helms

3.4. Water Wheel

Federal University of Itajubá

DISCIPLINES: FIS 461

PROFESSOR: Antonio Marques

Students
Alexandre Nogueira Ottoboni Dias
Rodrigo de Lima Coelho
Zaqueu Oliveira dos Santos

EXPERIMENT: Water Wheel

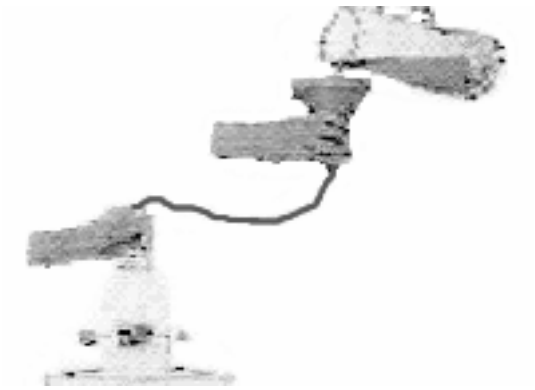

Figure 3. Water wheel assembly

Objective

1) To show transformation of potential energy in kinetic energy.
2) To show the basic principles of generation of energy in the hydroelectric.

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USED MATERIAL:

• Cork
• Mass of shape
• Plastic Pipe
• Jar with water
• Plastic Bottle with cover
• Nail
• Funnel
• Scissor
• Adhesive Ribbon
• Tin
• Earthen ware
• Knife with tip
• 1 small stick of barbecue
• Sewing
• Piece of Expanded polystyrene (isopor)

Experimental description

1) Make 4 equal cuts around the cork.
2) Cut 4 pieces of tin with the same size of the cuts in the cork. These are the shovels of the wheel.
3) Fix the shovels in the cuts of the cork. This is its water wheel. Verify if the shovels are firm.
4) Make two holes (one greater than another) in opposite side of the bottle.
5) Cut the deep of the bottle. Verify if the cut edge is plain the enough to keep the bottle straight.
6) Stick a small stick of tooth in the cork. Put it in the bottle. Introduce the stick of tooth in the smaller hole.
7) Introduce the stick of barbecue in the other hole and sticks it in the cork. Put the mass of shape in the top of the stick of tooth and next to the other hole, in the stick of barbecue.
8) Tie the sewing on the piece of isopor and than on the extremity of the stick of barbecue.
9) Do a hole in the cover of the bottle of the size of the diameter of the plastic pipe with the tip of the knife
10) Introduce the plastic pipe in the cover of the bottle.
11) Insert the funnel in the plastic pipe and fix it with adhesive ribbon.
12) Place the bottle in the earthen ware.
13) Fill the funnel with water and direct its fall on the shovels.

Questions

1) The funnel is in certain height of the soil. That type of energy is associated to the water stored in the funnel: kinetic or potential?
2) What happen with the water when it falls in the shovels of the water wheel?
3) That type of energy is associated with the movement of the shovels: kinetic or potential?
4) From your answers of item 1 and 3: What happened with the energy during the fall of the water?
5) Raise the funnel highest and repeat the procedure (13) of experimental description. What happened with the movement of the shovels? Explain the fact using the concepts of potential energy and kinetic energy.

Commentary on the used materials

We observe that a good part of the used material is recycled and of easy acquisition, being the other part consisting of materials with low cost, for example, the mass of shape, the adhesive ribbon and the plastic pipe. The cost of the experiment varies a little with the quality of the material used. It was 4 euros approximately.

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4. Analysis and discussion

The objective of the practical experiences is to foment and to develop the use of experiences in the classroom, with the purpose of allow the Brazilians High School students “make” science instead of only it to be “exposed” to it. For this happen, it is fundamental that the assembly of the experiences is made by the proper High School students. In this way it will provide the complete familiarization of the experimental apparatus and will provide a full domain of all its aspects causing a better agreement of the experience itself and also of the boarded concepts.

The proposals experiences present characteristics of the philosophical conception hand-on science. The experiments are of low cost, they have an experimental conception, they are project-guided and technological experiments, they are of practical and instrument kind and we wait that they are efficient for all students. Therefore we believe in the potential effectiveness of these experiences as instruments of learning in the conception of the philosophy hand-on science.

5. Conclusion

The disciplines FIS 461, Practical of Education IV, from teacher education undergraduate course in Physics of the Federal University of *Itajubá* (UNIFEI) presents forms of boarding the energy concept in High School.

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First of all it intent to give to the students a conceptual and quantitative vision on energy, stimulating the student to present subjects related with the concepts as well to elaborate and to mount experiments involving the concepts of energy learning.

We believe that the contact of the student of the teacher education undergraduate course in Physics with this boarding provides a significant improvement in their academic formation. Therefore, in the lessons, we argue, besides others things, that in the produced materials, seminaries and the scripts of the experiences, we must to have in mind the importance of clarity of the concept discussed, and also the clarity in the exposition of the concepts.

This improvement in the formation of the teacher education undergraduate course in Physics students, must to cause a better learning of the concepts of average education that the futures teachers will work. It will cause an improvement in the quality of average education in what refers to Physics.

The experiences proposals present characteristics of the philosophical conception hand-on science as: they have a conception mainly experimental, are experiments of low cost, project-guided and technological, they are of practical to the instrument kind and we wait that they are efficient for all the students. Therefore we believe on the potential effectiveness of these experiences as instruments of learning in the conception of the philosophy hand-on science.

6. Acknowledgements

I thank to Prof. Dr. Helena Libardi, of the University of Caxias of the South (UCS), for the incentive, contribution and revision of the text of this article.

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Implementing ICT in Science Education

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Abstract. Implementing ICT in scientific education as well as keeping our teachers and students connected to the world is our "school philosophy". Redesigning the teaching -studying - evaluating process, using IT methods during classes, developing the students' creativity, stimulating teamwork, the importance of your work's result, all of that representing the contribution for an added value.

This way, the application put forward for development contains three modules, which point out every team's way of working. Thus, in the college's "VIRTUAL TOUR" one can see the possible activities in the classroom, and how IT technologies are utilized in physics, chemistry and computer science classes:

- teacher's preparation for the lesson (traditional didactic material, modern didactic methods – educational software created especially for the student's needs)
- carrying the lesson, running each didactic activity needed for reaching the objectives already established by the teacher (the diagram in the LESSON PROJECT "THE OXYGEN" points out every didactic aspect developed by the teacher, every method of teaching used in the lesson, putting in perspective the essential role of the feedback during a lesson),
- the teacher's conclusions as well as the student's – partners in the process of teaching, studying and evaluating,
- the teacher's possibility to innovate, to utilize everything new, everything that contributes to education:

The slides below show how the ICT can be utilized in physics, chemistry and IT lessons.
LIVE INFO presents the "real life" of the college's students and teachers in their cabinets and laboratories of the school – the real "geometrical space" of scientific creation.
The ORACLE Internet Academy, the DATA MODELING COMPETITION – the world class projects 2004 – 2005 – 2006 – 2007, educational

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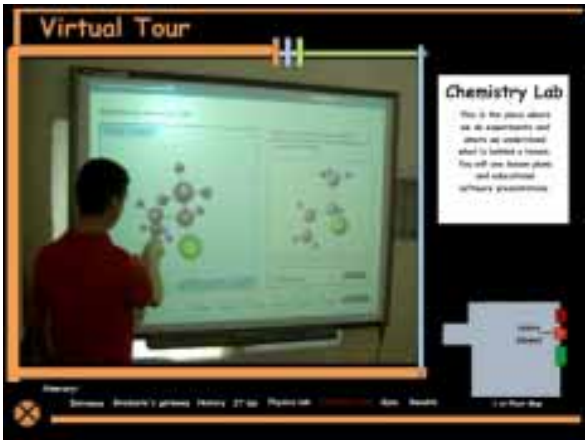
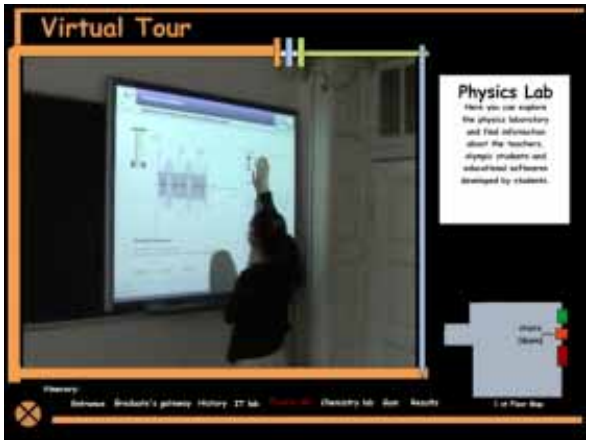
software, developed by mix teams (teachers – students), can be accessed by all those interested.
FORMER STUDENTS assures the LIVE conferences between the college and its graduates, who are currently attending classes at European and American universities. Teachers, students, parents as well as all those who are interested in knowing us and the ones who want to collaborate with us.



The program puts forward:
- the utilization of all multimedia products "Tudor Vianu school made" by the college's teachers, students and more,
- the "LIVE CHAT" system – a soft the assures the "LIVE" video conferences between the college and the students that learn abroad,

The project is meant to be extended, each study object having to contain a database necessary for development during the teacher's career. The interactivity stipulated between the group of experts and interested teachers shows special module of communication, the possibility of achieving online development for every teacher.
In conclusion:
- the teacher – student team who created the VIRTUAL PLATFORM noticed the ICT importance in EDUCATION, valuing all its components,
- the college's philosophy mentioned in the application description is the "engine" which guides the didactic changes – using the ICT in lessons will lead to spectacular results for students and teachers,
- the enhancement of the student – student, student – teacher and teacher – teacher communications will raise the interest of the partners in education. This way the "lesson focused on the student" becomes reality, the student as well as the teacher being interested in the outcome of the didactic activities,
- teamwork: students – students, students – teachers, teachers – teachers will prove their efficiency.



Keywords. Virtual Environments, Innovation, Creativity, Interactivity, E-Learning, Science and Art, ICT.

 ISBN 978-989-95336-1-5

An Experimental Webquest: Adventure and Science

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Abstract. In this paper we present a pedagogical experience with 7th, 8th and 9th grade students within a transversal work between Chemistry, Physics and Computer Science.
We developed a web-based strategy to induce an interdisciplinary integrated approach to Science learning through experimentation, and to promote hands-on experimentation activities using ICT tools. This type of strategy is an inquiry-oriented activity based on www which guides students' learning. The webquest structure was defined in 1995, when Tom March and Bernie Dodge started to use it.

In this work we will make a description of the hyperdocument that will focus on 3 important aspects: duration, which depends on the complexity of the theme, the structure and the evaluation of the WQ in the end we present some thoughts about the effects of this strategy on students' learning.

Keywords. Webquest, Physics, Collaborative Work, Chemistry,

1. Introduction

1.1. The concept

Although nowadays thousands of people know about the webquest concept, in 1995, only Tom March and Bernie Dodge knew about it and used it in their classes. They idealized a hyperdocument based on web which contained an attractive and appealing challenge. Students had to search, select and use the information on web to answer the challenge. As Dodge [5] said in 2001, a webquest is "an inquiry-oriented activity in which most of all of the information used by learners is drawn from the web".

The webquests structure has six components: Introduction, Task, Process, Resources, Evaluation and Conclusion. This sequence of steps allows for a specific organization and guidance for both learners and tutors.

1.2. The webquest: Adventure and Science

The Adventure and Science was designed to increase on 10-13 years old, pupils the science interest and to develop collaborative network competences. It was planned to be implemented in 4 90 minutes lessons of. Many of the resources are embedded in the WebQuest document and there are 2 types of resources: internal and external hyperlinks. The internal hyperlinks are connected to protocols, videos, photo gallery and other information about the lab experiences. The external hyperlink is connected to a website where students can find further and pertinent information.
The evaluation criteria include three aspects: a photo report content, the dynamic of the group and the presentation.
In the conclusion we analysed the vantages of doing this activity and describe to the playful nature of this task.

First we will make a description of the webquest structure, we will analyse the advantages of using webquest and present some thoughts about this methodology.

2. Description of the Webquest structure

The webquest description focuses on 3 essential points: the structure description (2.1), the navigation analysis (2.2) and the evaluation of the WQ (2.3).

2.1.1. Introduction

The introducing page of Adventure and Science WebQuest provides some background information and contains the title and author's references. This page includes a section which contains help directed to the tutor user with definitions, objectives and instructions about the webquest concept.

Figure 1. "Adventure and Science"

The interface is intuitive: the user can access the WQ by clicking the central animation.

The movement of the animation represents the science in motion, the idea of hands on

 ISBN 978-989-95336-1-5

science appeal to do/experiment science. The layout fits the WQ theme.

Figure 2. Introduction

There is a main menu (frame) with six hyperlinks which are connected (informative nodes) to all the components of the WQ.

2.1.2. Task

"WebQuests might be enhanced by wrapping motivational elements around the basic structure by giving the learners a role to play (e.g., scientist, detective, reporter)" [5].

In this websquest, Adventure and Science, we defined 4 different tasks. The students must follow protocols and reproduce the experiences:

- Sticky monster,
- Sun clock,
- Volcan,
- Fresh cheese.

Students find small texts for each experience proposed. These texts introduce the theme and present the main objectives of the tasks.

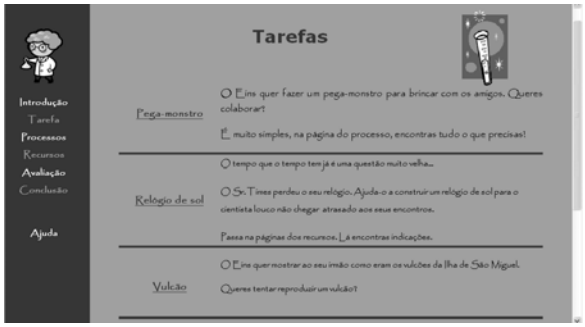

Figure 3. Task

2.1.3. Process

In this component we organize the work and describe the process:

1st Group formation (2 or 3 students),
2nd Choose the experience,
3rd Search and select information in resources,
4th Reproduce the experience,
5th Elaborate the final product (a photo report of the experience).

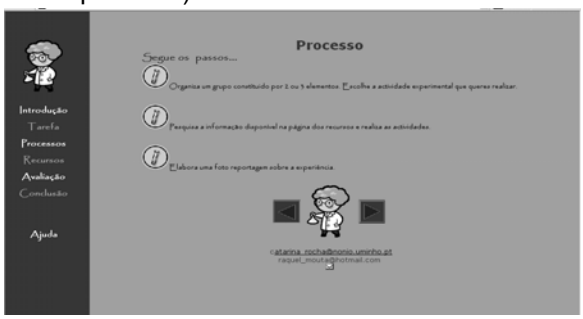

Figure 4. Process

2.1.4. Resources

Some of the resources are embedded in the WebQuest document as anchors pointing to information on the World Wide Web. We integrated 2 types of resources: internal and external hyperlinks. The internal hyperlinks are connected to protocols, videos, photo gallery and other information, whereas the external hyperlink is connected to website where students can find further and pertinent information.

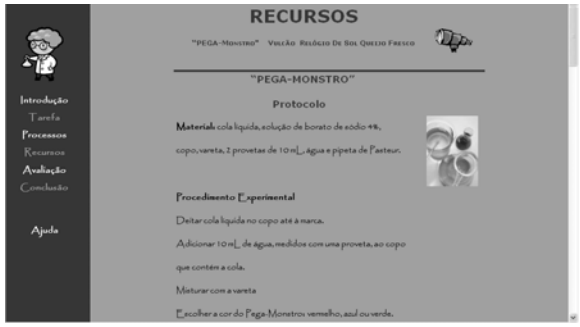

Figure 5. Resources

2.1.5. Evaluation

The evaluation criteria include three aspects: the photo report content, the group dynamic and the presentation in the classroom.

2.1.6. Conclusion

In this page, we analyse the advantages of doing this activity and appeal to the playful nature of this task.

Before WQ concretizing, students must read the conclusion page, so that has to promote the students' motivation and encourage them to extend the experience to other domains.

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Figure 6. Evaluation

2.2. Hiperdocument Navigation

This web includes a frame which contains the main menu. The menu is always active. This characteristic allows for net navigation. Nevertheless, the user does not feel lost while navigating in the hyperdocument. It is possible to accede to all points of the WQ.

The user of the hyperdocument can also decide to make a guided or sequential navigation, using the buttons with hyperlinks: go back and forth, step by step, covering the whole website.

Figure 7. Conclusion

2.3. Evaluation of the Webquest

The WQ was evaluated by Bellofatto *et al*. [1] table (47/50) and graphic aspects were evaluated by the Fine Points Checklist (15/15).

3. Some thoughts

In the information and knowledge society age in which ICT tools have a privileged importance, entertainment, and advertisement "fight" against education. The core sciences of chemistry, physics, and mathematics, which seem to require a special level of concentration, knowledge, and training, need to find some different ways with harder performances, to motivate and compromise students to science, and induce a deeper learning.

3.1. Wq as a strategy on sciences learning

The (CSCL - Computer Supported Collaborative Learning) is a variant of collaborative learning and is based on the hypertex. According to this educational strategy, two or more students build their knowledge upon discussion, reflexion and making decisions, using ICT tools as an interface.

The CSCL produces efficient learning groups and allows connections between previous knowledge in real contexts.

The ICT tools, especially the internet, are collaborative learning resources. The hypertext gives the opportunity to add information, such as definitions, elaborations, or related material, when the hot spots are activated. Sweeters [11], in the other hand, are informatic systems which create an educative environment to collaboration between the computers, or between two or more people.

The World Wide Web started a revolution in society and in our schools. As Berners-Lee (1994) explained about the meaning of the www concept, "it was developed to be a pool of human Knowledge, which would allow collaborators in remote sites to share their ideas".

In fact, we believe that the WQ concept can be a vantage in the learning process. It accumulates the benefits of the internet phenomenon, use ICT potentiality and creating collaborative environments favorable to learning.

3.2. The future

Tom March [7] raised the challenge,

"The most important factor is you, the teacher. You know your students, their prior experiences and knowledge, the things that tend to interest them (…)

And, as Bernie Dodge [6] told us in Braga,

"The WebQuest model continues to grow and change, but at its heart it remains as unimportant tool for preparing young learners to think for themselves. Personally, I can't wait to see what happens with it next."

The future is in our hands. When we use innovative and interactive strategies based on web, we are allowing our pupils to integrate the information and knowledge Society, inducing their autonomy, creativity, motivation and scientifical spirit.

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Lesson Plans for a Course Based on Historic Experiments for the Secondary Educational Level

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Abstract. In the past testing new ideas in science led several scientists to introduce a number of scientific experiments. Some of those contributed to the establishment of revolutionary theories and have influenced the evolution of ideas in science and society. We call them Historic Experiments.

The significance of developing problem solving skills is generally accepted today. The problems included in the conventional textbooks are usually applications of the theory explained, the student can solve them using the concept included in the chapter being studied. Students don't have to test an initial hypothesis and follow the steps of the scientific method.

On the other hand, a lesson based on a Historic Experiment includes the presentation of the method that was followed to overcome the difficulties and reach the historical breakthrough. In this way Historic Experiments become an excellent didactic tool in familiarizing the students with solving real problems and with the nature of science. Designing modern variations of Historic Experiments it is a way to bring our students in the position of the early researchers.

Conventional lessons in science usually deal with a theory which is presented in class through a mathematical model and through the applications in the modern society. We think that this way the student might miss the point. The experiments which played a central role in the evolution of ideas in science should also play a central role in the physics courses at the secondary level.

In this article we present lesson plans around Historic Experiments. We propose a general lesson plan, which includes the objectives, the structure and the time-frame of the different elements, the activities and procedures. We give examples of lesson plans around the Historic experiments like the Electromagnetic Induction Experiment. The last one includes a modern variation of the experiment using Microcomputer based labs (MBL) - sensors, moreover it combines the ideas of Faraday with those of

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Galileo in the Free Fall experiments, which give excellent results in a simple school laboratory.

Keywords. Physics, Historic Experiments.

Conceptual Questions and Physlets. A Case Study in a Portuguese Undergraduate School

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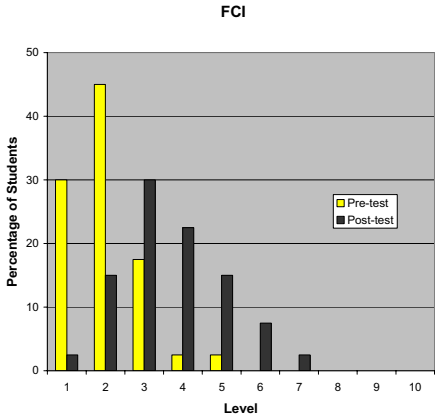
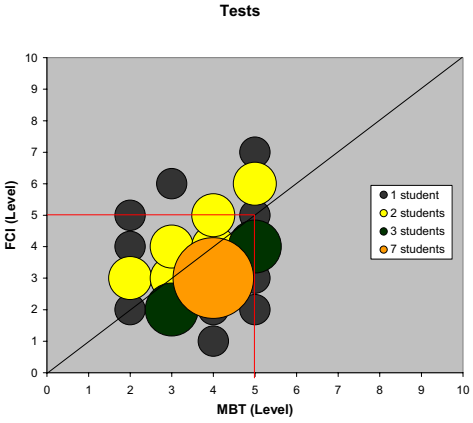
Abstract. Teaching Physics to non-physics majors is an ongoing challenge. As The Bologna Declaration is adopted across our country, a paradigm shift needs to be made from teaching our students to help them learn Physics. To achieve this, an interactive methodology was used with a freshmen group in an Applied Physics class, on the subject of Newtonian Mechanics. An interactive conceptual approach to physics was made following Eric Mazur's suggestions in his book "Peer Instruction" [1]. In addition, Physlets [2] were used both in class and as homework assignments, to promote further interaction, to motivate students and also to encourage autonomous work. The Force Concept Inventory, FCI, was used as a pre-test and as a post-test, to assess students' progress and the effectiveness of this approach [3]. At the end of the intervention, the Mechanics Baseline Test, MBT, was also given to evaluate students' knowledge [4]. Graph 1 shows the scores of the class in both the pre-test and the post-test. A T-test for paired samples shows that the difference between these results is statistically significant (M=-1,62, SD=1,30, t(36)=-7,60, p<0,0005). The average gain of the class was 19%. Graph 2 compares the results for the MBT and FCI as a post-test. The results for the class are highly consistent, but not completely satisfactory, as the majority of the students are located in the inferior left quadrant.

The students found the Conceptual Questions and the Physlets very useful for understanding physics, but undoubtedly Physlets were more challenging and motivating. They were supportive of maintaining this approach in the future.



Graph 1. Results of the class on the FCI as a pre-test and a post-test. The levels are related to the percentage of correct answers



Graph 2. Results of the class on the MBT and the FCI as a post-test

Keywords. Conceptual Questions, Physlets.

References

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 ISBN 978-989-95336-1-5

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 Grit Stones, 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).

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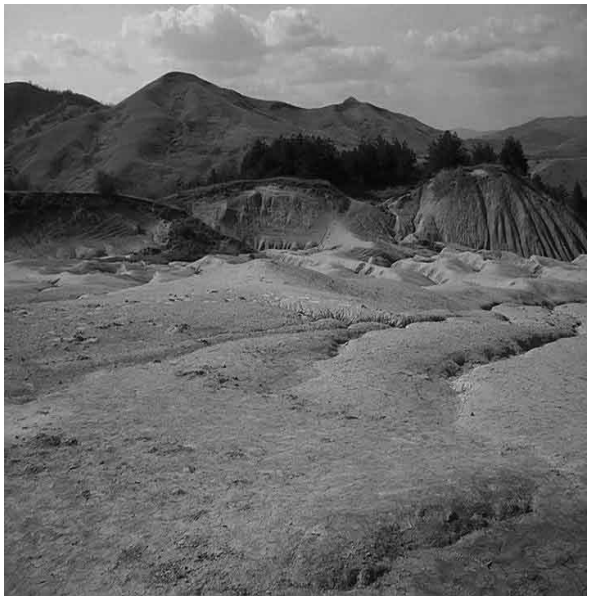
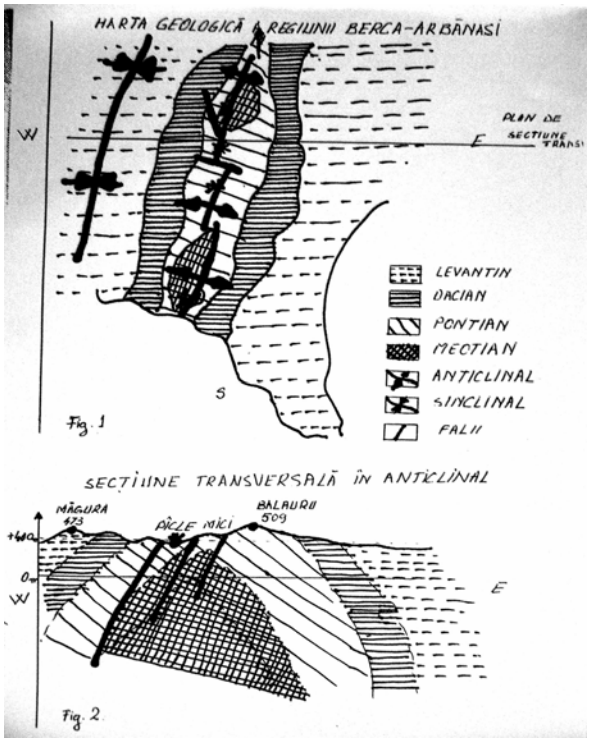


The layers' inclinations vary from 10 m in the upper part of the Levantine to 80 m in the culminating parts of the anticline (Berca, Paclele mici, Beciu) or in the area of some other faults. (Figure 2)

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 grit stone, 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 grit stone 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

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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, 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 centimeters to 7-8 meters, throwing out differently coloured marls, with a vast network of ravines, tracks, and torrential formations, remodeled 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.

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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 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:

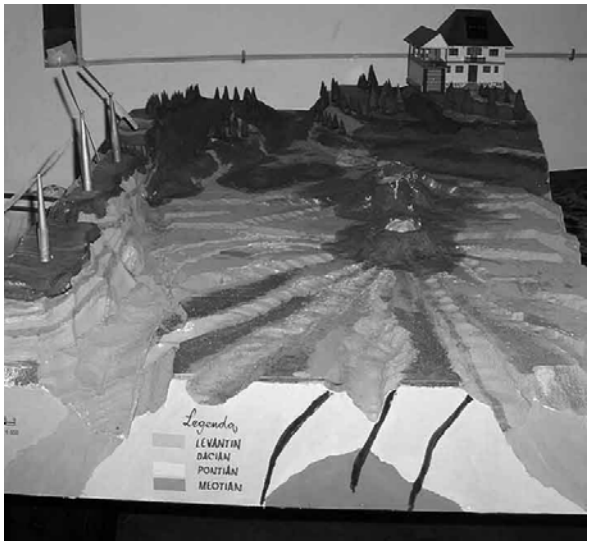
- Building a fence around the protected area,
- Stopping the agricultural exploitation of the land, allowing it to be afforested again
- Prohibiting grazing
- Identifying the grit stone heads or slightly cemented sands in order to identify the alignments of small terracing works for the forestation works
- 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 colors 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 modeled 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

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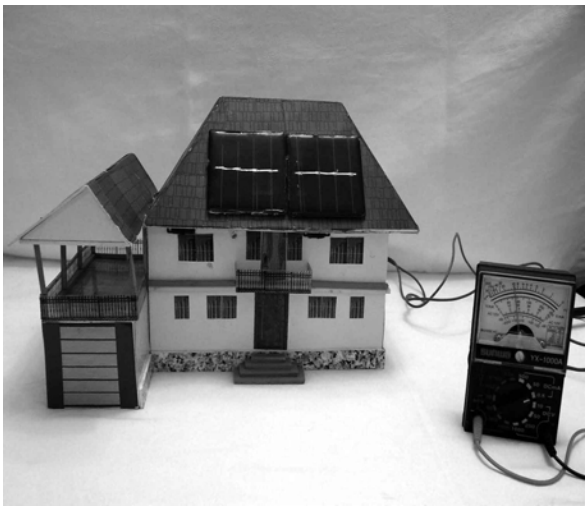
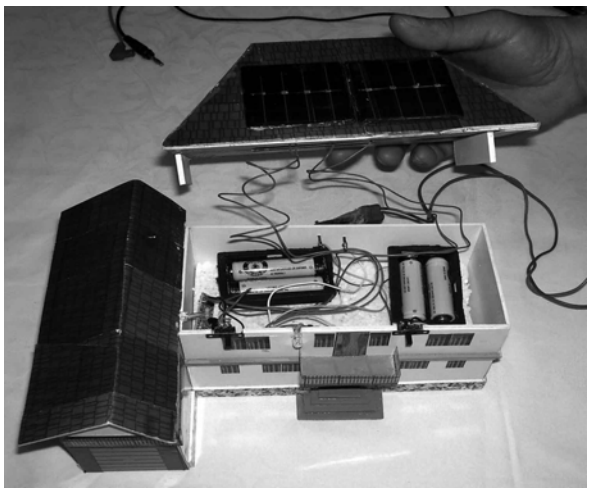
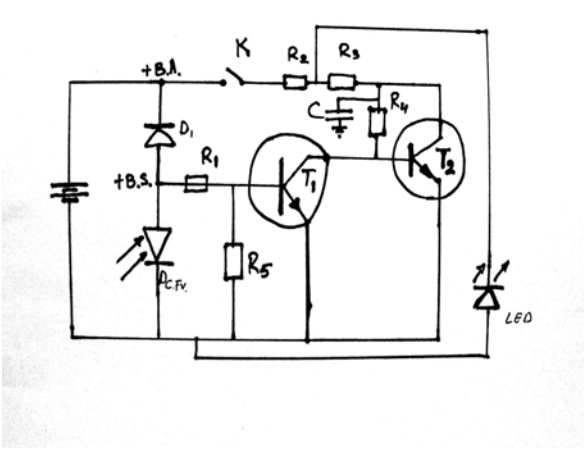
transistor is polarized through the R1 resistance. This one becomes saturated and shifts the T2's transistor base to mass.

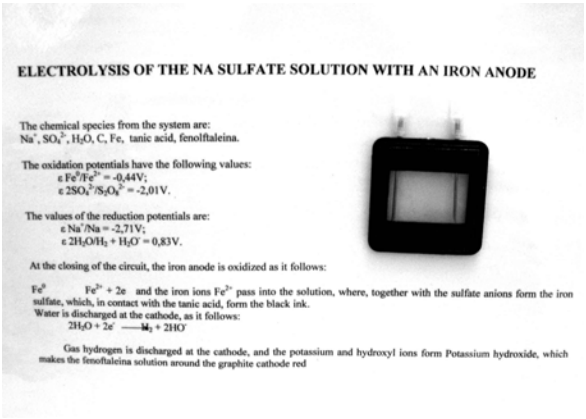




In the absence of light, the photovoltaic cell doesn't produce electrical tension anymore, the T1 transistor is blocked and the T2 transistor is polarized in the base, entering a conductivity mode.



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.



ELECTROLYSIS OF THE NA SULFATE SOLUTION WITH AN IRON ANODE

The chemical species from the system are:
Na^+, SO_4^{2-}, H_2O, C, Fe, tanic acid, fenolftaleina.

The oxidation potentials have the following values:
ε Fe^0/Fe^{2+} = -0,44V;
ε $2SO_4^{2-}/S_2O_8^{2-}$ = -2,01V.

The values of the reduction potentials are:
ε Na^+/Na = -2,71V;
ε $2H_2O/H_2 + H_2O^-$ = 0,83V.

At the closing of the circuit, the iron anode is oxidized as it follows:

Fe^0 $Fe^{2+} + 2e$ and the iron ions Fe^{2+} pass into the solution, where, together with the sulfate anions form the iron sulfate, which, in contact with the tanic acid, form the black ink.
Water is discharged at the cathode, as it follows:
$2H_2O + 2e^- \longrightarrow H_2 + 2HO^-$

Gas hydrogen is discharged at the cathode, and the potassium and hydroxyl ions form Potassium hydroxide, which makes the fenoftaleina solution around the graphite cathode red

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.

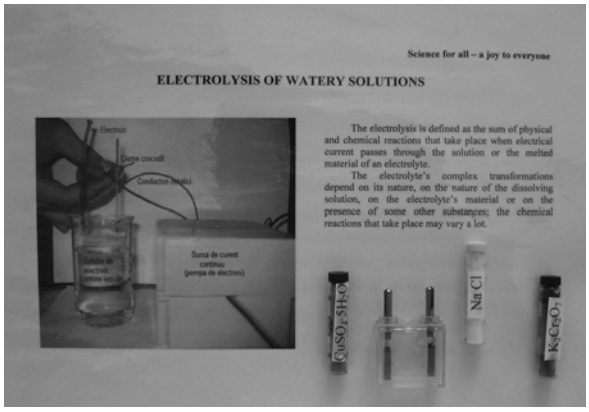
This set up presents the following advantages:

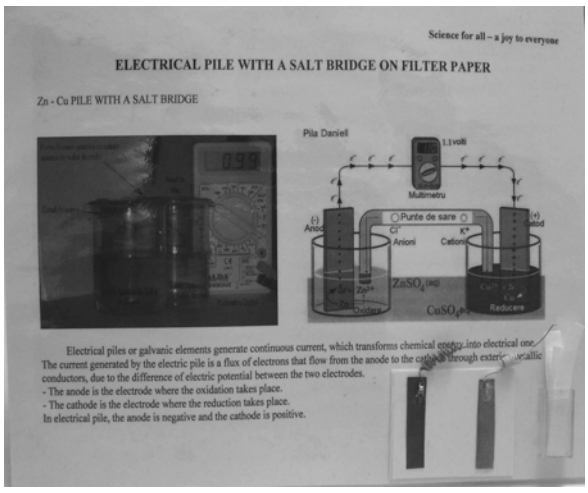
- Energy consumption is 75% lower
- The high efficiency of 25 up to 80/lumen/watt is better than that of the light bulb 917 lumen watt) halogen (22 lumen/watt), neon (50 lumen/watt).
- Longer lifespan. The LED's lifespan is of at least 100000 hours, compared to 1000 for the light bulb or 10000for the neon.
- 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

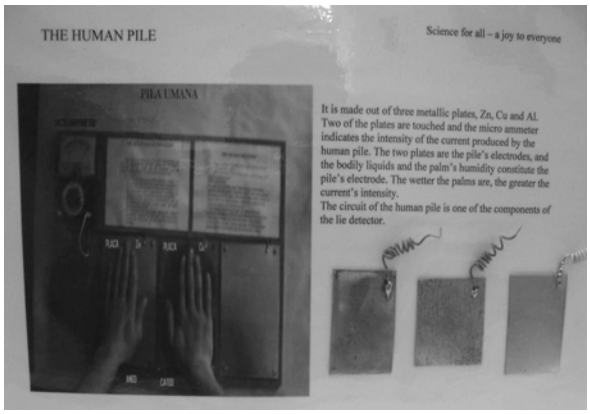
 ISBN 978-989-95336-1-5

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.







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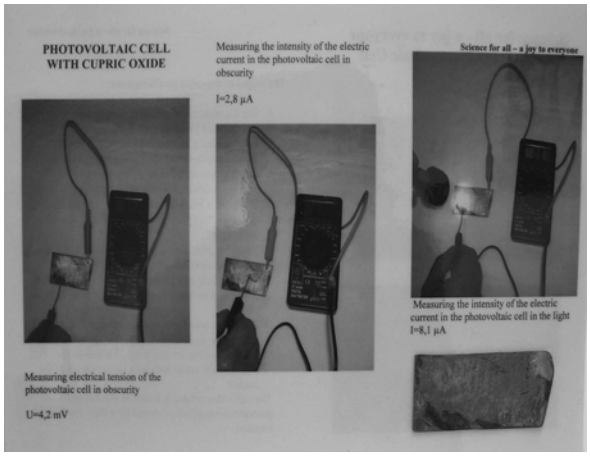

Inquisitive Mind and it's History

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Abstract. For revitalizing the pupils interest for studying science we created the group "Inquisitive mind", group which was entered in October '05 in Portugal at the international coordinator of the project "Hands on Science" (110157 CP-1-2003 for COMENIUS C-3).

A basic preoccupation of schoolwork has always been the optimization of the ways the student has access to the scientific information and its understanding, from all these methods, finding the most efficient one represents an important issue.

 ISBN 978-989-95336-1-5

Out of class activities represent an organic part and an element of the teaching-learning activity. Its purpose is the development of independent work and students creative capacities. Out of class activities allow the enlargement and profound study of the pupils, the stimulation interest for science study and the students education in initiative and independent work.

Out of class activities have a positive effect on the lessons, because a lot of pupils start to have a more serious attitude about learning, they manifest a higher interest for wall gazette editing, helps the teacher in the enhancing of the laboratory equipment.

Into the project "Hands on Science" we took part in almost all the activities initiated of which we mention:

- 16.04.2005 – Action Science Club Foundation dedicated to the International Physics Year held at Costin Kiritzescu Economics Highs School
- 4.06.2005 – Action Science Club Foundation held at Costin Kiritzescu Economics Highs School
- 28.10.2006 – National Symposium: Education and Training in Science for a society of knowledge held at Costin Kiritzescu Economics Highs School
- 15.01.2007 – National Symposium organized within the framework of Global Science and the methodical action of technicians and their assistants under the theme: The efficient usage of learning methods in the constructive educative process.
- 24.03.2007 – National Symposium under the theme: Light
- 21.04.2007 – "Day of the Earth" Symposium.

A few projects presented at the 15 actions:

The F Files – success at the BAC exam, Method of the radar in TRR, Study of colliding in plan, Order in chaos – first prize at the section "Powerpoint presentations", The checking of the law of impulse conservation by the means of experiments, Geometric optics under the microscope, A new approach for physics problem, A new application for ultrasounds, Anagrams on Earth.

Keywords. Physics.

The Century Formula

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Abstract. Not once the scientists had to continue their real experiments through the so called "mental experiments", drawn up in "mental laboratories". Unexpected discoveries have proved the fertility of these dimensions.

In this project, the importance of mental experiments used by the scientists is given back. These experiments are characterized by the lack of materials, but this lack is replaced by the brain.

In 1905, Einstein made known the famous equation $E=mc^2$ which ties up static features with dynamic features of the substance.

From Einstein's equation results that to no matter what modification of the pause of an object, must correspond a quantity equivalent of absolute energy given up by the object. In other words, if the weight of an object decreases, then it gives up energy, but if the weight of an object increases, it means that it receives energy.

For a century, from Lavoisier to Einstein, the science world thought in the weights inability to vary, because the energy transferred through ordinary chemical reactions is equal with weight variations so small that it is impossible to measure them with any mechanical device.

Keywords. Physics, History.

Cathode Rays' Properties and the Establishing of the Electron Elementary Charge Using Millikan's Method. Didactic Movie

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Abstract. This project is intend to present the contents of a didactic movie, that we have created, regarding the cathode rays and the calculation of the elementary electric charge of the electron, using the classical Millikan method.

 ISBN 978-989-95336-1-5

The movie is made for being presented, and meanwhile interactively discussed with students.

Keywords. Cathode Rays, Electron, E-Learning.

1. Introduction

During the 2nd half of the 19th century physics revealed a series of unexpected experimental facts, whose interpretation led to the discovery of the structure of matter at atomic scale, and the imposing of new laws regarding the way atom subdivisions are acting.

In our movie we present the experimental facts that led to the discovery of the electron (name introduced in 1874 by Stoney in order to represent the smallest possible value of the electric quantity, e).

Here we presented some of the cathodic rays' properties, as well as channel rays, Thomson's experiment, and few more experiments regarding their behavior in electric and magnetic field.

Because we can easily understand the utility of the computer in our daily life, as it offers and moderates our access to information, we've created this movie using computer facilities and web documentation. This shows that the information technology represents a need in any modern school and society. For example, regarding physics, there are many experiments impossible to reproduce in schools' laboratories, either because of the high costs, or the lack of materials, either because of the material's toxicity. So the PC alternative comes forth creating a new type of learning: E-learning, based on computer simulated experiments, presented among with theory.

2. Experiment's theory and synthesis

First, the cathode rays' properties were unveiled. Their discovery preceded Millikan's experiment. Afterwards, using our computer software, a virtual lab was created in order to complete the experiment. Each part of the virtual lab has an important role that is explained during the assembly.

The experiment's procedure was simulated, pulverizing (with a pump) very small (microscopic) oil drops. These oil drops gain, as they are created an electric charge that can be altered by being exposed to X-rays or UV radiation.

The fact that almost all the oil drops are electrically charged was proved experimentally, having either positive either negative charge. The oil drops (electric charges) reach the space between the capacitor's conducting foils (situated at the distance d apart). All the possible cases are shown and discussed here.

If the capacitor is unloaded (meaning no electric force), and the Archimedean force is being neglected, the only force acting over the oil drop will be the gravity force (G). The drop will start falling down, gaining at one point a maximum velocity (v_0), because of the friction with the air (F_{R0}). This happens when the forces' modules are equal:

$$G = F_{R0} = C\, v_0 \qquad (1)$$

Where, $G = \rho_0 V g$ (ρ_0 = oil's density, V = drop's volume, g = gravity acceleration), and $C = 6\pi\eta R$ (η = air's dynamic viscosity coefficient, R = drop's radius) represents Stokes's force. F_{R0} is directly proportional with the particle's velocity, but of opposite orientation.

If, during the drop's fall, the tension U is being applied on the capacitor (an electric field will be generated, $E = U/d$), the drop's velocity will change, moving upwards, or downwards, according to the foils' polarization. This can be seen in the experiment.

Let's assume that the oil drop is positively charged and moving upwards with the velocity v_1. The condition of uniform moving, at a constant speed, will be (neglecting the Archimedean force):

$$F_E = G + F_{R0} \qquad)$$

where F_E represents the elastic force.

Relation (2) can be written under its equivalent form:

$$C\, v_1 = G - qE \qquad (3)$$

We will then study the movement of the same oil drop after having switched the polarity of the capacitator's conducting foil. In this case, the drop will move downward, with maximum velocity, v_2, the electrical force and weight having the same orientation (opposite to Stoke's force):

$$F_E + G = F_{R2} \qquad (4)$$

With the equivalent form:

$$C\, v_2 = G + qE \qquad (5)$$

From equations (1), (3) and (5) we can write:

 ISBN 978-989-95336-1-5

$$q=(Gd[v_1- v_2])/(2U v_0) \quad (6)$$

or:

$$q=(\rho_0 Vg\, d[v_1- v_2])/(2U v_0) \quad (7)$$

In this relation, U, d and g are known variables. Velocities (v_0, v_1 and v_2) can be determined experimentally, by watching the drop as it crosses the lines of the microscope's graded object lens and by measuring the necessary time. The volume of the drop is not known but it can be determined experimentally, from relation (1).

The electrical charge can be modified several times, under the influence of the UV rays, which cause a photoelectric effect. Due to this, velocity v_2 will modify accordingly.

It can be noticed that different values of the velocity are not randomly distributed, but grouped around a certain value, depending on the electrical charge of the studied drops. Analyzing the experimental data, from equation (7), it results that the charge of the drops must be a multiple of the elementary charge e:

$$q=ne \quad (8)$$

where, e=-1.6*10^{-19}C, and n is natural number.

Milikan measured the electrical charges of thousands of drops and found out that they possessed, as made possible by errors, the charges: 1e, 2e, 3e, etc. This discrete character of the electric charge was considered to be a result of the particles being charged by one, two or more ions, which bared one, two or more electrons (elemental particles that cannot be divided).

3. Simulation and graphics

We will simulate Millikan's experiment, with the possibility of introducing the parameter: the difference of potential (U), between the capacitator's foils, the volume (V) and the electrical charge q of the drop. Also it is possible to record the time need for the drop to fall a distance measured with the help of the graded scale.

4. Computer use

We should notice the advantages of this program: first of all, every student can study, and realize this experiment, can review those parts of the theory that are unclear to him and, concluding, can study in his own pace. Even more: the experiments are realized individually, thus every student must solve the physics problems on his own, trying to come close to a real simulation.

5. Conclusions

This experiment combines physics and informatics to present, as eloquently as possible, a virtual experiment, which cannot be realized in a real laboratory, due to the lack of the necessary means, as it, unfortunately, the case in many schools and high schools.

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Informatics in Science and Technology Teaching

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Abstract. A result of the rapid developments in Science and in Technology and of their implications on the technology based societies, the operation of an effective Science and Technology teaching has emerged as one of the most important issues of education. Consequently, there is a need for an overall and, in many aspects, an innovative approach in Science teaching. This approach should refer to the syllabus but also to the teaching strategy and the use of appropriate means, tools and techniques. Within this context, the use of Informatics may be proved an especially useful tool. In this present work I present a review on existing implementations of Informatics in Science and Technology and related perspectives. Specific examples are given and cases of good practice are mentioned.

Keywords. Science Teaching, Informatics.

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1. Introduction

The rapid developments in Science and technology, with their subsequent impacts on society, impose the need of literacy in modern Science and in contemporary Technology, a literacy which should cover the majority, if not all, of the members of Technology Dependent societies. As these advances are new, the contribution from the society (in a Vygotski context) is almost non-existent if not negative (fear of the unknown – alarm for the new'). The only way for a familiarization, moreover for a literacy, on these Science and Technology advances may be achieved only through an effective education and training with innovative approaches to teaching methods, to means, tools, techniques and equipment, to methods of presentation – communication, to the syllabus selection, … . Towards such an effective education and training, the use of New Technologies, especially of Informatics, is a very useful tool. In combination with already existing experience it could produce real breakthroughs in Science and Technology Teaching.

The need for a more effective Science and Technology Teaching has lead to an extensive exploitation of the use of Informatics in Education and Training. It seems that, the initial period of concern on and, in many cases, of negation of the use of Informatics to teaching, has evolved in a dominant trend, mostly unsupported, that the use of Informatics will solve problems of education. In all cases it is overlooked the fact that Informatics, as all technologies, may only enhance the results of a good or a poor instruction design. This dominant trend has resulted in an especially flourishing activity. An ever increasing number of relevant works on the use of Informatics in Science and Technology teaching appears in scientific journal, conferences and symposia with the majority of them appearing also on the web [1].

The development of teaching approaches based on the use of Informatics requires expertise on three fields, namely on the specific subject to be taught, on the teaching techniques specific to the subject and on the use of the appropriate modules, H/W and S/W, of Informatics. This expertise is rather unusual to be encountered in a single person. Consequently, the development of teaching approaches based on Informatics is usually effected through teamwork of experts on the three fields. This teamwork performance is better when the experts in one field are also at least literate on the other fields. This may illustrate the recent trend to include courses on pedagogy (instructional design, teaching approaches …) to the undergraduate curricula of technical departments related to Informatics. On the other side, many special S/W applications have been developed facilitating the development of teaching approaches using Informatics by teachers who may be not experts on Informatics. Also, the curricula for the initial education or training of school teachers include now a considerable section on Informatics. In parallel, there is an extensive program of training of teachers on the use of Informatics in Education [2]. As the tools and processes of Informatics fall within the Science and Technology (S&T) sector it is no surprise that initially the vast majority of Informatics in Education contents referred to S&T issues. In this work, information from a previous presentation [3] is used for a short review of past and current uses of Informatics in Science teaching and cases of good practice which are followed by some perspectives and suggestions.

2. A brief review

The first applications of the Technologies of the information and Communication technologies (ICT) in Education were mainly towards the organization and the management of class and of teaching, e.g. preparation of notes, transparencies, etc for teaching, name lists of students with their marks, formation and adaptation of work- and evaluation- sheets, teaching logbooks, etc. An initial significant application was also the adaptive use of general S/W applications as teaching tools. Examples surviving so far are the use of word processors for language spelling and syntax courses, the use of painting or drawing programs in geometry courses, the use of spreadsheets in mathematics, etc. In Science and Technology Teaching (S&Tt), a very significant development to the acquirement of technical dexterities is still the extensive use of spreadsheets to calculate values and functions, to present graphs and tables, to process experimental measurements, etc. The concern that the 'automation' of the process of experimental measurements (e.g. calculation of mean values, error estimation, axis and scale choice for graphs, …) deprives students of quantitative feeling (order of magnitude of physical quantities, measurement accuracy and size of experimental errors, etc) may be compensated for by manually carrying out similar exercises focused on the process and rules used (e.g. how to choose appropriate scale and axis in a graph, what are the significant factors in error estimations …). However, when such 'automatic' calculations are used in S&Tt, special care should be given to allow the

 ISBN 978-989-95336-1-5

students time for reflection and feedback in order to achieve long term learning.

The use of general purpose S/W has evolved, especially in the area of tertiary education, to the presentation of whole courses in an electronic form. In combination with existing web authoring systems, these may become available through the INTERNET forming a whole sector of electronic books and bookstores. The electronic books very soon were enriched with drawings, pictures, sound, animation, video … and have been evolved to attractive, mostly, multimedia presentations forming the basis for distance e-learning [4], which have the advantage of easy and low cost development with simple means [5]. Combined with their possibility of smooth integration in teaching they can replace other teaching means as the video, the educational TV or the expensive conventional book libraries. Examples of electronic bookstores are presented at [6] while the actions of the European Union on e-learning are presented at [7]. May be used as a very effective presentation type teaching, useful in training, initial and continuing, and in education aiming at factual knowledge and data. Combined with their low space requirements (a whole encyclopaedia may be contained in a simple mp3 player) and the easiness of production, adaptation and updating of their content it is no worry their extensive use, especially in Technical Vocational Education and training. Also, most of modern repair workshops (i.e. garages, machinery and other complex equipment repair services) operate using electronic manuals and help.

Although innovative as a teaching mode and useful for factual – technical knowledge or for reference purposes, electronic book and multimedia presentations scarcely may be considered to bring fresh ideas to teaching addressing complex cognitive skills. This may be achieved when they are enriched with links and a modular structure to evolve into hypermedia applications. Hypermedia applications which, if properly designed, may operate ('run' or 'executed') either locally, on the computer of the user, or on a server being available to anyone connected to the INTERNET, which, due to its increasing promulgation, becomes another powerful teaching mode with S&T education in the lead. The combination of hypermedia with INTERNET presents many new educational possibilities such as:

- on-line immediate help to teachers, a very useful service especially for isolated schools, without the need for transportation of experts,
- the creation of virtual communities of teachers and other educators where specific subjects may be discussed between colleagues living anywhere,
- the use as a worldwide information data bank,
- the use as a powerful teaching mode.

Some concerns (drawbacks) on the use of widely available information and resources at the INTERNET include:

- In simple INTERNET searches a very large number of data is returned resulting in a need of selecting the relevant information (*'where is the knowledge we have lost in information?' - from 'The Rock' by T.S. Eliot, 1934*). Even using sophisticated search criteria the returns are still many.
- The validity of information is, in many cases, questionable or biased. Note however that any different viewpoint and any criticism on any issue may appear on the INTERNET without, up to now, any effective ban (censorship) impeding it.
- Possibility of a unilateral presentation of information due to two concurrent causes: a/ the attempts from governments to ban information on the INTERNET on reasons of combating terrorism, pornography or otherwise, and, b/ the intelligence of the search engines trying to guess the more probable type of information wanted. This intelligence although mostly useful, may hide the (rare) type of information actually wanted. It is also prone to malicious exploitation, see for example the 'Google bombing'.

An experienced user can minimize or even eliminate these drawbacks leaving all the advantages of hypermedia applications used to education. For Science and Technology education where experimental expertise, modern field advances and examples of good practices are in demand, hypermedias on the INTERNET present good alternatives. Simple such examples may be found in [8].

There are S/W applications addressing specific groups, e.g. educators, or/and specific sectors, e.g. physics, that facilitate the creation of web pages. Most of these applications are of a good quality and low cost while many may be found for free on the INTERNET (just search for 'free software' see also [9]). On the other hand, the technology of web pages has been enriched with active elements that permit the interactive use of hypermedia applications. These elements (e.g. JavaScript©, Java© applets) are lines of

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computer code that instead of directives on the type and way of presenting information (like e.g. the standard html code) are passed on as commands to the operating system directing it to perform specific tasks, e.g. the execution of another application. Although this possibility has been maliciously exploited for computer cracking, nevertheless it presents many possibilities and, actually, it makes possible high quality teaching approaches, from simple vivid presentations up to complex real self-study teaching applications. The object oriented and modular structure of JavaScript and of Java applets have lead to the creation and availability of specialized modules addressing specific subject areas, e.g. the so called 'physlets', namely Java applets for Physics (see more in [10]). Together with the development of specific Software applications [11] that facilitate the management of providing courses to different groups, they permit realistic distance education e-learning. With these advances in Informatics, an experienced user may develop complete education environments.

Education environment based on Informatics and incorporating the basic principles of constructivism in the form of 'constructions' [12] has been realized in 1967 by the MIT Artificial Intelligence Laboratory with Seymour Papert as a main actor with the Logo© programming environment. Logo, a LISP like programming language, was used, although on an experimental basis, in teaching young pupils aiming to the development of space understanding and movements (with the 'turtle robot') or to the development of complex cognitive skills (with the 'turtle design' on the display of the computer). In simple teaching implementations with Logo none of the school subjects was, in principle, excluded. However the majority of the simple teaching implementations with Logo addressed Mathematics. The structured programming incorporated to Logo with its recursive modules ('routines' and 'subroutines') permitted to complex teaching presentations (including graphics, sound and animations) often with feedback from the user (learner) mainly in the Science and Technology sector, including visualizations of natural phenomena and, sometimes, virtual experiments a trend peaked after Papert published 'Mindstorms' [13] and facilitated by the proliferation of (personal) computers. Complete libraries of routines were developed (check the INTERNET for 'Microworlds') and distributed with specific Logo implementations addressing school subjects, usually from natural sciences. Another following innovation from MIT Media Lab was LEGO-Logo in which computers with the Logo environments were connected to artefacts made by Lego© bricks and including sensors, lights, and motors. With current advances in Informatics and microelectronics, this has been evolved having now a computer as one of the Lego (or Lego like) bricks making thus possible the construction of autonomous robots. Courses on 'Educational Robotics' are constantly appearing as a potentially very powerful tool for the Science and Technology teaching. Another advance is the construction of small size sensors and other measuring microelectronic devices with low cost and capability of connection (e.g. through USB port) with computers or with a microcomputer as one of their constituents. The term MicroLab or Microcomputer Based Laboratory (MBL) refers to the use of such devices which permit in a Science experiment or observation the measurement of many quantities concurrently and for long times.

3. Perspectives

It seems that the trend described previously will continue in an expanding way. More and more teaching approaches will appear either as autonomous applications or on the web addressing broader groups. This Open Distance Learning type of development may answer problems due to the lack of buildings, equipment, expert teachers and other infrastructure observed especially in Science and Technology at all Education levels, a factor that explains partially the increasing appearance of 'Virtual class'. These are classes in which the teacher(s)-student(s) and the student-student communications are done through computer communication in a synchronous (e.g. videoconference or teleconference) or in an asynchronous way in which the information is prepared, studied and exchanged by the virtual class members at their own convenient time [14].

The development of virtual classes The multimedia capabilities offer the possibility of a multitude of presentations of natural phenomena considered difficult and or outside common experience (see examples in [15]) providing thus the possibility of learning at the level (Bloom's taxonomy) of knowledge and facts. The achievement of learning of complex cognitive and psychomotive skills (e.g. experimentation skills or other practical dexterities) and emotional attitudes requires interactivity with the learner, choice of different learning paths depending on the performance and previous achievements of the learner, time for reflection and active learners' participations. These requirements may be achieved by the appropriate incorporation of active and object oriented programming

 ISBN 978-989-95336-1-5

elements to develop simple simulations or more complex virtual reality environments. Simple simulations appear already in increasing numbers on the web with an expanding range in their contents within a Science and Technology teaching context, e.g.:

- Simple calculations of a table of values and graphs referring to physical quantities in natural phenomena. These usually may be repeated on different parameters ('initial conditions') of the choice of the learner e.g. in order to study the importance of the different factors.
- Real time presentation sequel of the evolution of natural phenomena repeatedly and with varying time scales. This permits comparisons and allows time for reflection.
- Scenario exploitations through the development of representative computer models of natural phenomena. These may be used either to find correlations between observations or to virtual test a scientific theory. This form, initially developed within Science and Technology (see for example the 'Monte Carlo simulations' used in particle physics and in Cosmology) is now used also in Social and Economic sciences e.g. to test an economic theory or to predict the evolution of society characteristics

Virtual reality has been used extensively (but not always effectively) in electronic games and is now entering teaching as education environments with the 'Virtual laboratory' being the most common application (on a more commercial basis electronic representations of known museums 'Virtual museums' have also appeared). In virtual laboratories, the user chooses equipment and devices, arranges them and conducts experiments specifying what quantities is going to process in a virtual computer space within an application simulating the experiment process [16]. Although it remains a simulation representing actual reality, virtual laboratories, if appropriately designed, may become a very effective substitute of actual experimentation [17].

Using special equipment (spectacles, headphones, helmets with sensors …) simulation may be evolved to complete virtual reality situations in which the user (has the feeling that he) lives the intrigues. Although are as yet simulations with multiple pictorial representations, complete virtual reality educational applications will soon appear and, based on past experience, they most probably start from the Science and Technology area.

The advantages of a well designed Virtual Laboratory include:

- Quick familiarization with the experimentation process including the manipulation and presentation of experimental data, with the use of equipment and of the safety rules,
- Reduces the time for preparation and understanding of the basic processes by permitting (virtual) experimentation under different conditions. This especially useful for expensive or for time consuming experiments,
- It reduces the (often high) cost for expensive devices and for operation maintenance, repair and replacement of the equipment.

Virtual Laboratories however do not, in general, advance scientific inquiry skills (unless used in a very specific way) and, as a faithful or not simulation of reality may be not appropriate for small ages where cognitive skills of abstract concepts are still developing (imaging, for example, how a simple electric circuit is represented and how it appears in reality).

4. Commentary

Informatics in Education will continue to spread out as it provides an affordable and efficient tool. For Science and Technology Teaching, Informatics presents the added advantage of facilitating the efficient teaching of issues that are considered difficult either because they are modern, e.g. elements of quantum physics or because they are prone to misunderstandings. Some naïve examples include:

- Simulations for the solar system and of the movements of the Earth in relation to the seasons of the year or the Bohr atomic model. Note that the traditional teaching of the Bohr atomic model is in reference to the solar system ('the atom is a miniature solar system') for which however there is no direct observations (it could be taught equally well that 'the solar system is a magnification of an atom').
- Pictorial representations of quantum atomic orbitals and comparisons with the simplistic Bohr atomic model.
- Use of Monte Carlo simulations for a visual representations of the thermal motion [18] a subject very prone to misunderstandings. This technique may be evolved to a full and consistent teaching of Heat within a kinetic theory of particles model context. Such

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approaches may facilitate the transition from the positivist conclusions of classical physics to the probabilistic (statistical) inferences of quantum physics.

It is increasingly accepted that an effective Science and Technology Education may be achieved by an interdisciplinary teaching approach within a constructive context. In this sense, Educational Robotics is especially useful. Pursuing the objective to construct (or assemble) a robot, students may develop complex cognitive and problem solving skills. They are also helped to a better understanding of basic concepts in Physics e.g. through their efforts to chose and manipulate the appropriate sensors or to incorporate movement to the robot. Their creative thinking and scientific interest is excited while they familiarize themselves with modern technology. Such an example of an Educational Robotics course is described in [19].

5. Epilogue

Although the use of Informatics to improve teaching is very feasible, empirical evidence shows that teachers are reluctant to use but prefer to teach within the lines they were taught as students [21]. They are reluctant to adapt themselves in new situations and prefer their familiar methods [22]. To my opinion this is the main obstacle towards the proliferation of Informatics in teaching for a more effective Science and Technology Education. To bypass this obstacle, the education and training of the teacher, especially of the Science and Technology teacher, should include an extensive use of Informatics with subjects from modern Science [23] preferring teaching approaches that promote a spirit of research and innovation such as a project type approach or the use of self-made apparatus [24] and connecting Science with everyday observations from everyday life [25].

6. Acknowledgements

This work makes use of a presentation titled 'Νέες Τεχνολογίες και Διδακτική των Φυσικών Επιστημών (New Technologies in the Didactics of Science)' that was invited at the 5th Pan-Hellenic Conference on the Didactics of Science and the Application of New Technologies in Education, University of Ioannina, 15-17 March 2007. I want to thank the organizers of that Conference for the initiative they gave me to work on this subject.

This work has been supported by the European Commission (project AESTIT - Contract 226381-CP-1-2005-1-GR-COMENIUS-C21). The views expressed here represent only the author of this work. Neither the Commission nor the author may be considered responsible for any use of the information contained herein.

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[14] Communication through the web is often criticized to enhance alienation in times where societies need closer ties between their members. However communication through the web develops new social skills and, if used in parallel or complementary to the face to face communication may improve socializations and common understanding. A search for 'virtual classes in the INTERNET may provide more information.
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Mindstorming

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Abstract. The objective of this work herein was to explore the use of the Lego Mindstorms robotics kits for the development of the problem solving competencies.

 ISBN 978-989-95336-1-5

The idea of associating the use of Lego to solving problems relies on its main characteristics that make it a popular and successful way for teachers to cover key areas of the Science, Technology, and Engineering and Math's curricula.

With this robotics assembling/construction type of materials students can work and/or play with techniques that are used in the real world of science, engineering and design. The students are able to design construct and program fully functional models. They have the opportunity to learn how to behave as young scientists, carrying out simple investigations, calculating and measuring behaviors, and recording and presenting their results.

With the implementation of this pedagogical approach we also meant the students to win the challenge of surpassing their own obstacles that they will certainly face in their every day life.

Keywords. Non-Formal Learning, Science Education, School, Hands-on Experiments, Lego, Robotics, Mechanics, Physics, Mathematics, Investigation.

1. Introduction

In this communication we will present an experimental work to be carried out by students, from the early ages of basic school, in a non-formal environment. With the use of the Lego Mindstorms robotics kit (Lego is a game/ toy well know to almost every students), our students performed a series of activities, aiming the development of skills in problem solving, facing concrete obstacles or objectives presented in order to be fulfilled or overcome.

The idea of associating the use of Lego to the teaching of robotics and training problem solving skills is based on the need to make the learning process more appealing on behalf of the students. Being Lego a popular and appealing game/ toy it would be possible to teach physics concepts in an apparently informal or non-formal context. This task is also simplified due to the fact that only day-to-day materials are used to create the environment of the proposed problem solving activities or the obstacles that must be overcame. In this way the final cost is also reduced as we only need to perform a few reversible changes to the Lego construction pieces or software created for in each activity allowing a large number of possibilities and applications. All with a common factor – *"have the audacity to do"* condition.

2. How to bring together Lego and Learning

Lego is a tempting incitement to create. It is impossible to keep your hands off a pile of Legos.

Figure 1. Playing

As we all know play is the "work" of children - all higher-level young animals develop life skills through play (children "are looking for fun games to share with friends. And, parents are also embracing trading card games because they teach math and strategy skills while promoting social interaction" [5]). Nevertheless often adults undermine or under use the process of playing. The child who can learn by play (hands-on experimenting) becomes more active, more skilled, happier and self confident, and with an increased capacity to continue to learn and develop.

Lego allows the development of art skills, as it allows creating abstract designs, kinetic artwork and the use of colour, shape, size, proportion and symmetry. As professor Seymour Papert concluded, "Schools generally do an effective and terribly damaging job of teaching children to be infantile, dependant, intellectually dishonest, passive and disrespectful to their own developmental capacities. I think that the examples I have given of learning in a computational environment provide a glimpse of a context for learning in which socialization would be based on a potentiation of the individual, an empowering sense of one's own ability to learn anything one wants to know, conditioned by deep understanding of how these abilities are amplified by belonging to cultures and communities" [3]. The Lego can result in a mind capturing challenge, like the construction of a model of an ancient Chinese roof that will support the total body weight of the builder and then calculate the weight distribution throughout the model, or the construction of a bridge and the relations of its length and the limit strength it can support.

Lego allows the development of the communication skills: verbal Communication - verbal descriptions of a Lego element by type,

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dimensions, colour, function (what it does), written communication (applications, spelling, punctuation, grammar, syntax - if the program syntax isn't absolutely correct it won't run), giving and getting information and instructions.

Lego contributes for the development of design due to the building of structures (symmetry, scale, stress). There are an infinite number of possible combinations when building with Lego products because the primary ingredient, a child's creative imagination is infinite.

Figure 2. Robotics contest

Lego help students to understand how they learn, allowing them to reflect along the way: "how things work" and "how things appear".

Lego can be a helpful resource in the mathematic abilities, like: calculations regarding ratios, gear relationships, building to scale, geometry, algebraic expressions (effort expressions for levers) and number systems (base two, base eight and base ten). As professor Seymour Papert once assumed "I believe that working with differentials did more for my mathematical development than anything I was taught in elementary school. Gears, serving as models, carried many otherwise abstract ideas into my head. I clearly remember two examples from school math. I saw multiplication tables as gears, and my first brush with equations in two variables (e.g., $3x + 4y = 10$) immediately evoked the differential. By the time I had made a mental gear model of the relation between *x* and *y,* figuring how many teeth each gear needed, the equation had become a comfortable friend". [4]

Lego products can be used as a function of organizational skills, accomplishing many objectives, like sorting (classifications, organization of elements, data base management).

Physics contents can also be acquired with the usage of Lego kits: there can be an oriented study of levers, mechanical advantage, pulleys, scales, states of energy - potential and kinetic.

We can not forget that Lego Was, is and it always will be a toy that many enjoy. Due to this characteristic it can be used in the training of teamwork, sharing, communications, caring, brainstorming, emotional intelligence (self and others).

Too often, the usual options children have regarding their own learning process aren't very appealing form their point of view. When we treat with contempt the world that a child cherishes, we negate the child. True teaching requires that we "ask" to become a part of their world. Lego products make this asking/granting activity quite easy. When a child sees a "significant adult" loving the act of "playing", the child readily accepts that adult into their world. That adult has demonstrated that he/she sees value in a part of their world and in fact, takes a part of the child's world into their adult world. It becomes very easy thereafter, for that adult to relate a part of the adult world through the understandings of the child world. Both parties to this activity come away winners. The child has been respected and valued by that 'significant adult.' The adult has been able to share something of his/her world with the child, thus perpetuating the educational/learning process.

Figure 3. Sharing ideas

Lego products can be applied as a function of self affirmation. Observe a child's "yes" as a project just completed. Nothing more needs to be said except that in such situations a child will build his own self-esteem as long as he has affirmation from at least one 'significant other.' Teachers should not praise the child directly but rather praise the child's project. It is through the project that the child is affirmed.

Lego products as a can also be used as a function of symbolic logic, teaching the following logic gates: and, or, nor, not, if and the creation of the related truth tables.

One of most important features of Lego kits is the developing of the dreaming abilities: when kids are building, especially "out of their minds", they are experimenting dreams and making them real and alive through their Lego models.

3. How to achieve the activity' objectives

The aims of Legos usage are very broad. The number of different suggestions and activities

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that can be developed is huge. One suggestion follows in the next paragraphs, that describe one possible approach of Lego usage, is divided in sessions – each one has its on objectives, distributed in a growing complexity objectives way.

First session: during one session, the students have one guided session, in which they are introduced to the Lego Mindstorms kits: they are allowed for some time to investigate thru the kit contents – parts, wheels, wires, RCX, the infra red tower, and every other parts (the empathy is instantaneous, due to the fact that everybody has already assembled Lego in some stage of their lives).

Then, the "investigation" gets more objective: the name of the key parts is given and they must identify them, as well as the role they play in the "game".

Figure 4. Assembling

In the second part of the first session, they get in touch with the programming language – the robolab software. The program is uploaded in every the individual computers and some of the basic command are explored, as well as the program download process.

Figure 5. Programing

Second session: with the kits and the computers, students have to put the batteries in the RCX module and execute the firmware download, after that, the IR tower has to be configured.

Then, they test the ability of the RCX module to receive information. In the end of the second session, the students got their fist assignment: to give the RCX instructions to make a sound for about two seconds.

Session three: in this session, the objective is to develop the building skills. The students have their second assignment – they must build a robot that has the possibility to move in every direction.

Session four: one of the advantages of this equipment is that it is possible, with small adjustments and a bit of imagination, to create new combinations that may allow the exploration and study of many different concepts. From this point on, students will be given specific and more ambitious objectives that will imply the development of all the multi-dimensional skills that are desired to be acquired. When the "game" starts, it just has to be played…

In a more developed stage of the experimentation of this system we can create more challenges such as the creation of autonomous robots that have the objective of searching for an object, identifying an object, follow a line drawn for that purpose, detect radiation sources or detect high temperature locations. Every one of the referred aspects can be, obviously, related with the school syllabus, being a useful tool in significant learning.

7. Conclusion

Learning in a non-formal or informal context often is easier and more effective, especially if the activities involved relates to former knowledge or experience from the students. Furthermore it is essential that the fun side of it is complemented by serious analysis that should always lead to the establishment of clear conclusions.

8. Acknowledgement

This work enrolls in the frame of activities of the Hands-on Science network.

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 ISBN 978-989-95336-1-5

Safety of the Human Body in Hands-on Science Experiments

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Abstract. The main objective is the safety of the human body in hands-on experiments. The safety of the human body in everyday living is the significant content for effective teaching-learning because of practical use and interest. Combining phenomena on the human body and hands-on experiments results in students' motivation. A lot of experiments on the human body can be demonstrated and used also in science education of handicapped and senior people etc. Family education is the transfer of information about the safety risks from school into families by means of students. This content develops better perceptions of science for students and society.

Keywords. Hands-on Experiments, Human Body, Motivation, Science Education, Safety.

1. Safety of the human body as an important content in science education

Everyday and safe living is very interesting content used in science education. If we combine everyday and safe living with hands-on experiments, we receive strong source of cognitive motivation [6] and interest of children, students and adults. Students are often not aware of the fact that they are surrounded by science phenomena in their everyday living.

Important information used in science education is the following [7]:

(a) The human organism: Students are acquainted with human body parameters which can be expressed with the aid of quantities, units and laws. Also external conditions are very important for preservation of vital functions of the human organism including health.
(b) Home, entertainment, sports etc: Students can be motivated by explanation of a basis of commonly used domestic equipment such as heat and light sources, means of transport, audiovisual technique, chemical agents, domestic plants and animals etc. Information on economical and ecological behaviour in everyday living attains more and more importance.
(c) Safety risks: Protection against negative extraneous influences on the human organism and information on safe behaviour in transport, at work etc.

For everybody, his human organism is an interesting object. Mainly astonishing information on the human body structure, especially its function, is a strong motivating content, e.g. huge amount of blood pumped by heart, optical illusions etc. can attract everyone's attention.

The main advantage of teaching-learning of the human organism is also a fact that every student's body is constantly at hand, therefore there is no need to obtain special complicate teaching aids.

Currently, measuring quantities are considered to be one of the students´ essential science skills. In science teaching, these skills are often acquired by measuring items that cannot attract neither the interest nor the application attention of students, consequently, they are not motivated enough to use these skills. For example, we can give a boring measurement the heat capacity of a metal weight located in a calorimeter. This activity could be replaced by measuring the human body heat capacity in the case of fever. Similarly, it would be appropriate to include learning the principles of human body measuring devices, i.e. blood pressure measurements.

Taking the human body measurement is a very practical skill for prevention and diagnostics of certain diseases or conditions endangering healthy organism functions, i.e. body temperature above normal or high blood pressure. Acquired information and skills can be useful in everyday life as well as in providing first aid, e. g. knowledge of the breath frequency providing artificial respiration.

Connecting the understanding to the human body with the skills and knowledge of surrounding environment could be a way how to reach the educational aims of environmental education. In this area, the important theme is human health and life protection against dangerous extraneous influences and life risks. These safety risks include fast change of atmospheric pressure, rapid change of speed, effects of forces, acoustic fields, meteorological conditions, temperature fluctuations, electric field, magnetic field, ionizing and non-ionizing radiation.

Experiments and measuring the human body parameters must keep following oddities and principles:

 ISBN 978-989-95336-1-5

- Observation, experiments and taking the human body measurement must be absolutely safe.
- The human body parameters are considered to be personal private information and must be treated as personal data (e.g. body weight).
- Recorded values of quantities of human body appear at limited value intervals (e.g. body temperature).
- Most quantities norms of human body are obtained statistically, that means using the average of measured data collected from many people.
- For measuring we use special and adjusted devices.

The human body anatomy and physiology is an integrated science topic. The human body is a very suitable content for interdisciplinary co-ordination and integration in science education.

Safety of the human body is also useful content for formation of collaboration teaching-learning projects and positive students' cooperation.

2. Hands-on experiments and family education as innovative teaching-learning method

Teaching-learning using hands-on experiments are the innovative solution for effective science education, creation of scientific literacy of students and also adults' life-long education. The many-sided use of hands-on experiments is an important psychological and pedagogical research-based innovation in science education ([1], [2], [3] etc.). This teaching-learning method is based on cognitive and social constructivism such as psychological keystone.

The important hands-one experiments are experiments with everyday objects. The transparency of phenomenon base observation is supported thanks to the fact that students know these objects from their daily life, so their attention is not taken away from the demonstrated experiment and they can concentrated on it [4]. Undemanding technical realization of hands-on experiments with everyday objects is also an important quality. This brings students a great opportunity to conduct simple experiment by themselves at school as well as at home.

There exist specific target groups which need special educational contents and educational technologies. It especially concerns handicapped people and seniors. Knowledge and skills of the human body and safety risks are needed to be passed not only to students at school but also to all members of the families. We can use "family education" as an appropriate educational method by education of the all family. A base of this educational method is a transfer of knowledge and skills acquired by students at school into families towards adults and small children. Family education by means of school education can bring to families (for parents and grandparents) important information and skills about new technical equipments at home (microwave, mobile phone etc.) and also about risks in everyday living (transport, fire, poison materials etc.).

Family education requires specially prepared teaching-learning materials. Teachers need also new designed teaching methods which include integrated teaching technology for young and adult people. Family education seems to be a challenge for pedagogy research.

3. Safety of the human body in science teacher training

An important task is the good preparation of science teachers in the field of simple experimenting and the use of information from everyday and safe living. Teaching methods of family education have to be involved in teacher training.

The character of science school experimenting results to necessity of acquiring these teachers' experiment skills in three stages [5]:

1. Scientific experiment skill (complex competency to carry out scientific experiments).
2. School experiment skill (complex competency to carry out school experiments).
3. Skill to teach students by experiments (competency to teach students by school experiments).

Creation of these science experiment skills is conditioned by several-year school work experience of the teacher. Therefore acquiring of experiment skill is not possible to acquire alongside pre-gradual teacher training.

For this reason, there is a need to prepare quality courses of school experimenting and insert it into pre-gradual teacher training at universities and particularly into in-service teacher training. Analogously, there is a need to offer enough relevant information about science and technology from everyday and safe living to teachers. Present use of ICT allows the creation

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of e-learning courses and different kinds of databases on the Internet.

4. Hands-on experiments on the human body and its safety

Everyday and safe living content on the human body can be used in teaching-learning in the form of hands-on experiments. We can arrange strong cognitive students' and their families' motivation by the combination of interesting content and hands-on experimenting.

There is a set of hand-on experiments about the human body with many alternatives. Every alternative is represented by a concrete example of a hands-on experiment and its explanation.

4.1. Demonstration of natural phenomena by means of the human body

The human body can be used as an effective teaching aid to demonstrate various natural phenomena.

Gravity and blood pressure:
The presence of gravity at the Earth's surface can be demonstrated using both hands. Stretch one arm upwards and let the other arm hang freely along the body. After a short time place both arms next to each other and compare their skin coloration. The standing hand is much paler than the hanging one. The discrepancy in skin coloration is caused by the different promoting the blood circulation in both arms thanks to gravitational pulling of circulating blood.

4.2. Demonstration of human organism functions

Hand-on experiments using objects from daily life illustrate the function of chosen organs.
A model illustrating the function of the lungs:
The bottle bottom is replaced by a rubber membrane. The rubber inflatable balloons illustrate the lungs function. The rubber membrane deformation effects the changes of air volume in balloons (lungs models). This is simulation of breathing.

4.3. Measuring human body parameters

It is possible to measure values of quantities of human body parameters. While taking the body measurement, we apply special measuring devices.

Figure 1. Model of the lungs

Body temperature:
Normal body temperature is the temperature of a healthy organism. We measure body temperature in the underarm where the temperature is proximate 36,5°C. In the rectum and in the ear canal this temperature is 37,5°C. If the body temperature is higher than 38,5°C (in the underarm) the organism has a fever. A critical high temperature is 42,0 °C and a critical low temperature is 27,5°C. In these temperatures, the cardiovascular system collapses and the person has a high risk of death. There are many different types of thermometers which are used to measure body temperature. When measuring the body temperature of children it is better to use a digital ear thermometer, which is possible to use while they sleep. An interesting application of body temperature measurement is in the method of the birth control based on the changes of body temperature during the menstrual cycle.

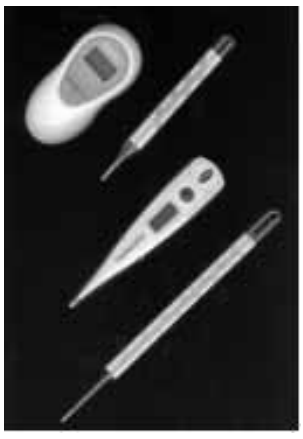

Figure 2. Thermometers

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4.4. Impacts of environment on the human organism

We can simulate impacts of the environment on the human organism. Hand-on experiments can simulate a function of chosen organs or parts of human body in changing external conditions.

Eardrum during diving:

Due to the hydrostatic pressure in water, differences in pressure occur in human organism during diving.

(a) Put the test tube with a membrane into a plastic bottle, close the bottle with a cap with valve and overpressure it with a small tyre pump. The rubber membrane buckles. We eliminate the overpressure in the bottle by removing the cap and the membrane straightens back up. This experiment simulates painful squeezing of eardrum during diving.
(b) Fix a thin hermetic plastic wrap onto the test tube tightly. On condition of overpressure as much as necessary, the membrane tears. Similarly to the membrane during the experiment, the eardrum in overpressure caused by water during diving can end up perforated. The water gets to the balanced organ through the ruptured eardrum. The result is sickness, loss of orientation and even drowning.

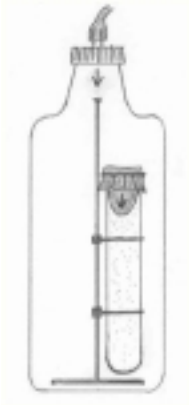

Figure 3. Model of the eardrum

4.5. Demonstration of the human organism at high-risks

Hand-on experiments can demonstrate the high-risk states for the human organism, which can result in its damage or even death.

Scuba divers´ Caisson disease:

Fill approximately a half of a plastic bottle with water. Close the bottle with a cap with valve and overpressure it with a small tyre pump. Shake water and air in the bottle several times intensively and leave it to stand for a while. In a minute, quickly decrease a pressure in the bottle by removing the cap. We can observe a noticeable escaping of gas bubbles in water and later on the bottle side. During diving, air gases dissolve in blood (e.g. at depth of 70 m nitrogen dissolves in blood about 70 times more than above the surface). Rapid loosening of these gases from blood during the diver's fast emergence on the surface is the reason of a gas embolism (so-called Caisson disease), which can cause diver's death.

4.6. Simulation of lifesaving procedures

Hands-on experiments on the human body support explanation of lifesaving procedures.

Auto-transfusion:

This experiment proves that blood is influenced by the gravity distribution. If we lift the legs of person lying down the blood gets redistributed into the rest of body, it increases the blood pressure in rest of the body vessels. This blood pressure we can measure. It is used as first aid for people who collapse because of low blood pressure.

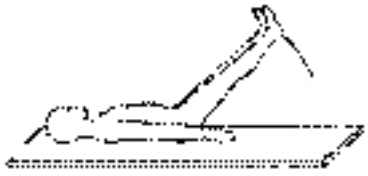

Figure 4. Auto-transfusion

4.6. Preventative diagnostics of human organism at risk

With the assistance of hand-on experiments on our body we can diagnose potential health dangers.

Body mass index:

Body weight is defined as an essential parameter that helps us to find out the state of health and even predict health complications in the future. The often used parameter for body weight assessing is a body mass index (BMI). It is calculated according to formula:

 ISBN 978-989-95336-1-5

BMI = (body weight in kg) / (body height in metres)^2

A BMI greater than 25 is considered overweight, above 30 obesity (above 40 as morbid obesity) that is valued to be at risk and should be cured. Changes of body weight, especially the fast ones, are regard as an indicator of serious health problems of the human organism.

Flat foot:

The diameter of the sole of the foot is measured to diagnose disorders of the foot. The foot structure is very important for the various movement conditions of the body. The most known disorder is flat foot caused by fallen arches. A simple measurement can discover this disorder. Inappropriate footwear is a large contribution to this disorder. That's why the length and width of the foot is important when buying the correct shoes. For the measurement of feet, shoe salesmen use special measuring tools. Measuring procedure:

1. Paint the sole of the foot with oil (ink, paint etc.) and step on suction paper (blotter).
2. Use a ruler to measure widest (w_1) and narrowest part (w_2) of the footprint.
3. Calculate I = w_2/ w_1.
4. Evaluate results using the table.

I = w_2/ w_1	
normal foot	I = less 0, 45
start to be flat	I= 0, 45
flat foot	I= more 0, 45

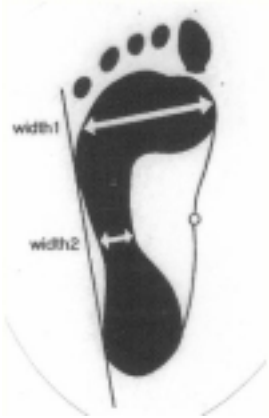

Figure 5. Flat foot

The flat foot diagnosis is a good content example of an effective science family education. We made the research of the effectiveness of family education in 2006. We used the measuring of flat foot described before as the teaching-learning content for our research. We taught 75 students of the fourth grade in primary science lessons. We distributed a questionnaire to their parents after two weeks. All 75 questionnaires we received back. We asked parents of our students to answer the questions:

(1) Do you know a simple method of measuring flat foot? (YES: 68%)
(2) Do you receive this method from your children? (YES: 60%)
(3) Have you measured your foot using this method? (YES: 24%)
(4) Have you found latent flat foot in your family? (YES: 4%)

These results make us sure to input family education into primary science teaching-learning.

5. Conclusions

Safety of the human body in hands-on experiments is significant for effective motivational science educational technology. Family education brings to all families important information about risks in everyday life (transport, fire, poison materials etc.). The combining of living phenomena on the human body and hands-on science experiments is the source of students' motivation. Hands-on active teaching-learning is the innovative solution for effective science education, creation of scientific literacy of students and also adults' life-long education. The distinctive quality of a hands-on science experiment is the transparency of presentation of science phenomena. A very important task is the good professional preparation of science teachers in the use of these hands-on experiments. The first experiences with use of human body hands-on experiments in teaching-learning science bring good results. Safety of the human body is also suitable content for formation of collaboration projects and positive cooperation.

6. Acknowledgements

The paper was created in the projects GRUNDVIG, SGE G2-P-2004-15, EuSTD-web 129455-CP-1-2006-1-PT- COMENIUS-C21 and GACR 406/05/0246.

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Acoustic Characterization of a Galician Bag-Pipe

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Abstract. Of remote origins, the bag-pipe has evolved from the coupling of an air reservoir to a flute, thus reducing the physical effort of the performer in continuously blowing the instrument. Besides, it allowed the connection of more than one pipe to the bag, giving it a polyphonic character.

The study of musical instruments from a physical point of view has remained a restricted field of study, mainly focused on those associated to the erudite music.

The evolution in the conception and the construction of musical instruments is essentially empirical and relies more on the musical and manual skills of the constructor than on his scientific knowledge. Small and subtle differences in the sound produced separate an excellent instrument of another one of only good quality. Is it possible to measure these differences?

With this work it is intended to present an acoustic picture of a Galician bag-pipe, characterizing the vibration modes of the pipes that constitute it and how they are excited by the vibrating elements (the reeds).

Keywords. Physics, Music.

Virtual Laboratory of Biotechnology

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Abstract. Over the last years we have witnessed the exponential growth of knowledge and practical applications related to Biotechnology. The Human Genome Project is a perfect example. This international effort resulted in an unprecedented increase of knowledge related to our genome. This research is already being applied to medicine, mainly in the development of new techniques to diagnose diseases. Within a few years it will be possible to identify individuals with predisposition for various illnesses and predict, within a range of decades, the appearance of late monogenic diseases. However, the use of genetic testing raises several ethical questions, mainly related to the confidentiality of the individual genetic data. In the near future these questions will have to be discussed and decided by our society.

It's up to the schools and teachers to form new generations of citizens with the knowledge and skills needed to allow a more active participation in the decisions of the society. We need to introduce the Biotechnology and its applications in our schools. But the transposition of the techniques used in Biotechnology to the classroom raises many problems, mainly when

 ISBN 978-989-95336-1-5

referring to the scarce material and financial resources. The ICT appear to be the best way to minimize these problems.

The Virtual Laboratory of Biotechnology was developed with this in mind. This lab is software that allows the virtual manipulation of instruments and techniques used in the genetic diagnosis of diseases in an investigative perspective. In the virtual lab the students investigate, in interactive work groups, a series of investigative questions that aim to highlight the characteristics of the different techniques. Afterwards, the students apply these techniques to specific case studies. Finally, they reflect about the ethical implications of these technologies through discussion in small groups and as a class.

Keywords. Biotechnology, Virtual Lab, Software, Interactive Learning.

Virtual Laboratory of Biotechnology: demonstration of a software

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Abstract. The main goal of this activity is to demonstrate the software Virtual Laboratory of Biotechnology. The participants will use the software, in interactive work groups, and will try to answer a series of investigative questions that aim to highlight the characteristics of the different techniques. Afterwards, they will apply these techniques to specific case studies. Finally, the participants will reflect about the ethical implications of these technologies through discussion. As the participants go through this educational pathway, they form a clearer picture about what Biotechnology is, its applications and ethical implications and about how this area of knowledge can revolutionize the future of humanity.

Keywords. Biotechnology, Virtual Lab, Software, Interactive Learning.

The Information and Communications Technologies in Promotion of Experimental Science Education: Exploration of a Multimedia Didactic Application in Thematic Sexual Reproduction

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Abstract. In a way to promote teaching of sciences, *"Reprodução 9|11|12"* (http://www.ibmc.up.pt/moodle), a multimedia didactic application, was developed. It's an application where the different domains essential for the educational success of the tool are conjugated: content, didactics, design and functionality. In relation to the content, the thematic of the sexual reproduction is approached, holding in mind, the curricular programme of the elementary and secondary education. It is approached since the procreation of a new being, with the junction of the two gametes to form a zygote, until its initial embryonic development. It is also pointed out the use that man does of the knowledge of these reproductive processes, manipulating the individuals' fertility. The didactics basis of the defined activities is inserted in a perspective of a constructive education, the Teaching through Research. Two main experimental activities were developed. In the activity called "*Laboratory*" several laboratory tasks are explored with the biological model sea urchin. The activity "*Clinic*" exhibits the simulation of several clinical proceedings in a fertility clinic. The graphic component developed, simple but attractive, was conjugated with different shapes of information: animations and photos in the "*Laboratory*" activity, animations, videos illustrating techniques/treatments of fertility and video sessions with specialists about ethics problems in Assisted Medic Procreation. Several functionalities were also defined in the incorporation of the didactics activities in the educational software *Moodle*, with the purpose to promote, essentially, the flexibility, the dynamics, the interactivity and the edition of the resources

 ISBN 978-989-95336-1-5

by the different users Teacher, Student or Administrator.

This multimedia application, resulting of the conjugated effort of experts of different areas represents, then, an innovative platform that unites Teaching through Research and the new technologies of information and communication. It's the support to the development of activities in the classroom in the 9th, 11th and 12th academic years, and it can also be used, at the same time, outside the classroom. It is a platform to a deepest learning in science, elementary to a development of a scientific literacy of citizens.

In this direction, the present *workshop/hands-on experiment demonstration* becomes pertinent for the spreading of *"Reproduction 9|11|12"* next to the professionals in science education. This is address, in particular, to teachers of Biology and Geology, of third cycle and secondary (group 520 in Portugal).

Keywords. Experimental Science Education, Information and Communications Technologies, Sexual Reproduction, Multimedia Didactic Application.

Robotics. Robot's Construction

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Abstract. Our project 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.

Keywords. Computer Science, Robot, Robotics, Technology.

1. Introduction

In the beginning of this school year, in "Área de Projecto", defined in the curriculum of Secondary Education current and contextualized by "Orientations" ratified in 09/08/2006 (ME, 2006), we had to choose a project to work on. We have chosen a theme that is related with engineering which is the professional area that we want to develop in college. Working on a project with subjects such as maths, physics, electronics, electrotechnic, etc, gave us the opportunity to get knowledge that will be very useful in our future life. Besides this, we wanted to be original. So, we decided to construct a mobile and autonomous robot. Like all projects, this one gave us some problems and we had to do a lot of research and we had to study to overcome all odds, as we had no knowledge or abilities in this area. After all research done and some contacts with experts, we finally chose the robot assembly.

The main points of this project are:

- How to build a robot,
- How to program a robot.

During our participation on the 7th "Festival Nacional de Robótica" (National Robotics Festival), we met other students from Vila Real. Due to the fact that we've been all developing the same idea and we helped each other during the Festival, we decided to join them and to apply to "Hands on Science 2007", where we would like to present our robots, increase even more knowledge, share experiences and find out about more interesting projects.

It's also necessary to emphasise the weight of robotics nowadays and how important it will be in the future.

2. The Project

Afterwards, we show the different stages of our work, since September 2006 until the end of school year.

2.1. First Phase

From September till December 2006, we did a lot of research and studied the options we had for our project. In first place, we thought in collaborating along with UTAD (Universidade de Trás-os-Montes e Alto Douro) that had presented us "Challenger", the robot that was developed by some students of this university the year before. Then, we decided to work with an electrotechnic teacher of our school, José Alexandre Breda, who gave us all the support in the construction of

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our robot. We learn how to plan a project. In this stage we decided how we were going to make the robot and how long we were going to take in each phase of construction (Table 1).

In this first stage, the main problems that we had were logistical and financial problems. The logistical problem was decided appealing to ANPEE (National Association of Electrotechnic and Electronics Teachers) that had available a kit that allowed the robot assembly. To solve the financial problem, we get sponsorship by a local institution called "Laboratório Pioledo" (Figure1) and we bought all the necessary material to build the robot (Figure 4 to 9) from ANPEE (National Association of Electrotechnic and Electronics Teachers) (Figure2).

		2006			
		S.	Oct.	Nov	Dec
Research		X	X	X	X
Sponsorships				X	X
Project	Planification	X	X	X	X
	Conclusion				
	Presentation				
Construction	Mechanics				
	Electronics				
	Programming				

		2007					
		Ja	Fe	Mar	Ap	May	Ju
Research		X	X	X			
Sponsorships							
Project	Pl						
	C					X	X
	Pr			X		X	X
Constr.	M	X	X				
	E		X	X			
	P		X	X	X	X	

Table 1.Time planification for the robot's construction

Figure 1. Logo of the sponsor

2.2. Second Phase

This stage has began in January and ended in March 2007. During these three months, we built the first version of the robot which was presented to school community in the science week of our school that took place in the month of March. At the end of this phase the robot was able to follow a track, distinguishing colours (black and white), going up and down slopes and making curves of 90º.

Figure 2. Logo of ANPEE (National Association of Electrotechnic and Electronics Teachers)

Figure 3. Logo of the 7th "Festival Nacional de Robótica" (National Robotics Festival)

Figure 4. Logo of the organisation of the robotics festival

The main problems that we had here were technical problems, which were solved by the accompaniment of the teacher José Alexandre Breda in carrying out this important project.

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2.3. Third and Last Phase

Since April until the end of this school year, we concluded our project. This phase was very enriching because we had to learn how to program a robot, one the most important knowledge in our project. In the second and last version of our robot, it was able to do what was established in the beginning, that is to say that now he can follow a track, make curves of 90º, go up and down slopes, get out of the way of some obstacles, distinguish some colour and warn by means of audio and light.

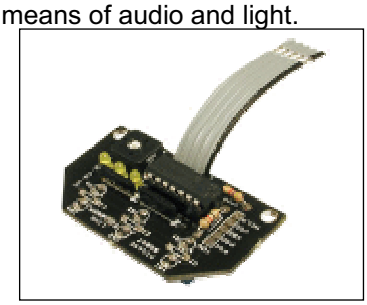

Figure 4. Mechanism that makes possible the task of following tracks

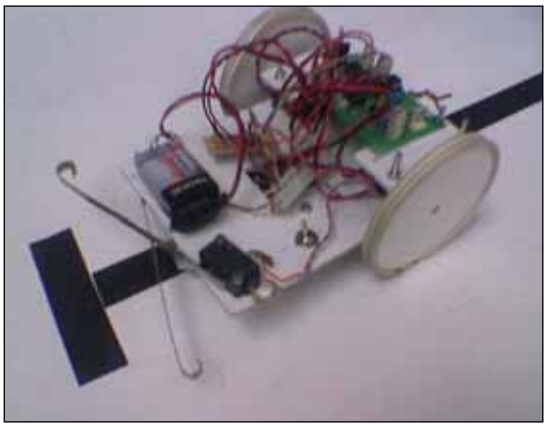

Figure 5. Robot in a construction phase, almost finished (1)

From 27th to 30th of April, we participated on the 7th "Festival Nacional de Robótica" (National Robotics Festival), in Albufeira. It was the first time we participated and we get the 27th position among more than 200 teams in the "Junior Rescue" competition, which is an excellent place (Figure 10 to 13). It was a very good experience for us, because we found out about other built up projects and we shared our knowledge with other young people. During this meeting, we met the other students of Vila Real in the same competition.

In May and June, we presented to our school community the last version of our robot.

The objectives of our project were all succeed since the robot works very well as we could see by our results in the national robotics festival.

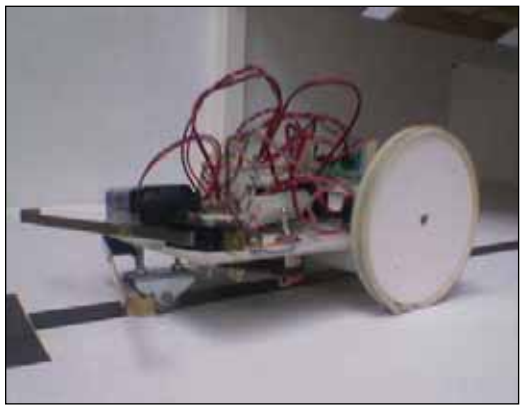

Figure 6. Robot in a construction phase, almost finished (2)

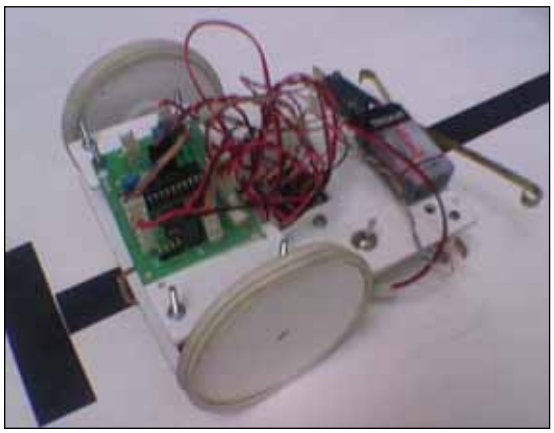

Figure 7. Robot in a construction phase, almost finished (3)

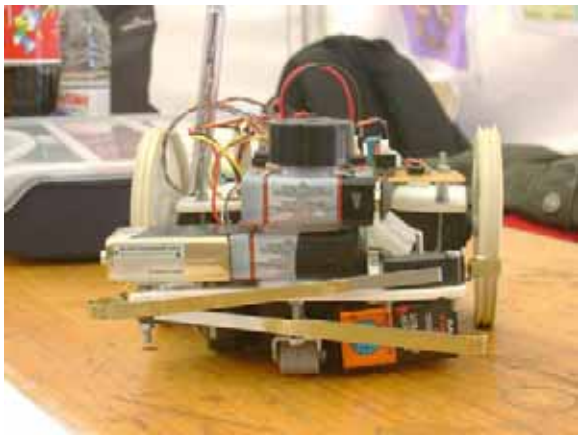

Figure 8. The second and last version of the robot (1)

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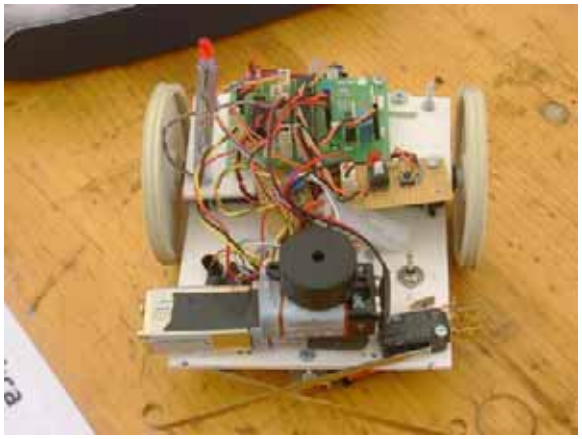

Figure 9. The second and last version of the robot (2)

Figure 10. "Junior Rescue" circuit

Figure 11. During the Festival (1)

4. Acknowledgements

The carrying out of this project would not be possible without some fundamental contributions that we refer and appreciate.

So we make notice our teacher of "Area de Projecto" for her determination, initiative and collaboration, and teacher José Alexandre Breda, for all the support and help given in the construction of the robot and in the participation in robotics national festival.

We also appreciate the financial support (sponsorship) given by "Laboratório Pioledo", fundamental in the development of our project. The presentation of this project is supported by Hands-on Science Network (Comenius 3 110157-CP-1-2003-1-PT-COMENIUS-C3).

Figure 12. During the Festival (2)

Figure 13. During the Festival (3)

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Robots at School. Operation TRI SERA TOP. The Eurobotice Project

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Abstract. The pedagogical usefulness of robotics in Science and Technology education is being proved in different contexts and approaches.

In this communication we will present and update on the activities of a Comenius 1 school cooperation project, Eurobotice, aimed to combine the study of the basics of robotics and of its applications. The students have to design and program a robot to accomplish, this year, waste-managing tasks.

The Eurobotice project involves around 300 students, ages 12 to 15 on average, from 7 schools of six EU' countries.

This year challenge includes 2 parts:

- Part 1: Design and program a robot to accomplish waste-managing tasks. The robots will compete at the tournament.
- Part 2: Research and organize the information into a presentation about waste-prevention.

A robotics tournament was organised where, the teams take part in matches with their robots. They also have to present their project to the judges.

Teams of school students are established and work cooperatively in order to solve a number of challenges under the theme of waste-prevention. The topic will be researched discussed and explored and several robots or robotic' artefacts are build and programmed in other to fulfil a number of task in a final robotic competition at the School EB 2,3 João de Meira, Guimarães, Portugal.

Keywords. Robotics, Science Education, School, Hands-on Experiments, Comenius 1 Projects.

1. Introduction

Hands-on experimental activities have long time proved to be one of the most effective ways to drive the students to a successful learning of science and technology [1,2].

Robotics is a topic rather challenging and appealing to our young students.

On the other hand robotics and automation is also very and ever increasingly important in science and technology, in a vast number of industries and even in our every day life. Robotics will certainly have a major role in the current and future development of our economies and society.

2. Eurobotice III – Waste Prevention

At the 1st International Conference on "Hands on Science, Teaching and Learning Science in the XXI Century" we introduced the topic of the learning and use of robotics in school education [3]. This time we are going to report the 3rd year on a European cooperation project centred in this in-school' robotics topic.

The Eurobotice project is a Socrates Comenius School project and this year were involved 7 schools from six European countries (Portugal, Austria, Belgium, France, Netherlands and UK) and promoted within the frames of the Hands-on Science European network.

The main objective of the project is to promote the learning and the dissemination of new technologies, with special focus in robotics,

 ISBN 978-989-95336-1-5

motivating and involving all the school members, as well as the whole community they are inserted in. In particular Eurobotice aims to improve the teaching of science and technology through the use of robotics and waste prevention research dealing with both subjects in an integrated and interdisciplinary way. The project wishes also to encourage an exchange of ideas between members of the European Union and to promote the study of science, engineering and technology.

The activities of student's teachers and schools will be driven towards the preparation of a final major activity. It is a robotics competition or festival on the theme of Robotics and the waste-prevention research. The aim of the project is to encourage young European citizens to heighten their awareness of the importance of waste-management to their country's future. Each team will be expected to explain the problem, present existing practises and propose an alternative solution or policy that could be implemented to solve the problem. Students will design build and program a robot or a set of robots built to perform a series of different but interrelated tasks. The robot teams will than, at the festival, be exhibited and run against other robot' team from other schools and countries.

For this competition there are two main preparatory activities that will take almost a full school year: the Robot Game and the Research Assignment.

Figure 1. The students present their work to the other teams the jury and visitors the results of their research work on waste-prevention

During the development of their Research Assignment the students will understand more fully the significance to the real work of the scientific and technological research being conducted by scientists around the world in this specific science and technology subject. In the context of Eurobotice the subject is waste-prevention. The research work will enhance our students' awareness of the issues at stake to improve waste collection and management by educating them to change their consumption-patterns so as to produce less waste and dispose of it in a more environmentally-sound way. Thus, the challenge for European citizens today is to achieve prevention of waste generation rather than focus on how to eliminate growing amounts of waste. They are asked to learn about the industries and research activities in their own country.

Reports shall be produced namely in the form of multimedia presentations and webpages or sites.

After this preparation phase (that in fact takes place throughout the all duration of the project' activities) the students enter the Robot Game phase. Here the students must design develop build and program a robot to solve a series of missions on a playing field.

Specific rules are associated with each one of the different tasks presented. The different missions will take place in a specially designed playing field (Figure 3) organised by the schools of the Comenius project. The eight chosen missions are named: Store the incinerator's bottom ash, Install a filter onto the chimney, Metal waste collection, Start the pump, Battery Storage, Radioactive waste storage, Composting, Deliver bring banks. Furthermore each activity focuses on tackling the learning of a specific competency (programming, building,…) or knowledge (kinematics and dynamics, friction, mass and volume, resolution and accuracy,…).

The project was integrated into the normal curricular activities of different and diverse disciplines: foreign languages – used to assist in the exchange of information between participating European countries- namely English and French, ICT, of great importance in the processes of learning how to program the robots but also on how to exchange information between the different teams and schools from the different European countries involved, through email and internet, physics, in all that relates to mechanics but also optics and electricity for instance as support to the understanding selection and use of the different robotic sensors, technology – on the construction of the robot's propulsion and manipulation systems, art and design – in what concerns the "look" of the built robots, and to enhance the presentation of the pupils' research reports to an international audience.

During the project students have to locate sources of information, select appropriate materials and organize it in a logical efficient and appealing way.

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Figure 2. The winning robot? ... The result of several months of intense highly motivated work…

This year the students:

- ✓ have to select one particular aspect of waste-prevention and evaluate the impact on the preservation of our environment,
- ✓ identify current practises and challenges we need to solve to improve waste prevention,
- ✓ find experts and organizations researching this field, contact them to learn more about their works or else read what has been written on the subject,
- ✓ get some information on the internet or from libraries and other media.

The project was also used to facilitate and induce exchanges between students and teachers from diverse European countries increasing the sense of European citizenship.

Teachers learn how to work with colleges of schools from other European countries sharing experiences and best practices.

Individual schools learn how to benefit from European fellowships by developing links with other European schools and institutions

At the end of the project the students are capable of:

- perform tasks methodically individually and in teams,
- to put in practice their theoretical knowledge concerning the programming of their robots,
- use the theoretical knowledge obtained in the solution of practical problems,
- increase their aptitudes and competencies of use of the technologies of information and Internet, elaboration of critical and logical reasoning, the ability to validate and to use all the obtained information towards a goal.

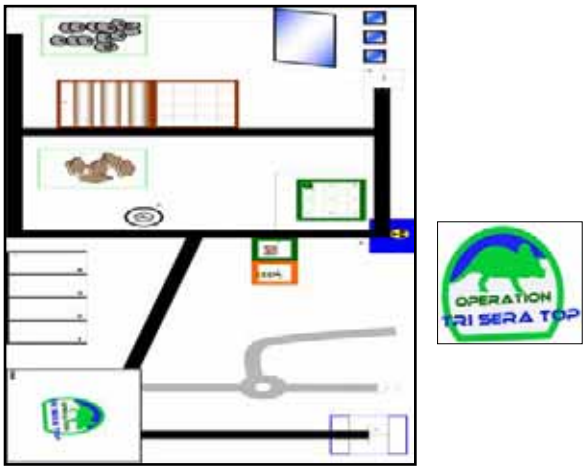

Figure 3. The Operation TRI SERA TOP playing field

At the end of the project the students' teams and the schools will produce and exchange a DVD with the conclusions of their work, their multimedia presentations, films and pictures of the accomplished work and the participation in the competitions. These products will be used in demonstrations to motivate other students to the study of robotics and other areas considered traditionally difficult as physics and mathematics.

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More information concerning these projects can be found in the websites created by the project students:

http://robos.no.sapo.pt
www.eb23-joaomeira.rcts.pt/indexeurobotice.htm.
http://www.pierrard.be/robotice/
http://www.eurobotice.tsn.at/
http://www2.lille-vaerloese.dk/lego2006/index.htm
http://www.pierrard.be/~galeries/euroboticeportugal2007/

3. Conclusion

In-class hands-on experimental activities have a very positive impact in the large majority of the students involved.

Waste prevention and robotics are appealing and challenging topics that students from early ages work with in an enthusiastic and committed but very responsible way.

The students, their teachers and schools gain a series of new competencies and knowledge invaluable in their educational development. The most important outcome of this type of projects is the self-confidence and responsibility our students developed and well as an excellent posture towards science and technology.

4. Acknowledgements

The authors and in name of the Hands-on Science network would like to acknowledge the support of all schools members of the Eurobotice project and of all National Socrates Agencies of the countries involved in the project.

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A Study of Educational Robotics in Elementary Schools

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Abstract. Educational Robotics (ER), the research field that studies the application of Robotics as a pedagogical tool, has been growing in importance in the last few years as an emergent approach, mainly suitable to scientific and technological education.

This work describes a study where Lego Mindstorms robotics kits were used by elementary school students to dramatize a portuguese popular tale (“Carochinha”). In this dramatization, each robot was built and programmed by the children to follow a sequence of steps, representing a role in the play.

A number of the skills identified for K-4 levels by the Portuguese national curriculum, were involved in this work, namely in the areas of Mathematics, Science, Portuguese Language, Drama, Music and Visual Arts.

The study was of a qualitative nature, using instruments such as direct observation, video filming, questionnaires, interviews and also documents produced by the students.

The evolution of the students along the project and their attitudes were characterized and the skills involved were analyzed. The relationship with the constructionist approaches was also explored. A major contribution of this study is the demonstration of the applicability of Educational Robotics to the elementary levels of education

Keywords. Constructionism, Lego Mindstorms, Educational Robotics, Elementary school,

1. Introduction

1.1. Background and motivation

Every teacher aims to find new pedagogical tools that motivate the students and that are

 ISBN 978-989-95336-1-5

ultimately effective in the teaching/learning process of a broad set of contents. Frequently, novel educational tools are developed that bring new sheds of hope to teachers, parents and students. Some of them are able to survive in the fierce competition, but most disappear in a short span of time.

The Information and Communication Technologies (ICT), as a whole, have offered lots of promises to education, and some even talk about a huge revolution. Nowadays, it is certain that its impact on the classrooms is still far from these promises, mainly in what regards elementary education. But, it is undeniable that nowadays there are already a number of tools that can be used by teachers and students. The question is shifting from "Will we use ICT in education?" to "How can we use ICT in education to obtain good results?"

In this context, *Educational Robotics* (ER), the research field that studies the application of Robotics as a pedagogical tool, has been growing in importance in the last few years as an emergent approach to Education. This development has been made possible by the technological advances in ICT and electronics, as well as by the progressive drop of costs.

The pedagogical potential of this new tool makes it suitable for a number of areas such as Mathematics, Physical Sciences and Technological Education. The results obtained with these tools have reported a lot of enthusiasm from the actors of the teaching/ learning process: students, teachers and parents. But if this enthusiasm is undeniable, lots of questions remain to be answered, in order to obtain a systematic and unbiased evaluation of this tool.

In fact, the use of Robotics in pedagogical tools has not been progressing in a homogeneous way, clearly lacking a systematic strategy to adopt this tool in the national curricula at the different levels. A large number of reasons can be identified to justify this fact, starting with the lack of adequate formation to teachers and ending with the lack of pedagogical material that can be used in the classrooms by teachers and students.

Many of the unanswered questions about ER are no doubt due to the fact that the field is still in its infancy and will be solved with its natural evolution. In this process, it is important that the sciences of Education fulfill their role and conduct studies that can answer questions such as:

-The students learn with Robotics?

-In what way(s) do the students learn and how does this learning differs from other pedagogical tools?

-Who has more to gain from this tool?

-Which skills can be learned and what contents can be taught using ER?

-What individual characteristics of the students (e.g. gender, technological fluency) are important to constrain their performance in ER activities?

It is, undoubtedly, a huge task to answer all these questions and an even greater task to really integrate ER in the educational systems. But the future of this tool will depend of the successful compliance of this task and the results that are obtained. Those will tell if this is one more hope that vanished in the air …

1.2. Aims of the work

The main question approached by this work is the following:

"Is Robotics an appropriate tool to allow elementary school students to acquire skills important in their instruction level?"

This question can be segmented into sub-questions, namely:

-Do Robotics activities motivate elementary school students to learn?

-Is the usage of Robotics kits that allow the construction and programming of robots adequate to elementary school education?

-What contents of elementary school can be approached using robotics bases activities?

-Are Robotics activities able to promote the acquisition of skills in elementary school education, and if that is true, which?

2. Educational robotics

In the last decades, in several places in the world, a number of experiments with the use of Robotics in educational activities have been conducted. These have focused mainly on university education, although a number of these experiments have also been conducted in secondary and elementary levels. The introduction of Robotics in the school curricula can be achieved by simply inserting it has one more subject to teach/ learn, in a traditional view of this process [19]. This is the practice of some university degrees, where Robotics is explained at a technical level, focusing on electronics, automation or programming.

However, in this work, another view will be followed, where Educational Robotics (ER) will be approached as a broad educational tool, used in several levels of education, as a way to approach a number of subjects, under a constructivist view of the learning/teaching process.

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2.1. Lego Mindstorms platform

In 1998, a cooperation effort from MIT Media Lab and Lego Company gave rise to the creation of first Lego Mindstorms robotics kit that was based on the RCX controller. The main components will be briefly described next, once this was the platform used in this study:

i) the RCX - It is the control unit (the brain) of the robot, possessing a microcontroller and internal RAM memory. It can execute programs that are loaded in its internal memory, being also able to interact with the environment through a set of sensors and actuators (Figure 1). The I/O interfaces allow the RCX to be connected to three input sensors and to three actuators (typically motors). It also has a LCD screen that transmits information to the user (e.g. the battery status or the selected program) and a speaker to emit sounds.

Figure 1. Lego Mindstorms RCX and its interfaces

ii) sensors – the sensors allow the collection of information from the environment and its transmission to the RCX. The basic kits have touch sensors that can detect obstacles in the neighborhood of the robot (essentially a switch that is on when it is pressed) and light sensors that can measure the intensity of light.

iii) motors – these are the actuators that are included in the basic kits. These are rotating motors that can be activated with several levels of tension, therefore varying the velocity of their movement.

iv) construction pieces – all kits have hundred of Lego building pieces that allow the construction of wide range o distinct robots. These include lots of technical pieces including several types of wheels, wheel rims, axes, pulleys, levers, etc.

v) programming tools – there are several interfaces to program these kits. In this work, the option was to use Robolab, developed by National Instruments and Tufts University. This application is based on iconic programming and has different complexity levels, allowing the natural evolution of its users. With the development of this application the aim was to create an environment accessible to children and adults, but that would not impair the full potential of the equipments [14].

2.2. State of the art of Educational Robotics

In this section, the purpose is to make a non exhaustive overview of the some projects and initiatives that were developed in the field of ER. In this field, the competitions have gained a special role, being the most participated activities in ER once they exert a special fascination over students, teachers and parents. In this context, the following can be referred:

-First Lego League (FLL): It is a competition created in 1992 by a partnership between FIRST and Lego that involves students with ages in the range from 9 to 16 years. In the 2006 edition, more than 60000 children were involved from 32 countries. In each edition, the competition has a different theme (in 2006 it was Nanotechnology and in 2007 it will be Energy Resources) and a number of challenges are proposed involving construction and programming of Lego robots. The teams have a period to train and then meet in regional, national and world-wide competitions.

-RoboCup Junior: This competition is incorporated in the RoboCup project, where the purpose is to organize several competitions of robotic soccer, with several types of robots. Since 1999, a partnership was made with Lego, enabling competitions of robots programmed by children, in a project named RoboCup Jr [8]. In this competition, teams of two robots compete playing soccer among each other. Other competitions have been created within Robo Cup Jr, namely the rescue and dance events, therefore making the universe of events more diverse and also being more attractive to the participation of girls.

But, competitions are not the only activities in ER. In fact, numerous schools and other institutions all over the world numerous activities have been developed. These have been mainly developed as extra-curricular activities and the inclusion of ER in national curricula is still not quite developed. Some interesting works can be summarized in the following:

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- Bers and Urrea [2] describe a workshop promoted in Argentina in 1998 where 4th and 5th grade students, accompanied by their parents, spent two weeks involved in robotics projects. Each team selected a project, collected the necessary materials, built and programmed the robots and prepared a presentation for the other teams. Both parents and children worked in the project in full time (8 hours a day and 5 days per week) for the two weeks.

- In Tufts University, a number of ER projects have been conducted. Bers et al [1] describe a work made by pre-service teachers, working with K-2 children. The work implied the implementation of some constructionist environments and its evaluation. The projects developed with the students included the exploration of the concept of metamorphosis (with 3 year students), the concept of balance by building cranes (with 4 year students), the notion of life cycle (with 5 year students) and the construction of a robot able to protect some planted seeds (with 1st grade students).

-In the same institution, Hacker [5] implemented an extra-curricular workshop with children from the 3rd to the 6th grades. In a first stage, the students learnt the basics of robotics, and in a later stage they developed their own projects, building and programming the robots. These projects were presented to the parents and other members of the community.

2.3. Pedagogical foundations of Educational Robotics

The pedagogical foundations of ER are based on the work of Seymour Papert [13] and the ideas proposed by the constructionism. This is based on the constructivist theories and can be considered an approach to the learning/ teaching process based on constructivism.

The constructionism is based on the idea that human beings learn better when they are involved in planning and building artifacts that are significant to them and they share this with the community. The process of building the object is accompanied by the internal construction of the knowledge about the process.

The innovation, regarding constructivism is centered on the added value given to the physical objects as a support to mental representations. The computational environments and Robotics make powerful tools to implement these ideas [16].

The origins of the constructionism can be found in the group leaded by Papert in the MIT during the 60s that became well known with the work on the LOGO language. This group built a shared vision of education that was based on the following main ideas [1]:

- Learning by designing – students learn by designing meaningful projects. Resnick [15] suggested that the interactions of children with technology should be more like finger painting than with watching TV. In fact, computers and technology in general, can complement existing practice and extend these experiences to “learn by designing” [6]. This approach involves the students in learning through the application of concepts, skills and strategies to solving relevant real world problems that have a meaning and relevance to the student. In this process, students are involved in problem solving, in decision making and in a process of collaboration [18]. The activities of ER fit perfectly in the previous description, since in this type of activities students learn by designing and building robots, solving problems created by a project and its underlying aims, where a number of obstacles created by the real world have to be overcome.

- Using concrete objects – In the elementary education there is a tradition of using manipulated materials (e.g. Cuisenaire bars).
ER makes an interesting opportunity to follow this trend, allowing the students to design and create interactive objects.
These work with concepts from Engineering, such as wheels, motors, sensors, pulleys or levers. They are also encouraged to integrate artistic materials to make their projects more aesthetically more pleasant.

- Powerful ideas – this term is used to denote a set of intellectual tools that when used with competence are really “powerful” in the sense that they allow novel ways of thinking not only about a problem, but also about the overall reasoning process. There is a consensus about the support to give children in the process developing new ideas by active experimentation and interaction with the surrounding environment. Is this process, powerful ideas come up and should be encouraged by the teachers [1].

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- Self reflection – Self reflection has a prominent role in constructionism, allowing the author of the learning process to reflect about it in a critical way. In this context, documentation has a major importance as a basis to the analysis of this process and its adjustment. In ER, the documentation of the projects is a common practice and it is also a tradition to show the results of the projects to the community. Indeed, competitions are the more extreme example of this.

2.4. Potentialities of ER in the teaching/ learning process

A number of potentialities are normally attributed to ER in the teaching/ learning process. A number of them are briefly discussed here.

- Motivation and enthusiasm by the students: this is a common feature mentioned by most researchers that have conducted studies in the field. Indeed, the enthusiasm of all the participants (teachers, parents, students) is a constant in the studies in ER. Portsmore et al [14] even report students that were always ready to work during breaks and other spare time. It is also reported by some researchers [18] that students that are normally inattentive in daily activities show a special motivation in robotics.
Given these reports it is not surprising to find that ER is usually a good solution to motivate students in "difficult" subjects such as Mathematics and Sciences, where good results have been reported [11].

- Multi-disciplinarity – Robotics is clearly a multidisciplinary field involving a set of disciplines like Physics, Mathematics, Computing or Electronics. The activities in ER integrate a number of subjects and skills, from areas such as Mathematics and Sciences, but also Arts and Languages.

- Problem solving – When involved in ER activities the students (and of course also the teachers) are faced with numerous problems, that originate from the obstacles that have to be overcome to reach the goals implied by the aim of the project under development. The fact that these problems arise from the real world makes them very different from the "artificial" problems solved in the classrooms. Indeed, these real world problems can be difficult or impossible to solve, require the application of other techniques to be solved (e.g. trial and error procedures) and sometimes the solutions are a best effort and not a "perfect" solution.

- Imagination and creativity – the idea of "novelty" is normally connected with imagination, and those are related to the processes of problem solving. The processes of building and programming robots require a process of creativity, inviting the students to innovate in the process of problem solving.

- Logical and abstract reasoning – The process of building a robot implies the capacity of planning and designing it in order to be able to work well under a given environment and accomplish a number of tasks. This implies a process of modeling the robot and the environment in an abstract way, in order to predict its behavior. Furthermore, the observation of errors implies the ability to reason about alternative scenarios and address concepts such as robustness. On the other hand, the programming of robots is conducted using a symbolic visual language, where the student needs to be able to map a set of symbols into the robot's physical behavior and predict the behavior of a given program or sequence of instructions.

3. Methodology of the study

In this section, a description of the study that was conducted is performed, by characterizing the nature of the study, the subjects that were involved, the surrounding community, the stages of the study and the instruments for data collection.

3.1 Nature of the study

The study conducted in this work was of a qualitative nature, under an interpretative and subjective perspective of educational research. According to Bogdan and Bilken [3] the qualitative research has as its main features the natural background, where the researcher becomes the main agent involved in data collection. Therefore, the data collected are descriptive, typically words and pictures.

Qualitative research focuses on the processes and less on the results or final products. Data analysis is performed in an inductive way. This type of research is not limited to analyzing behaviors but is mostly worried with the meaning that the subjects give to their actions and experiences, as well as with others.

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Merriam [9] emphasizes that in qualitative research the subjects are not treated as numbers, but are analyzed in their natural environments. Using descriptive data allows us to better capture some behaviors, attitudes and opinions, enhancing richer and more significant conclusions. On the other side, they have a natural limitation in the lack of generalization.

Ludke and André [7] identified several distinct forms of qualitative research. One the main approaches is the case study, the option followed in this work. This approach is characterized by the following main features:

- The aim is to discover novel elements and issues that are important to research that were not considered initially;
- Emphasis is given to the context where the study takes place, and to its importance on the final outcome;
- They characterize reality in a more complete and deep way;
- They use a more diverse set of information sources;
- They seek to represent the distinct perspectives in any situation;
- The language used is more accessible when compared with other methods of educational research.

The option to use this type of study in this work was, on one hand, the natural result of the objectives of the study and of the constructivist view that underpins this investigation. On the other hand, the resources available also limited the options available. Therefore, the main objective was to understand the phenomena related to ER, focusing on the processes that allow the students to acquire new skills.

3.2 Description of the study

The study described in this text involved the development of a complete Robotics project, using Lego Mindstorms kits and involving a set of elementary school students (3rd and 4th grades). The project was implemented within a club of extra-curricular activities, organized by the parents association, during 5 weeks in the months of June and July 2006.

The robotics kits were partly gathered from a project leaded by the University of Minho that involved the Agrupamento André Soares, a group of schools that includes the elementary school where the study was conducted. Some of the kits were kindly lent by some members of the ER community from Minho, which is a quite dynamic group of teachers, parents and students. The study had a total duration of 30 hours, divided by 15 sessions of around 2 hours.

The main idea of this project was to dramatize a Portuguese popular tale: “Carochinha”. In this story, the famous lead character “Carochinha” is cleaning her house and finds a coin. She decides it is time to get married and announces her decision to the world, seeking a suitable candidate. A number of potential grooms appear, namely the cat, the dog and the ox but none of them is chosen by the demanding bride. Finally, the mouse comes and conquers the lady’s heart. But, he is quite gluttonous and ends up drowning on the pot where the wedding lunch was being cooked.

The project involved the dramatization of a simplified version of this story, where each student was responsible for a character that was represented by a robot. The tasks of the project involved learning the basic of the Lego Mindstorms kits, how to build and program the robots for the project tasks, and also to design and build the scenario where the play took place.

The objective was to create a project that would be attractive to the students enhancing their motivation in a season where the competition was huge coming from outdoor activities such as the swimming pool. One important aim was to create a “show” that could be presented to the overall community.

The activities were organized in the following stages:

- Preparation: devoted to learning the basic concepts of Robotics and Lego Mindstorms. This was organized into three steps: first contact of the students with Robotics (1 hour); learning to build Lego robots (4 hours) and learning how to program Lego robots with Robolab (5 hours). These sessions included solving a number of exercises organized by increasing complexity in a script [17].
- Dramatization of the play “Carochinha”, organized into four main steps: first experiments in programming the characters (4 hours); rebuilding the robots for enhanced robustness (2 hours); programming the definitive versions of the characters (4 hours); integration of the wardrobe and final rehearsal (3 hours). The first programming experiences were conducted on the robots built in the first stage and in a preliminary set. Then, robots were rebuilt to avoid some problems (such as wheels that came out) and a new scenario was built, taking into account the results from these first experiences. Finally, the programming was fine tuned to this new set and all components were thoroughly tested in a final rehearsal.

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- Presentation of the project to the community: firstly, presenting to the ATL where the project was developed and then a participation in the Science Fair and Robotics festival of the Hands-on Science 2006 Conference. These events were of extreme importance to the students that were extremely motivated and were quite satisfied with the positive reception of their work. The publication of two news in local newspapers gave them an extra motivation and reward to the participants.

3.3. Characterization of the individuals and community

The study was conducted in a Robotics club that was integrated in a summer program organized by the parents association of an elementary school, situated in the center of Braga, the capital of Minho in the north of Portugal.

The overall program had about 40 students and 3 elementary school teachers. Only 5 of the students were directly involved in the project, but most of the others were involved by helping in the construction of the set, the wardrobe and the characterization of the characters (the cat, the mouse, the ox, etc). There was also an interesting cooperation from the parents of all the students. The community of this school can be socio-economically characterized as middle/ upper class with an urban prevalence.

The students in the Robotics club were from the 3rd (3 students) and 4th grades (2 students). Those were average students in Mathematics, Portuguese Language and Science subjects. They had a good background in Informatics, since they were involved in the Informatics club from the school. There were 4 boys and only 1 girl involved in the project.

3.4. Instruments for data collection

In the research, a number of instruments were used to collect data that are typical of qualitative research. These were all designed by the authors.

The main instrument was the direct observation. In the study the first author was also the participant researcher who did the observations. Bogdan and Biklen [3] suggest that this form of observation allows 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.

Some of the advantages of this type of study are the fact that the researcher can select, register and analyze only the most relevant occurrences and develops an informal and intimate relationship with the participants (Bailey, cited by [4]).

In this study, the researcher was also the teacher and coordinator of all the activities. It is a complex role, but it also allowed an atmosphere of more complicity.

Furthermore, the sessions were all filmed on video for posterior observation. This allowed the researcher to carefully study all the sessions, capturing some details that its involvement in the activities impaired during the sessions and therefore improving the reliability of the study [4].

Both the direct observations and video visioning were written down in reports of each session that captured all the relevant actions, behaviors, reactions, attitudes and dialogues of the subjects.

Other important instruments were the questionnaires and interviews conducted both in the beginning and end of the project. The first questionnaire, answered by all the students previously to the study, had as an objective to determine the previous ideas and attitudes of the students towards the field of Robotics. So the students were asked to define robot and Robotics, to tell how a robot could be built and programmed and which tasks it could perform.

The final questionnaire had the aim to evaluate how these ideas evolved during the project. In this case, the questionnaire was performed orally. So the students were able to give longer replies and to explain clearly their opinions about the study. The set of questions was predefined but the researcher could follow up on some of the replies and get deeper insights on some issues.

Finally, documents that were produced by the students were also used in the study, mainly the programs developed in Robolab. These were all kept, maintaining all versions of the programs for every student. In this way, the problem solving strategy of each student could be better understood and the evolution of the students could be studied in detail.

4. Analysis and discussion of the results

4.1. Categories of analysis

A number of analysis categories were taken into account in the evaluation of the study, with a close relationship to the data collection instruments.

The direct and video observation allowed the researchers to analyze features such as:

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- students' attitudes and behavior: persistence, discipline, enthusiasm, commitment;
- quality of the students' work: organization, fulfillment of the tasks;
- skills: programming and building the robots, Mathematical skills;
- understanding the way students think and solve problems.

On the other hand, the interviews and questionnaires were most useful in:

- analyzing the students perceptions and attitudes towards the project, the tasks and Robotics in general;
- understanding the way students think and solve problems;
- evaluating the students level of enthusiasm and motivation.

Finally, the documents produced by the students allowed:

- understanding the way each students reasoned about the problems and found a solution;
- study the evolution of each student regarding programming skills.

4.2. Evolution of the students' behaviour

Since this was a qualitative study, a main concern was to describe in detail the attitudes and behaviors of the subjects involved [3]. The complete details of this project can be found in Ribeiro [17] and a brief description is given next.

In the beginning of the project, there was a lot of curiosity and enthusiasm. Everyone wanted to look and touch the robots and the students were anxious to start learning how to build and program them.

The sessions devoted to building the robot were quite enthusiastic and the need to build robust robots was becoming more and more clear.

The transition to programming was quite smooth. The first exercises in the script went very rapidly. As the problems became more complex, some students started to feel difficulties. Trial and error strategies became more common, since the logical reasoning was getting more difficult.

The start of the development of the dramatization increased the levels of motivation. The first signs of difficulty were easily overcome. But the most difficult tasks were still ahead.

The first experiments made clear that the first constructions were not perfect and the programming in the first scenario was difficult. The reconstruction of the robots to make them more robust was a success. A new stage was built with routes for each robot that were more adapted to the characteristics of the robots.

The final rehearsal helped to correct some last minute problems. The integration of the wardrobes made the robots more difficult to maintain the balance. Some adjustments both to the wardrobe and to the programming were made.

And everything was ready. The first to see the show were the colleagues in the summer program. And most of them were amazed with something quite different from what they were used. Then, the team conquered the community of robotics and the attendants of Hands-on Science 2006 Conference.

4.3. Analysis of students' interviews

The conceptions of the students about Robotics in the beginning of the project were rapidly changed by the work developed. They realized the difficulty of the building and programming tasks, even to accomplish simple aims. Some of the student referred the use of Mathematical concepts in these tasks. In the end, all students were quite happy with the results and eager to continue their work on ER in the future.

4.4. Skills

During the project a number of skills, identified by the Portuguese national curriculum for the 3rd and 4th grades were approached.

In Mathematics, arithmetical operations are heavily worked in several programming tasks, by calculating times, velocities, distances, etc. The ability to estimate results of operations is quite important, since in Robotics there are always errors and every calculation is approximate.

Geometry was another important area specially in building the robots, were geometrical constructions must be planned and executed, in order that a given aim is achieved. Skills related to visual perception are quite important. The ability to work with spatial routes and program the robots to follow them was essential.

Problem solving was another important area. ER projects create lots of real world problems, where solutions need to be developed and refined frequently using trial and error procedures.

In the subject of Natural Sciences, this project allowed a better understanding of the scientific methods in action. Furthermore, lots of important Physics concepts were pinpointed, namely velocity, acceleration, strength, transmission of motion, and also the concept of luminosity.

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The contributions in Technology Education are quite obvious. An improvement of skills related to ICT was certainly achieved, but most importantly the experiment dealt with basic concepts of Engineering education, such as building spatial artifacts, programming, modeling and simulation, as well as dealing with noise, errors and unpredictable and stochastic situations.

The particular nature of this project gave a special attention to artistic expressions. In fact, dramatic expression is quite present in the aim of the project, music is also used taking advantage on the possibility of playing and composing music in Lego Mindstorms and plastic arts were heavily used in the sets, puppets and wardrobes. Finally, the Portuguese language skills were also used in the text of the play.

5. Conclusions and further work

5.1. Main contributions of the work

The work described in this text is one the first (at least to the author's knowledge) that investigates with some detail the applicability of Robotics activities in the context of elementary education. This makes one of its main contributions to the ER field, thus attempting a reply to the main question approached by the study (cf. section 1.2).

In this regard, this work gives an affirmative reply to the question: "Are ER activities suitable to elementary education?"

In fact, the students were quite able of building and programming Lego Mindstorms robots and, furthermore, they were even able to plan and implement a project where the final aim was to create a show where a popular story was dramatized.

All these tasks were achieved with merit and acclamation from all that had the opportunity to see the final result.

One important issue to accentuate is the broad set of skills, in all areas identified by the national curricula. In fact, skills related to Mathematics, Sciences, Technology, Language, Arts, Drama and Music were identified.

5.2 Conclusions

When, in a September evening, the team that had just presented the "RobôCarochinha" project in the HandsOnScience Robotics Festival was leaving the premises there was an enormous emotion and joy in all of us, students, teachers and also parents that joined us for the presentation.

The reception of our work from a community with know-how in ER was excellent. The students showed a continuous enthusiasm and a striking group spirit. And they kept saying they wanted to participate in more robotics activities.

It is obvious that none of these emotions are facts that can be used in a rigorous study of ER. Yet, these feelings are a confirmation of some results presented in literature by other ER studies that describe similar attitudes, perceptions and behaviors.

And not all conclusions are so subjective. It is a fact that it was possible to convince 5 elementary school students to voluntarily spend 5 weeks of their summer holidays working on a Robotics project. The persistence they have shown and the results obtained are a clear answer to the first of the sub-questions referred on section 1.2.

In fact, in activities that approach ICT in Education the students show a high degree of motivation in the beginning of the activities. However, as the study develops the levels of motivation typically subside. That was not the case with this work, where although the duration of the study was more than 1 month, the persistence was the dominant note.

The final results of the project, even in technical terms, surprised many of the "experts" in ER, specially given the fact that the authors were quite young (even younger than the 10 years recommended by the boxes of the Lego Mindstorms kits).

The success of this experience has opened the way to new experiences of this kind. This makes a different way to work with Robotics that attracts both genders equally and does not have some of the disadvantages of the ER competitions. It is also richer and more attractive than dance competitions, since it demands a more diverse set of skills from the students.

One of the main claims of this work is that it was really multidisciplinary, helping to develop skills in all major areas of the elementary school curricula.

Finally, in terms of pedagogical analysis, this work confirmed in our view, some of the epithets normally attributed to the constructionist practices. In fact, students learnt to build and construct robots, reaching a pre-defined goal and clearly improving their skills along the project.

All this was achieved through a learning process based on solving real problems in a meaningful context. It was clear that these activities meant a lot to the students and they wanted to show their work to the community and were willing to discuss every detail of the project and the best form of solving their problems.

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5.3 Further work

Given the innovative nature of the kind of ER activities presented in this work, a lot remains to be done to further validate this approach. So, in the near future the authors hope to be able to implement other projects that enable to further validate this approach in other scenarios.

A lot of work also remains to be done regarding the implementation of ER in elementary schools, namely in what regards the development of materials that teachers in this level can use in their classrooms.

The authors believe that if well designed materials are developed and suitable formation is provided a large number of teachers would welcome the implementation of ER activities in their classrooms.

These materials can focus on well defined skills and contents of the curricula, or they can be developed with a more multidisciplinary nature complementing other curricular activities. A long way is still ahead in this regard and the authors expect to be actively involved in these tasks.

6. Acknowledgements

The authors acknowledge all the students, parents and teachers involved in the summer program at EB1 São Lázaro that made all this possible. Furthermore, the authors thank the project “Educational Robotics at Elementary Schools” funded by FCT through program Ciência Viva , ref. CVI/277, for the equipment made available, as well as all other persons and institutions that made this study possible by making available all sorts of equipment and materials. A special thanks to the welcome of the ER community in Minho for the wonderful reception to the novice.

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Using Simulation Software to Teach Computer Networks

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Abstract. This paper shows how easy-to-use computer simulation software can achieve the advantages of simulation-based instruction and provide additional learning enhancements. We present a computer-based simulation that helps students to learn computer network concepts which are key matters in computer networking and see many factors influencing the network performance.

The instructional potential of two simulation packages, NetCracker Professional 3.x and Packet Tracer 4.x, and a connection-oriented protocol analyzer, EtherDetect Packet Sniffer 3.1, is addressed.

Keywords. Computer Simulation, Software, Computer Network, Multimedia, OSI Model, Hands-on Learning, Protocol Analyzer.

1. Introduction

Multimedia simulation uses a virtual reality interface and brings together a model of real devices and a virtual visualization of network situations in an interactive manner. Simulation enhances students' understanding by providing a feeling of reality through creating an interactive learning environment [1]. A user becomes the participant in a computer-generated world.

Simulation of computer networks provides students with simulated observations of the operation of a network [2]. During simulation the individual stations on the segment may be customized if a more detailed representation is desired. Individual workstations or types of workstations may be specially modelled. Special characteristics can be implemented by modifying the individual modules of the station of interest or the physical line connecting the stations. It is valuable in allowing students to observe and to experiment the effects of bottlenecks, delays and other network phenomena.

2. Simulation software used

Two simulation packages, NetCracker Professional 3.x and Packet Tracer 4.x, are used. Both applications can be run on a networked PC as well as a stand-alone one. Simulation software is available via web-sites:

http://www.netcracker.com,
http://cisco.netacad.net

Additionally, EtherDetect Packet Sniffer 3.1, a connection-oriented protocol analyzer available at *http://www.etherdetect.com*, is useful to monitor a network, capture packets and analyze the packet content that facilitates understanding the concept of the OSI Model and the interaction between different network protocols. Packets can be viewed in Hex or symbol formats.

3. Simulation assignments designed for Packet Tracer 4.x

Simulation experiments focus on matters of different difficulty and have different target audiences. The three first simulation lessons are for beginners, other ones – for advanced learners.

3.1. Hub-based Ethernet networks and collisions

Students will consider basic components and resources of a network, both hardware and software, construct a network and explore interactions between its elements, and observe the network operation over the time. Simulation of a hub-based network allows understanding how an Ethernet network works, why collisions may happen, and what the difference between logical and physical topologies is.

1. Select the Hubs icon in the Available Equipment pane at the left bottom part of the program window (Figure 1).

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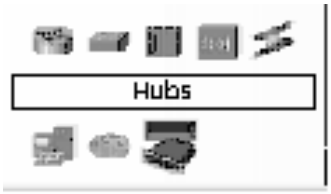

Figure 1. Available Equipment

2. Select a device in the Available Device Models pane (Figure 2). If the characteristics of a specific model don't matter, the Generic icon may select to get a device with basic functionality.

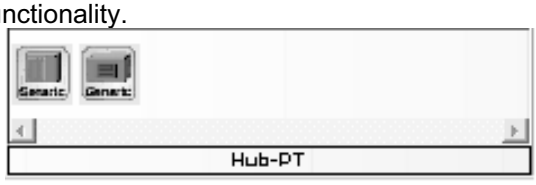

Figure 2. Device models

3. Move a selected device in the workspace pane by one of the following methods:

- Drug-and-drop a device icon,
- Two left-mouse clicks: the first - on a device, the second – on a device location in the workspace pane,
- When several devices of the same type are installed, press and hold down the Ctrl key and then make a left-mouse click on a device being selected. Then select a location in the workspace pane. To cancel selection, click again on the selected device.
-

The hub has been installed.

4. Installing PCs. Select the End Devices icon in the Available Equipment pane (Figure 3).

Figure 3. Selection of end devices

5. Select Generic-PC-PT in the Available Device Models pane and move it in the workspace pane (Figure 4). You need at least two PCs to simulate how a hub operates.

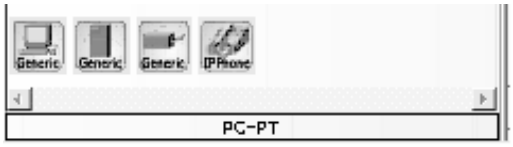

Figure 4. Selection of PCs

All necessary devices have been installed.

6. Connecting devices. Select the Connections icon in the Available Equipment pane (Figure 5).

7. Select a proper cable in the Available Connection pane (Figure 6).

If a user doesn't know which kind of a cable is required, it may be chosen automatically (Figure 6). If you select the Automatically Choose Connection Type option, the program will install a proper connection type.

Figure 5. Types of connection

Figure 6. Selection of a cable

8. Adjusting a PC. To adjust PC basic parameters, click on the PC icon in the workspace pane. The window containing three tabs - Physical, Config, and Desktop - is displayed (Figure 7). On the Physical tab you may choose the device configuration, but power supply should be turned off first. On the Config tab you can set basic adjustment parameters. By clicking the Settings button you can indicate a PC name in the workspace pane, a method of assigning IP addresses, and IP addresses of the Default Gateway and DNS server. By clicking the Fast Ethernet button you can set an IP address of the PC, a subnet mask and other additional parameters.

9. When IP addresses are indicated for all PCs, we can check collisions in the hub-based distributed environment. To do this, switch from the Real-time mode in the Simulation mode (Figure 8).

10. To simulate a collision, run the Ping command at the two PCs simultaneously. Select the envelope icon in the right panel (Figure 9).

Figure 7. Adjusting PC parameters

11. Click on a source PC first and then click on a destination PC. The envelope icon appears near both PCs (Figure 10), with a description of transmitted data and the protocol used being displayed in the right pane (Figure 11).

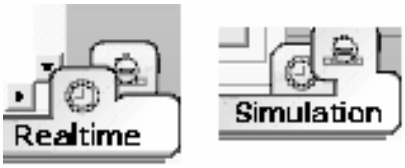

Figure 8. Switching Real-time and Simulation modes

Figure 9. Selection of a packet (Protocol Data Unit) to be transmitted

12. Start a simulation by pressing the Auto Capture/Play button. To stop the simulation press the same button. The simulation can be re-viewed in a step-by-step mode using Capture/Forward and Back buttons.

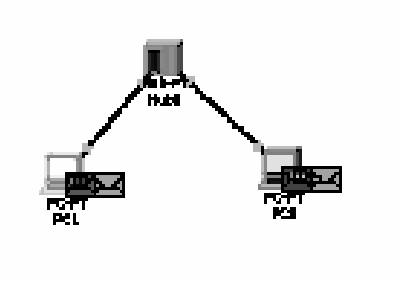

Figure 10. Simulation of a collision in a hub-based network

3.2. Switch learning

This experiment helps to see how using a switch instead of a hub changes the load in different network segments. Students develop a switch-base network and observe switch learning (Figure 12).

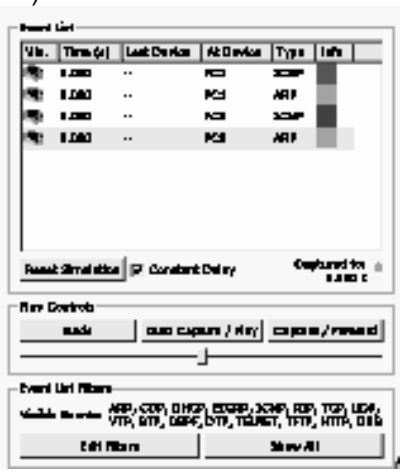

Figure 11. Description of transmitted data and the protocol used

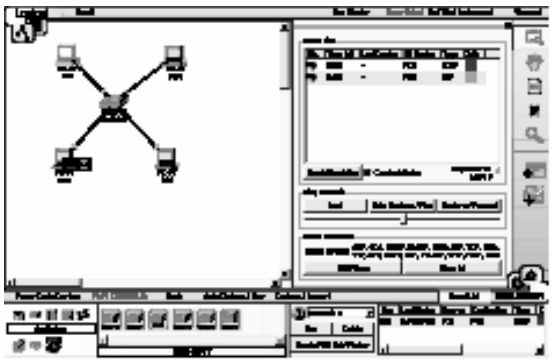

Figure 12. Simulation of switch learning

1. Create a switch-based network selecting the Switches icon in the Available Equipment pane.
2. Choose one of the switches available and place it onto the workspace pane.

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3. Choose several PCs in the End Devices pane.

4. Indicate IP addresses for PCs as described in the previous section.

5. Simulation of switching learning includes two steps:

- Set a data transmission between two PCs in the Simulation mode as described above and start a simulation session.
- After the previous step is completed, the MAC Address table in the switch should be reset, because an ARP enquiry was transmitted and this event has a poor effect on the experiment for the ARP enquiry being done in the broadcast mode. So, the switch has gotten data about addresses associated with its ports.

  To reset the MAC Address table:
  - Click on the switch icon and choose the CLI tab in the window being displayed. In this way you will switch in the Command Line mode.
  - Press the Enter key and wait till the Switch> line appears.
  - Run the Enable command to switch in the Switch# mode.
  - Run the Clear mac-address-table dynamic command, the window is closed.
  - Press once more the Auto Capture/Play button.

3.3. Data transmission between network segments and the Default Gateway option

The third simulation explains the "Default Gateway" option.

Since creating a multi-segment network requires the knowledge of routing and routers, we suggest that beginning learners use a teacher-prepared network (Figure 13) to do this experiment. The experiment contains two steps:

1. Switch in the Simulation mode and start data transmission between two PCs in the same segment. Notice that the data blocks are not transmitted to a router, but only to a destination PC.
2. Choose PCs in different network segments and start data transmission. Notice that data is transmitted to the router and then follows to the destination segment.

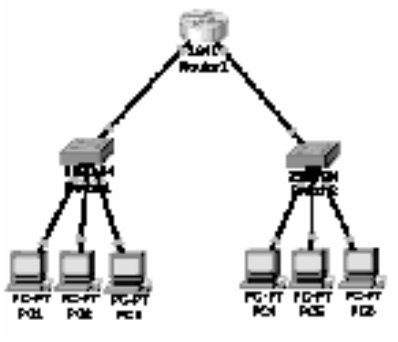

Figure 13. Simulation of a multi-segment network and the Default Gateway option

Students can watch the transmission of data frames via the network by selecting different locations for both source and destination computers.

3.4. Advanced level simulation

Two more experiments demonstrate that broadcast messages are processed by switches and routers according to different algorithms. A special assignment illustrates how a routing protocol works, with RIP being taken as an example. Many modifications can be made via built-in menus. Detailed instructions will be provided during a training session.

4. Simulation within the NetCracker Professional 3.x environment

This simulation software allows a student to search a large database of different network equipment, both communication and end ones, to view and configure devices, to create one-level and multi-level network projects (Figure 14), to set traffic, to run animations, to collect statistics and explore the network performance through changing, for example, traffic characteristics or type. Generally NetCracker focuses rather on the network performance than on the details of network protocols. Students like this application, probably because it looks like a game to a certain extent. However, we would like to notice that the traffic in a hub-based network and in a switch-based network looks similar that is not true.

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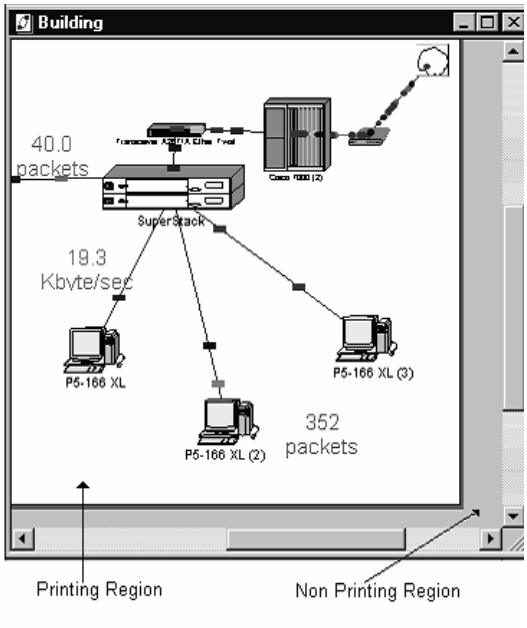

Figure 14. Simulation of a network with NetCracker Professional 3.2

5. Network monitoring with EtherDetect Packet Sniffer 3.1

We believe reasonable to introduce monitoring a network with EtherDetect Packet Sniffer 3.1 in the laboratory course (Figure 15).

This is a connection-oriented protocol analyzer provides a very clear picture of an Ethernet frame. This, in its turn, helps students to understand how protocol data units of different OSI Model layers interact with each other. As a result, the idea of links between protocols at each OSI level becomes clearer to learners.

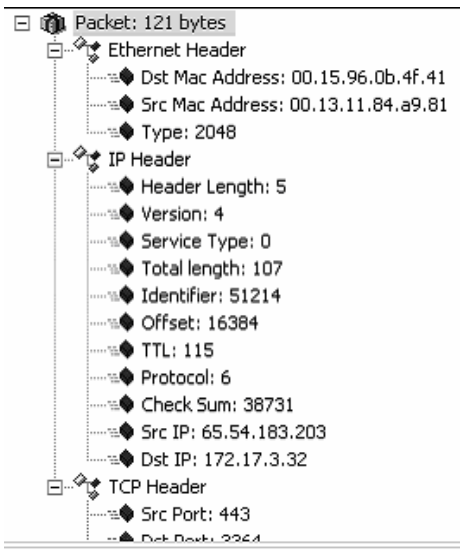

Figure 15. A packet structure

6. Conclusions

Simulation software by itself is too general and needs the added structure of recommendations to help a student get the most benefit. A tutorial by itself is too specific, and lacks some of the interactivity and visualization strengths of simulation software. Integration of multimedia tutorials and simulation software packages is expected to provide the most benefits in enhancing teaching and students' learning.

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On-Line E-LIT SCIENCE Summer School. Challenges within the European Area. Extracurricular Project of Developing the Learning Styles

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Abstract. The three fundamental directions of the new educational system, defined within the Lisbon and Feira summits – school endowment, teacher training and ensuring necessary resources – must be understood by reporting them to new action directions – ensuring quality in education, continuous training/learning throughout the whole life. The educational routine has proved that the success in the learning activities depends, to a certain extent, on the learner's intelligence and especially on adapting the learning experience to his specific style.

Keywords. Creativity, E-Learning, Learning Styles, Gifted Education.

1. Introduction

As teachers, we understood that in the process of evaluating the pupils' school performances, we need to diversify the methods,

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the techniques and the instruments in order to catch and appreciate objectively the evolution of all types of skills (cognitive, affective, attitude and kinaesthetical). The interdisciplinary extracurricular activities allow us to project the contents and the strategies of learning-evaluating so that we can have in view the diversity of the pupils' learning styles: concrete styles of perception, abstract styles of perception, active styles of processing the information, reflective styles of processing the information.

2. The relationship between motivation and creativity

The extracurricular project On-line E-LIT SCIENCE Summer School – Challenges within the European Areas, suggested by a team of teachers from "Vasile Lupu" High School, is articulated around two concepts: hands on approach and hands on science, which organise ideationally and practically the activities projected in an interdisciplinary manner. The project will be launched at a national and international level (within active partnerships with schools from Austria, Portugal and France), in June, and will actually take place on-line, for a period of three weeks, when there are going to be developed a series of activities, individually or in groups, on a diverse topic, of common interest for teenagers. The on-line summer school will end with an interdisciplinary projects contest – media applications, which will be evaluated by a jury made of professionals from different areas (science, literature, written, audio, video journalism, photographical art, film direction). All the projects realised during this on-line school will represent the final product, which will be distributed to the schools involved in this active partnership that we are going to initiate, as a model of good educational, extracurricular practice, emphasising the multiple possibilities of the ICT in motivating and developing the pupils' learning styles.

Mihai Mircescu, researcher within the Educational Science Institute in Bucharest, remarked that the acceleration of changes and the inevitable shock of the future, the impact between technology and the social or the natural environment, passing from the forced technology to the to high technology all required a new education and technological mentality. Thus, NTCI appears to be a new important part in the modern education.

The task of education and formation based on the new technology of information and communication is not to prove that it has immediate results in a contest with other types of educational systems, but to replace a part of the present structures with a new, probably superior spectrum of achievement, in order to meet with the inherent changes that happen in culture and civilisation[1].

The interdisciplinary project proposed by us, starts from the enrichment model used in gifted education (inspired by School Enrichment Model described by Joseph Renzulli), which considered the talent of each child is prior to his personal development.[2] According to this model, there are two factors that interact: the possibility of choosing a research area corresponding to his own abilities and passions and the possibility of a thorough searching of the areas, beyond imposing on chronological ages, of curriculum openings.

The programme is centred on learning styles and on the students' areas of interest, as well as on the consolidation of the already classical areas (science, language and communication) and on the opening of modern research areas (education within the NTCI, especially in the written, audio and video media). Being addressed to the development of new talents, the interdisciplinary project On-line E-LIT SCIENCE Summer School suggests real solutions through which we aim at the raise of the students' efforts, their achievement and the performing of a large spectrum of positive educational experience as a consequence of applying creative didactical strategies used especially with highly talented students. These strategies, as practice has already proved us, can also be adapted to heterogeneous groups of students from the perspective of their capacity to achieve a certain level of performance. In such interdisciplinary approaches, we identified the opportunities, resources and the motivations that can support the student to overpass his limits, by the self selection of the activities, of individual or collective projects where they are encouraged to explore the ideas they are interested in. As teachers, we came to the understanding that the best way to help the students reach a high creative potential is to do what they like, better said by T.M Amabile[3], to have the freedom to choose the activity that allows them to search for

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[1] Istrate, Olimpius, ***Education at Distance. Projecting Materials***, Ed Agata, 2000, p. 39

[2] ***Accelerating and Enriching the Curriculum. Developing Abilities and Talents: Instructive and Applicative Models*** - http://www.supradotati.ro/gifted-education/modul_c/index.htm

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 ISBN 978-989-95336-1-5

topics for which they feel an intense intrinsic motivation.

The psychologists who reserved important researches to the relationship between motivation and creativity (SE Golann, R Crutchfield, CR Rogers) identified componential model of creativity, which considered that there were three essential parts involved in producing the creative things: the intrinsic motivation, related to creativity, the capacities proper for this area and the process proper to creativity (the cognitive capacity and the learning styles which lead to the production of original things) . The intrinsic motivation is defined as the motivation to start an activity, first of all for its sake, because the student finds it interesting, brings him satisfaction and intensely satisfy him, is characterised by the focus on the stimulation and the enjoyment produced by work itself, as opposed to the extrinsic motivation which is characterised as the focus on the external reward, of external recognition and of the external orientation of work[4].

By planning to create and offer our students an environment favourable to the development of creativity, we applied a set of questions that consisted of a work preference inventory[5] of teenagers/students, having in view the free time activities. The analysis of the questionnaire applied to a number of 120 high school students revealed the fact that their preferences tended towards activities that stimulated them to express their opinions on the world, reality, rights, aspirations, feelings, by using NTCI.

3. The strategical aims of the on-line summer school

The on-line E-LIT SCIENCE summer school interdisciplinary project aims at the development of the abilities of learning of the students capable of performance, by extending the teaching-learning process, in the area of out-of-school activities, by using modern media methods. The learning contents are included in the large topic of non (electronic) school journalism, its general objectives being:

- The cultivation of a true technological humanism,
- The development of the creative capacities, of the availabilities towards innovation,
- The understanding of the report between technology-environment and the cultivation of a proper ecological behaviour
- The promotion of the European dimensions, of the education in the spirit of the European values and of the national and international partnerships,
- Knowing professional families, with a scientific, technological specific, for a future socio-professional option.

The cultivation of the technological humanism refers to the realisation of a balance between the training and the rational-technical and scientific formation of the students and to the release and cultivation of sensitivity through socio-humanist subjects[6]. This is the reason which determined us to conceive and group the activities within the summer school around two concepts hands on approach and hands on science.

These activities are realised by using the advantages of e-learning[7] /on-line courses: co operant learning, the rhythm of passing through the contents of learning – different to each student, the high flexibility of the used material and the possibility of permanent reactualization, the integration of a variety of research areas, the possibility to immediately access a multitude of resources available on the Internet, a high motivation and a more active involvement of the student in learning – an adequate attitude to the creative approach.

Figure 1. E-Lit Science website

Having projected and implemented a interdisciplinary course to the superior cycle of high school, we were able to analyse objectively and to the point the opportunities and the limits of e-learning instruments in the process of teaching-learning and evaluating certain contents

[4] *Ibidem*, p 231

[5] *Ibidem, p 233*

[6] Mircescu Mircea, ***A Basic Part in Modern Education – Technological Education***, Ed. Educational Science Institute, Bucharest, 2007

[7] Petre Botnariuc, ***E-Learning – Fantasy or Reality*** – Seminar organized by the Educational Science Institute, Bucharest, 2007

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which refer to several curriculum areas (Language and Communication and ICT), in order to achieve transdisciplinary skills: optimisation of oral and written communication by the use of new informational techniques.. The e-learning course, Techniques of writing (non)literary texts by means of ICT (http://roinfocds.blogspot.com) stimulates the pupils in a continuous and efficient learning process, promoting the development of important skills available for the entire life, of using new technologies in order to communicate, organizing skills and cooperation and interrelation skills.

The on-line summer school has the following strategical aims:

- The familiarisation of the student with the basic mass communication, with the techniques and the moral exigencies of the journalism, seen as a current and rational reflection, through the written and audio-visual press of the events,
- The thorough study of their knowledge in the field of communication/of written, audio, video media by using the advantage of the on-line journalism,
- The improvement of the degree of understanding the modern media characteristics and the mechanisms of public communication, by training, different possibilities of study, conferences, own publications and others.
- Creating a favourable intellectual climate, of support and cooperation, security and good fellowship, which should offer the students and the teachers involved in the project, professional satisfactions, in order to encourage the activity of research and creativity. The academic area allows the access to the major values of culture and through these, the opportunity to an intellectual construction, to a development of free thinking.

The E-LIT SCIENCE online summer school will be organised in Romanian and in English, on a private "prinsea"[8] site, using a Drupal platform which allows to fill in a file with multiple facilities. It is found at: http://jonline.prinsea.net/, and among the multiple facilities, the common users will be able to make use of:

1. Subscribing on this site http://jonline.prinsea.net/ by e-mail control,
2. Subscribing another user with the administrator's agreement,
3. Creating a content text:

- Adding images such as .jpg .bmp .gif by HTML learned structures
- Attaching documents such as .doc, .pdf, .ppt
- Adding films such as .mpeg., .avi
- Adding commentaries at the articles from the Forum or the interview
- Participating by vote to the surveys
- Viewing all the recent articles exposed in the Forum
- Viewing the profile of each user
- Accessing other general information regarding the organisation, aim, content and methods of reaching the targets, the proposed subjects for the study, results, comparisons, organisers, sponsors, and conclusions.

The administrator of the site will use more than the simple users, the following facilities:

- creating a Forum
- creating an on-line interview section
- creating a survey
- administrating the structure and the site content, of the rights and access of all the users no matter if they are subscribed or not
- solving the access conflicts, over content, trespassing the rules of netiquette

The access and subscription to these online courses are made with the agreement of the administrator, and then the user can change his name and password. Each user can show his articles on a subject given by the organisers in the Webforms section. Each user can also participate with comments, articles with answers or articles with a new subject o Webforms or in on-line journalism Forum.

The learning contents refer to the publicist style:

1. The media socio-cultural functions(the function of informing, interpreting, connection, culturalisation, entertainment),
2. the liberty of speech and the right to information. Rights and responsibilities of the journalists,

[8] We have to mention that the necessary space to host the website http://jonline.prinsea.net/ of the Normal School "Vasile Lupu" was put at our disposal through Mr. Gabriel Radic's amiability, en emigrated specialist to Paris, with high preoccupations in the field of Informatics, translated on http://www.timbru.com/jurnal/

 ISBN 978-989-95336-1-5

3. Methods and techniques of collecting the information,
4. fundamental techniques of writing a journalistic text
5. Journalistic genres(news, report, reportage, photo reports, portrait, interview, survey
6. Audio-visual:

   - Radio news, TV bulletin
   - Radio interview – art of communication
   - Radio reportage, TV reportage
   - TV interview

7. On-line journalism: means of collecting and spreading the information.

From the perspective of developing the abilities of using NTCI, the participants to the on-line courses will be offered consultancy related to the following aspects:

- Accessing the information under all forms, in different stages: searching, getting and downloading, processing with SOFT instruments (text, images, sound, film, graphics, and animation), producing the information using SOFT for the subordinates, sensors, mixing. The students will learn the rights and obligations regarding the production, processing, and broadcast and trading the information produced.
- Fitting the information to the different types of media products: audio, video, written.

The participants will be able to choose the form of presentation of the media product realised individually or min group as the end of a project they will realise during the summer school, until the announced dead line (written audio/video reportages, photo reports, surveys, interviews, and advertising spots of promoting school, native town, and short documentary films)

The projects can be included in one of the two sections:

A. Culture and civilisation. Customs and traditions
B. Specific ethos. Personalities of the science and culture within the native area.

4. Conclusions

The stages of implementation of this interdisciplinary project, as well as the results of the final evaluation will be presented at the Thematic workshop *Science literacy and life-long learning* Bucharest-Romania, in October 2007. All the projects realised during this on-line school will represent the final product, which will be distributed to the schools involved in this active partnership that we are going to initiate, as a model of good educational, extracurricular practice, emphasising the multiple possibilities of the ICT in motivating and developing the pupils' learning styles.

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Hands-on Mathematics
What Maths is on a Water Invoice?

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Abstract. We present a classroom practice based on the reflection and analysis of the family students' water invoice as part of a mathematics project on the statistics theme. This classroom practice can promote the development of diversified abilities that could be useful for the

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citizen life of our students and for the acquisition of the mathematics knowledge (statistics, functions and geometry). We ask our students to carry to the maths classroom their family water invoice. In classroom they analysed some of the data of the water invoice, in particular the relationships with some of them with water consumed. Another work consisted in infer and predict some results not present in water invoice. The tasks of this classroom practice were accomplished in group work. In this presentation we shall share the invoice exploration done by: i) the students of the Basics Education at the 7th class and their difficulties, ii) master students of a Mathematics Education Master of the Mathematics Department at Aveiro University.

Keywords. Mathematics, Classroom Practice, Abilities, Mathematics Education.

Experiments in Educational Robotics with 4th Grade Students

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Abstract. This text describes some experiments on Educational Robotics implemented in two classes from the 4th grade of the Agrupamento de Escolas Gonçalo Sampaio, in Póvoa de Lanhoso (north of Portugal).

The work involved two stages: in the first, the students learnt the basics of Robotics, in the tasks of constructing and programming of robots. A set of Lego Mindstorms robotics kits with the new NXT control unit were used .The Robolab programming software that allows iconic programming was used to program the robots.

Once these basic skills were acquired, a project was proposed to each of the classes that involved building and programming robots, in order to create a "show" that could be presented to the parents. In the first class, it was proposed to the students to implement a dramatization of the story of the "Little Red Riding Hood". The second class was involved in creating a fashion parade, also with robot dances.

In both cases, the projects started with the definition of the role that each robot would play. The robots were built to fulfill their jobs by defining the paths that each robot would need to follow, and then the students programmed this behavior in the Robolab software. This was the harder task for the students. It was time to get all things together and a number of tasks remained: painting the sceneries, designing the wardrobes of the robots and doing a final rehearsal.

The show was presented to the community at the end of the school year (in June). Several parents were involved in helping with scenery and the wardrobes. Most of the parents and numerous students and teachers from the school attended the show. For most this was the first contact with Robotics.

The teachers involved are unanimous in acknowledging the fact that important skills that are present in the national curricula were addressed, as well as transversal skills such as problem solving, logical reasoning, critical thinking, creativity, autonomy, cooperation, communication and group work.
All those involved in the project emphasize the enthusiasm and motivation of the students, and mainly their persistence in following a project until its completion. The students were visibly proud of the result of their work. It was one more proof that Educational Robotics is indeed a powerful tool in elementary school.

Keywords. Hands-on Science, Robotics.

Art and History: New Motivations for Students in Materials Engineering Learning Classes?

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Abstract. In the frame of the practical lecture "Integrated Laboratory V", scheduled for 3rd year of Materials Engineering - University of Minho (Portugal), among the proposed subjects, one dealt with original baroque ceramic tiles (XVIIIth century); From this starting archaeological pieces, lent by the Tibães Monastery, students

 ISBN 978-989-95336-1-5

should produce copies like the originals using, by one hand, mineral components, by other hand polymeric reagents. Also, a contribution of metals will be included in their lab's work.
For the supervision, this lecture included one teacher from each Materials area (Ceramics, Polymers, and Metals).

This work presented, a priori, several difficulties that should be overcome by the students and the teachers: First, this subject requires a necessary important bibliographic work, with an increased difficulty since these ancient items are not widely studied among the scientific community. Also, an integrated laboratory means the capability to handle and "integrate" polymers, metals and ceramic contributions. Finally, the matter included in this theme should be taught in the past semesters or during the same semester.

During three months, the students developed step-by-step the subject at the rhythm of two afternoons per week. In the present work, we present the evolution of the subject, the main difficulties encountered and the sources of motivation for these young students. Finally, we'll examine the final pieces produced by the students, i.e. the aim of the proposed subject.

Keywords. Hands-on Science, Materials, Art, History.

1. Introduction

A priori, Science and Art have been regarded as opposite sides in our educational world, whatever was the level of the student, and the country [1]. Also, the same statement could be announced about Science and History. While these fields were considered valuable and complementary for the ancient Greeks, at the moment, the dichotomy due to the successive selections during the scholar evolution leads to a complete ignorance of one or the other basic knowledge. Because these fundamentals of our culture are considered incompatible in the mind of common Portuguese people, let's try an experiment including Science, Art and History. Selecting only a narrow class of people, in the present case Materials Engineering students, let's see their evolution in the frame of one compulsory lecture, a practical work in laboratories. These students without warning then become pure study objects, real rats of laboratory for some weeks.

2. A new Course, new lectures for Materials Engineering students

Effectively, because of the Bologna agreement, several courses at University of Minho (Portugal) started their remodelling in order to follow the general line defined in this agreement. The new articulation of the lectures, and its content should obey some rules dictated by E. Manuca et al. [2] recently: "learning to know, learning to do, learning to live with the others and learning to exist". The transition was studied and proposed for several Engineering courses. Among these courses, Materials Engineering one becomes a new Master Integrated Engineering Course, i.e. the student could easily go into a 3rd University Cycle leading to Doctoral Studies [3].

The teaching progress of the students is evaluated semester by semester, so, for example, in the 6th semester (3rd Year of Materials Engineering), the new milestone included several teaching fields not only in the different materials areas (Ceramics, Metals and Polymers), but also in general formation (Electronics). The new lectures are the following:

- Materials and Ecological aspects
- Electronics and Instruments
- Ceramic Processing
- Composition and Modification of polymers
- Thermal Treatments
- Integrated Laboratories V

For each lecture, the scheduled timetable gives 140 hours of study per semester, where 45 hours (3h/week) will be contact hours, i.e. in the presence of a teacher.

The concept of Integrated Laboratories is relatively new in our University, since, till now, every fundamental science (Physics, Chemistry, Computer Science...) and many applied sciences have their own practical work. With the new Bologna rules, the students have a reduced contact with their teachers, so they should study mainly by themselves.

In the frame of the practical lecture "Integrated Laboratory V", the head teacher should integrate the various lectures of the same semester in an integrating subject, integrating also all the teachers of the same semester: The responsible for this lecture should manage lots of "integrations"!

Conscientiously, the difficulties for our young students, that didn't use to fix so wide subjects was foreseen, but the difficulties for the different teachers in the supervision were also predicted.

Among the proposed subjects, one dealt with original baroque ceramic tiles (XVIIIth century); From original archaeological pieces lent by the Tibães Monastery, the students should produce copies like the originals using, by one hand,

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mineral components, by other hand polymeric reagents. The contribution of the metals, not fixed a priori, should be proposed by the students, but we expected a basic degradation/oxidation of a metal in order to get a pigment for the glazed phase.

3. Articulation of the Lab's work

The practical work will be evaluated during a public evaluation every month approximately. So these three evaluation with be the milestones of their work.

The first step of their work, is to define the "learning to know", so they should plan their work during all the semester. Their plan is completely classical: Bibliography, Preparation of Ceramic Tiles by conventional way, and so application of polymers to substitute the glassy phase. Effectively these should be the correct steps...

Figure 1 *Azulejo* used as starting and reference material

Unexpectedly, the first difficulty occurs: there are very few publications dealing with the subject "*Azulejos*", (Figure 1) even in Portugal where they are used in so many monuments. In fact, since this is a very old technology, it remained several centuries in the field of semi art-craft, or in little workshops. There were identified in fact mainly three production sites of ceramic tiles in Portugal (Gaia, Coimbra and Lisbon), but these were concurrent, hiding then their processes and technologies [5]. The nowadays production is completely different from the ancient way, and their raw materials. The only published works deal with recent innovations in terms of colours, firing or abrasion resistance.

Then, they came back to more basic work, established a definition for the Portuguese *Azulejo*:

Structurally, the *azulejo* decorative tile is roughly composed by a clay tile covered with a white opaque enamel containing a high amount of tin oxide, where the decoration is then painted, using colours, whose pigments based on metal oxides will melt with the stainniferous enamel during the firing step. The common used colours included the typical blue derived from cobalt, green from copper, purple from manganese, yellow from antimony and lead, and reds and browns from iron.

The clay is an earthen material plastic when wet but non-plastic when dry. During firing, because of its thermal decomposition several reactions occur, giving a permanently hard compound. Clay types vary throughout the world, and even within a region, in terms of composition, crystallographic structure and impurities.

Since ceramic tiles with a first firing step were given to start the work, the students should focus their lab's work mainly in the glazed layer.

The earliest and most common method of clay tile decoration made use of tin-glazes which were essentially based on transparent lead glazes. The glazes were generally made with white lead, flint, or china clays ground up and mixed with finely ground metallic oxides that provided the color. The Clay glaze, used more recently because of the lead toxicity, consists predominantly of clay, with a low melting point, that vitrifies during firing. The glaze is the generic term describing the vitreous surface used to cover pottery. The glaze gives the product brilliance and ensures that it is watertight. Tiles were either dipped into the glaze or the glaze was brushed on the tile surface.

Figure 2. *Azulejo* produced by cold processing using polymer cross-linking

Because few quantitative data were available, they decided to perform directly the characterization of the ceramic tiles lend by the Tibães Monastery (Figure 1). They used for this the habitual processes (Electron Microscopy,

 ISBN 978-989-95336-1-5

Chemical analysis, X-Ray diffraction) that they heard about in theoretical aspects in lectures during other semesters: It's the beginning of integration! Also, they contact by themselves other teachers in the Physics department and they manage the spectroscopic analysis of the glasses and the colour analysis of the pigments used in the XVII and XVIII centuries. This is "learning to do and learning to live with the others". The dynamic of the students were so high that they contact pigment companies, local porcelain factories. Also they meet and discuss with investigators from the Textile Engineering department of the University of Minho; from these, they bring later some pigments used to induce colours in clothes...!

4. The results

Finally, using a mineral process, they prepared a glass composition in order to deposit over the terra-cotta piece and obtain the glazed layer. On the other hand, with the help of the teacher from Polymer Department, they prepared a complex mixture, based on polyester compositions. They included also some mineral pigments in order to give a color to the transparent polymer and they applied this over the raw brown ceramic tile, in an original cold process of application of glaze over *azulejos*. (Figure 2)

Also, in the frame of their metallurgical formation, the students studied the metallic Cobalt, they selected the adequate conditions (time/temperature) in order to manage and control the oxidation step, and finally they evaluated the proportion of the different amounts of Co^{2+} and Co^{3+} in their mixture since the complete oxidation of Cobalt is difficult.

Moreover, they perform some tests of corrosion of the polymeric layer in order to evaluate its stability in outdoor conditions, like are man y of our *azulejos* in monumental panels suffering weather cycling along centuries.

5. Conclusion

The last criterion "Learning to exist", concerning their autonomy in the study, is completely fulfilled since, like a team they establish objectives and manage them. Their successful work makes them confident and enthusiastic about this course and their capabilities in leading a project, i.e. leading their life.

The integration of various lectures, what seems so difficult at the beginning, was managed efficiently by the students' side and by the teachers' one. Our conviction is that this kind of practical lectures will only work with flexible and available teachers that want/can to accompany the students in this uncertain route.

Finally, to answer to the first question: "Art and History: New Motivations for Students in Materials Engineering Learning Classes?" One could say that Materials Engineering could be a motivation to study Art and History. At the beginning, the students were doubtful about their capabilities and their reduced knowledge, but in their last oral presentation their dynamics carried them to proposed new ideas, new processes and new strategies for the study of the archaeological pieces from the Tibães Monastery.

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4th International Conference on Hands-on Science
Development, Diversity and Inclusion in Science Education
 ISBN 978-989-95336-1-5

Interactive Courseware for Computer Science Teaching and Learning

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Abstract. The paper presents the results of the Slovenian national project focused on development of SCORM compliant courseware for computer science teaching and learning. The requirements were that the teaching material should have integrated multimedia and interactive elements. This was achieved by introduction of flash based animations and also with several java applets. Following the experience with some other didactic applets the effort was focused on reusability of such interactive elements in different didactic scenarios. According to the basic aims of the project the developed materials cover most of the different curricula of computer science teaching that are implemented in Slovenian schools. The developed courseware was tested on different learning platforms and checked by several 10 schoolteachers.

Keywords. SCORM, E-Learning, Interactive Examples.

1. Introduction

Slovenian Ministry of Education and Sport granted several projects focused in development of-learning courseware which could be independent and compliant with the most popular Learning management Systems which are planned to be used in Slovenian Schools. The use of SCORM standard [2] was an obvious choice and also one of the prerequisites of the se projects. This means that the learning content should be packaged in so called SCORM contents packages, a special form of zip files. Other preconditions were that the e-learning pages should be enriched with multimedia and interactive elements. The use of SCORM should also lead to the reusability of the developed materials.

The basic principle of SCORM is to implement SCORM compliant material on a server running LMS (Learning management System). The user (usually a learner) accesses this server as a client. However it should also be taken into account that only some schools are already using servers with learning management systems. In order to avoid restriction to such advanced learning environment it was decided that the developed learning material should be also runnable as usual hypertext.

One of the granted projects is focused in teaching and learning of Computer and information technology according to the official curricula in the secondary schools. The first phase of the project was dedicated to the analysis of these curricula and to the definition of particular topics that should be covered. In particular the subject of Informatics for general gymnasiums and the subjects of Computer technology and Computer networks for technical gymnasiums were treated.

2. SCORM fundamentals

SCORM, the Sharable Content Object Reference Model, is a technical specification that governs how online training (or "e-learning") is created and delivered to learners. It is a collection of standards and specifications for web-based e-learning. It defines communications between client side content and a host system called the run-time environment. The former is usually a function of a learning management system). SCORM also defines how learning content may be packaged into a transferable ZIP file.

Sharable Content Objects (known affectionately as SCOs) are small, reusable, building blocks of instruction. They are the interchangeable parts that people creating instruction can put together in different ways to create a lesson, a course, or even a curriculum. A SCO can be as small as an image, text, or audio used to support e-learning, a block of information such as a procedure or a concept, or a meaningful assembly of smaller objects like a lesson, a unit, or a course.

SCORM Navigation defines how learning and system initiated navigation events are triggered and processed, resulting in the identification of learning activity for delivery. Navigation is the process by which a learner and an LMS cooperate to identify navigation requests to realize a learning experience.

For a learner to access a course or any of its activities, it must issue a navigation request. The result of each navigation request is one of two things: an activity is delivered to the learner or the current activity is taken away. Only one activity can be experienced by the learner at a time.

How the LMS knows which activity to deliver in response to a navigation request is defined by the content package's activity tree and sequencing information. By default, a learner

 ISBN 978-989-95336-1-5

experiencing a content package will choose an activity from the tree to launch. Some typical navigation events are the following:

- **Start**: request to identify the first activity of a tree, generated automatically by the LMS when the learning begins his learning.
- **Resume:** request to resume a previously suspended attempt on an activity tree
- **Continue**: request to go to the "next" learning activity available in the tree
- **Previous**: request to return to the "previous" learning activity (in relation to the current activity) in the tree
- **Choose**: request to "jump" directly to a specific learning activity in the tree
- **Abandon**: request to immediately terminate the current activity

SCORM 2004 defines the sequencing information that describes how SCORM-conformant content may be sequenced to the learner through a set of learner or system-initiated navigation events. It provides the ability to prescribe the intended learning sequencing strategy.

SCORM is a standard still in development and currently many tools support its previous version, SCORM 1.2 and only some are compliant with the current SORM 2004 (also known as SCORM 1.3).

3. Structure of the courseware

One of the main questions was the granularity of the developed material and corresponding content packages. One possibility was to embed the entire subject in one single content package. This could simplify the importing of the SCORM package into a given learning management system. But it also means decrease of the flexibility and reusability of such courseware. Therefore a second alternative was chosen. According to this each particular topic was considered as a package. The disadvantage of this approach is that the administrator has to import many packages in order to publish on the server the whole subject.

This disadvantage was bypassed with the introduction of composite content packages. This means integration of several content packages, all belonging to a particular subject, into a single-more complex package. From the internal point of view we should know that each content package is represented by a single zip file which contains a so called manifest file (imsmanifest.xml). This file describes how the content package is to be used by a LMS. Such files become sub-manifests of a larger package.

4. Interactivity of examples

The basic didactic units are represented as hypertext pages which contain pictures, animations and also interactive examples, mostly represented by flash animations and some enriched with applets. Following the experience with well known physlets [3] the interactivity of applets was achieved by public functions which permit the integration of interactive commands in hypertext. Some attention was paid to reusability of such applets in different didactic scenarios.

One example of such generalized applets is shown in the Figure 1. It demonstrates the model of a simple computer. The algorithm can be written as a pseudo code or in a simplified assembly language.

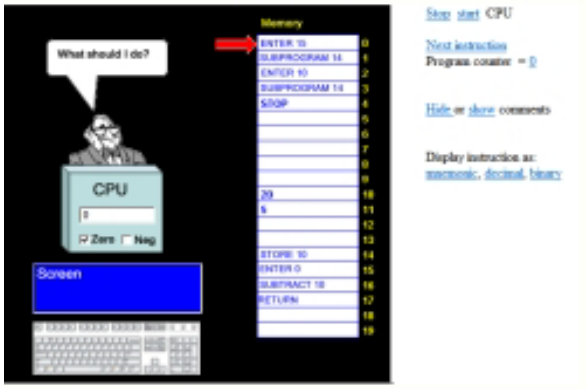

Figure 1: Interactive example of a simplified computer, controllable by JavaScript functions Other scriptable applets are used for illustration of history timeline, comparison of analogue and digital data, demonstration of basic digital circuits, etc

One basic problem of such interactive demonstrations is that it is sometimes difficult to find the idea what can be animated with such approach. This is in contrast to the experience in natural sciences, in particular in physics where the interactive simulations of natural phenomena are an obvious didactic alternative.

5. More problems

One basic problem encountered during development and adaptation of the already available materials was the incompatibility of tools with selected standards. Some authoring tools are still supporting SCORM1.2 or their declared conformance with recent version 2004 is only declarative. Sometimes the deficiencies can be discovered only on some internet

 ISBN 978-989-95336-1-5

discussion forums. Even using conformance test tools provided by the official associations the behaviour of the developed courseware is sometimes strange, unexpected. Therefore it was decided to use only the possibilities that represent a common denominator of used authoring tools and most popular learning management systems. Despite interesting possibilities of courseware sequencing defined in SCORM2004 it was decided not to use it and use only navigation possibilities.

6. Conclusions

During the project more than 800 hypertext pages were created or adapted. These pages were enriched with more than 1500 pictures and more than 200 flash or java animations or interactive elements. In development several problems were encountered. One was the lack of needed learning materials and most of them have to be rewritten. The second was that the official curricula have many discrepancies. The third problem vas the lack of experience with SCORM standard and encountered nonconformities of used tools with it.

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Mobile Technologies Integration into E-Learning Environment

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Abstract. The paper describes an approach to integration of mobile technologies in e-learning environment at the early stage of mobile networks and services development. Considered situation is very typical for East-European countries. Practical recommendations and example of system architecture are provided.

Keywords. E-Learning, Mobile Learning, System Integration, WML, WAP.

The mobile technologies may be effectively used for purposes of e-learning support even under conditions, when cost of mobile traffic is relatively high and most of audience does not have mobile phones powerful enough to deal with multimedia-based content. Some important tasks within e-learning environments may be performed by the use of basic mobile services like SMS and WAP. Here is proposed an approach to integration of mobile technologies into e-learning environments by development of automated system for conversion of the content in the WML format and providing SMS as an alternative for email-based instant messaging systems.

Recent years have demonstrated a rapid development of mobile communications worldwide. While not so many years ago mobile phone was an attribute of the high social status and its use was accessible basically to business and administrative top representatives, today mobile communication is available for almost all layers of the population, including schoolchildren and students. Now users of mobile communication have an opportunity to order air tickets, rent a car or make a hotel reservation just by use of their mobile phones.

Such fast-growing area of education as e-learning, should not stand aside of use of the last achievements in branch of mobile communications.

However, when thinking of mobile technologies use for the educational purposes, it is necessary to take into account that in some cases the cost of the mobile traffic is relatively high and that not all of potential users have corresponding resources. For example in developing countries mobile phones with wide multimedia support are inaccessible to a significant part of a potential audience till now.

Beside this in some regions the bandwidth of the wireless channels, provided to users by mobile communication operators, despite of the mobile traffic high cost is still insufficient for an effective use of multimedia-based services, such as an exchange by large MMS-messages or use of streaming video.

So it is easy to make a substantiated conclusion, that in the cases when it is essential to provide the maximal scope of a potential audience (for example in case of implementing the elements of mobile learning in the educational institution), the optimal approach is to use a combination of popular and accessible services, such as SMS and WAP [1].

A useful approach to introduction of mobile technologies in traditional web-based e-learning environments would be to provide certain mobile-based educational services, which at the initial

 ISBN 978-989-95336-1-5

stage would not be vitally important components of the e-learning environment and would play a role of auxiliary features.

However, such services should be interesting for a significant part of the students and should have sufficient functionality in order to become a base for the process of gradual integration of traditional (PC) and mobile technologies within e-learning environments [2].

Here are listed main requirements for such services:

- low cost of usage,
- requirements to a client hardware and software (mobile phones) should be acceptable for the most of potential audience,
- simplicity in use - special knowledge in the field of mobile communication and wireless networks should not be required from the potential user,
- Web-based equivalents of offered mobile services should be provided for cases when user by some reasons has no desire or an opportunity to use the mobile service,
- Help and support resources should be available for the users of offered mobile services.

The correspondence to the given requirements allow to involve as wide as possible audience in use of new mobile services and will encourage the users to compare the offered mobile services and their Web-based equivalents. Such comparison is especially useful for the purposes of the diagnosing bugs.

Consideration of users' demands and wishes also will form a good base for the further modifying and improvement of the offered services. Among services, which are perspective at the first stage of introduction of mobile technologies for e-learning environments should be considered a creation of WML-versions of the Web pages, containing learning schedule and other Web-resources, not large in size and containing regularly updated information - for example "news" and "announcement" sections of Web-based e-learning environments.

Another perspective mobile service may be implemented as an instant messaging system for the students. They may stay informed about news, educational events, etc. via such system. Systems of this kind in e-learning environments are traditionally built on the basis of mailing lists. Their mobile equivalents may be successfully built on the use of SMS service.

Let's consider a system constructed by integration of two services, described above and their Web-based equivalents. Such system generates and sends instant messages to the users each time its content is being modified. At the same time it provides access to the content via both HTML and WML interfaces.

The main components of the system are:

- Administrative interface module allows to update a content of a resource and to initiate sending of instant messages to the users signed on this service,
- User interface module provides an automatic generation of various content representations, it allows to represent a content in different formats, in this case in the HTML and WML format,
- Instant messaging module provides users with instant messages in the form of SMS and (or) email each time the content is being modified.

The considered system in this case performs the single direction communication, the information goes from system to the user - one is informed about the content modification. The user also has an opportunity to check up modifications both via PC through the Internet and via mobile phone through a mobile network.

A system built on the base of proposed architecture has been implemented and tested with the group of 12 master course students, who used simple models of WAP-enabled mobile phones, under conditions, when cost of the mobile traffic was relatively high while bandwidth of the GSM(GPRS) network connection was insufficient for use of multimedia-rich content.

The described approach and proposed system architecture allow integrating of mobile technologies into e-learning environments and can serve as a starting point for introduction of mobile technologies in educational process. The further development of the described system assumes implementation of the two-directional communications when the student not only accepts the information, but also performs a feedback by sending SMS or interacting with interactive components of WML-resources.

In future, when implementation of multimedia-rich content support will became more useful, it will allow minimizing and then moving to eliminating the divide between traditional Web-based technologies and mobile ones in learning.

 ISBN 978-989-95336-1-5

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Mathematical Games in Today's Intercultural Generation

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Abstract. Games have had an important role in education since olden generations, particularly in the teaching of Mathematics.

Apart from this role games still have the quality of fostering intergenerational relations, in an intercultural sense, since they can be handled by parents, children and grandchildren of the same culture or from different cultures.

My communication aims to highlight the enormous importance of didactic games on the learning-teaching vector of mathematics at First Cycle level (5/6 to 9/10 years old). Its importance can be centred on facilitating the development of, amongst others, skills of greater understanding of some concepts, the development of internalizing group work rules and those within the psychomotor area. The use of games in Math classes is certainly a strategy that promotes and motivates the taste for discipline, happiness and personal fulfilment of the student through success in its achievement.

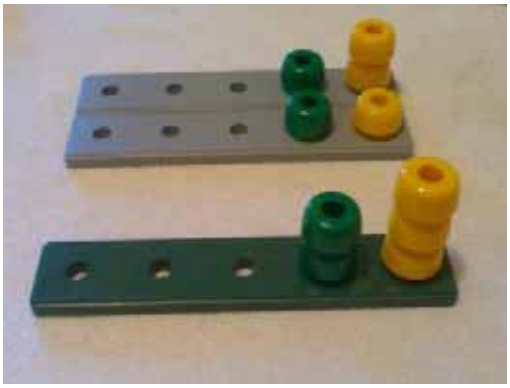
Keywords. Mathematics, Game, Intercultural

1. Introduction

In face of ludic situations the child learns not only the logic structure of play but also the mathematical structure present in the game.

Vygostky claimed that through toys children learn to act in a cognitive sphere, being free to determine their own actions. According to him toys stimulate curiosity and self-confidence enabling the development of language, thought, concentration and attention.

I'll present real life situations experienced by students from different First Cycle grades in a few lessons during my training period at Escola Superior João de Deus.



2. Conclusion

One of the reasons for introducing games in math classes is the possibility of diminishing the blocking out which is present in many of our students that fear Mathematics and feel unable

 ISBN 978-989-95336-1-5

to learn it. Within the game situation where a passive attitude is possible and motivation is high we notice that, at the same time as these students "speak" Mathematics, they also present better performance and more positive attitudes towards their learning processes.

Failure and lack of motivation in Mathematics are situations that have been researched by many generations through the invention of didactic-pedagogic strategies. Fröebel (1782-1852), for example, who was the first to emphasize toys, play activity and to grasp the significance of family in human relations, developed the theory of Gifts as he thought that through them children could not only understand the elemental forms of reality but also manifest their creativity. Gifts are seen in Maths as a facilitating tool for the internalizing of the basic numeric operations notion and the development of the ability to abstract in problem situations.

João Nabais (1968) felt the need to create Calculadores Multibásicos (Multibase Calculators) to facilitate the learning of numeric operations. With this game, children travel through a world of colours where each one has its code. By handling this game children from very early ages mentally record operations without registering the respective algorithm on paper. I have testified with my experience that a child that has worked with multibase calculators from the age of 3/4, when starting the 10th grade of the 1st Cycle, has great ease in completing the different operation's algorithm and the notion of inverse operation and easily comprehends orders and classes of the decimal number system. Another major advantage is children realizing and correcting their own mistakes.

I myself, when realizing the great difficulty in internalizing the concept of rational number at this age level, created the "Jogo das Fracções" (Game of Fractions). By handling this game a child easily grasps not only the concept of rational number by understanding what the numerator and denominator of a fraction represent but also identifies and completes the operations. Another great advantage of this game is greater dexterity of reasoning in face of a problem situation with rational numbers (as we visualize with the last child).

As Chateau (1987) used to say, "A child who can't play will be an adult that can't think".

In Honour to Leonhard Euler

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Abstract. This year the scientific community commemorates the tercentennial of the birth of the Swiss-born Scientist Leonhard Euler.

The foundation of The *Euler Society* and the website *The Leonhard Euler Tercentennial* are just two great examples of the importance given to his work, namely to reinvigorate the teaching, learning, and wider understanding of mathematics, and for efforts to plumb deeper interconnections among mathematics, physics, mechanics, astronomy and technology.

Leonhard Euler was born in Basel on 15 April 1707. His father was Paul Euler and his mother Marguerite Brucker.

Paul Euler, pastor of the village of Riehen near Basel, was his first teacher and prepared him towards theological studies.

However he became a student of Mathematics. Euler's first mentor in mathematics was Jacob Bernoulli. Later, when he was sent to the University of Basel, he became a Johann Bernoulli student. Assiduous in his studies and having a pleasant character he was able to become friends with Daniel and Nicolas Bernoulli, disciples and already rivals of their father.

At the age of 20 Euler wrote *Dissertatio* as part of his application to the Physics chair of the University of Basel. Euler did not get the job and instead left for a position at the Saint Petersburg Academy, where he spent most of his working life.

Euler's contributions to Mathematics and Physics were very extensive and remarkable. In fact it was not possible yet to have all his work compiled.

Being one of the main founders of mathematical analysis, he has also definitely contributed to its formalism. He introduced the concept of function and was the first to use the notation *f(x)* to denoted the function f applied to the argument *x*.

The letter *e*, for the bases of natural logarithm (Euler's number), the greek letter Σ for summations and the letter *i* to denote imaginary unit, were introduced and popularized by him. In what concerns to π, to denote the ratio of a circle's circumference to its diameter, it was not

 ISBN 978-989-95336-1-5

introduced by Euler but he popularized this greek letter.

In this short presentation we want to make a small tribute to a great mind in Mathematics and Physics, one of the top mathematicians of all time.

Keywords. Mathematics, History.

Developing the Spirit of Innovation through Hands on Science: An Indian Perspective

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Abstract. India being an ancient culture possesses a great deal of traditional scientific and technological heritage and wisdom that still form an integral part of our grass root innovation system based on the day-to-day needs of the people and an inherent thirst to problem solving using low cost or no cost hands on experiments which one can easily witness while walking through even a remote village. Age-old innovations, which came in place, are modified from time to time depending upon the current problems and requirements. An interesting illustration is noteworthy here. A group of young participants of an environment activity workshop was exposed to a simple problem: How to save matchsticks of a matchbox to eventually save trees without replacing the matchbox? It triggered a very interesting interaction and encouraged children to think something new leading to creative thinking to solve the given problem. This exercise continued for only 20 minutes and resulted into an exciting innovation by the children themselves. A child suggested putting the ignition material on the other end of a matchstick, as it'll allow a matchstick to be utilized at least twice thereby saving half of the wood being used in matchsticks making. Another child suggested putting a ring of fire-retardant material at the middle of matchstick to restrict the flame to reach other end. This simple exercise speaks in volumes and clearly indicates the potential of innovative hands on science experiments to creating an excitement of science amongst young minds and thereby attracting them towards the mainstream of scientific research and development. The present paper discusses various in-depth factors, issues and stimuli that were responsible to kindle and trigger a grass root innovative idea laying the foundations of today's high-end science and technology with suitable examples. The paper also tries to find out problems those impede innovative practices and explore ways and means to further strengthen the grass root innovation system to enhance the pace of developing the spirit of innovation especially amongst children and young students.

Keywords. Innovation, Scientific Temper, Technological Temper, Hands-on Science, Group Discussion, Problem Solving.

1. Introduction

Generally it is believed that necessity is the mother of invention. At the same time it may also be understood that there are many other factors which are responsible for a successful innovation, i.e.: i) how quickly one is able to identify the necessity or a problem, ii) how he or she develops an urge to find ways and means to solve that particular problem, iii)how one is equipped, in terms of skill and technology, iv) how he moves on to solve the problem and v) how he involves people through group discussion for further refinement of the solution of the problem reaching to a socially acceptable innovation!

Incidentally, India's traditional innovation system demonstrates a great deal of people's collective wisdom and potential. The age-old potter's wheel is being traditionally used for making mud pots. The shape, design and usages were remained almost same for the centuries. This traditional technology is still continuing to offer livelihood to millions of potters in India. Rotation of the wheel on its routine axis causes lot of friction taking more time for making a pot. Moreover, its uneven rotation affects the shape of the pot and the potter has to be extra careful. Recently, a grass root innovator, with his keen observation and ability problem solving, has introduced a simple modification in a potter's wheel, a ball bearing. This simple attachment has turned up as a remarkable breakthrough in the traditional pottery industry. It has not only enhanced the efficiency and quality but also liberated the potters form irksome process of uneven rotation of wheel. Now, at some places, the hands operated potter's wheels have been upgraded to power operated. Therefore, understanding the problem, keen and minute observation, questioning and finding answers to them are some of the basic attributes essential for innovativeness.

 ISBN 978-989-95336-1-5

2. Scope for Innovative Ideas: NCSTC's Perspective

Since its inception, the NCSTC has encouraged, adapted and enriched new experiments, innovations, new ideas and schemes in the field of S&T communication and popularization. Nowadays, several ways and means are being used for S&T communication and popularization, affecting the life style of common man directly or indirectly. The main aim of such programs and activities is to disseminate scientific and technical knowledge, and to inculcate and foster development of scientific temper and understanding among them using all possible media.

It is not so that all the ways, techniques, means and media have been tried out. As a matter of fact, we have touched only a few facets of this diversified area of communication techniques for science communication and there is an ocean to be discovered, adopted and tested. The scope for new ideas and innovations in the field of S&T communication is as much as that in fundamental research in S&T. All that is needed is to explore, discover, adapt such innovative ideas and put them in to practice.

In 1987, Bharat Jan Vigyan Jatha came up with a new and novel concept and it is realized that where our print, electronic and other media have limitations to reach, Vigyan Jatha using folk media could reach. Its impact was enormous and format was proved to have infinite potential. So all of us, who are closely associated with science communication, should take the responsibility of exploring newer vistas and make new frontiers for science communication.

Who knows, when a bright innovative idea flashes in whose mind! So let us tune and condition our minds for the purpose. Generally, new ideas come either on requirement, as we say "necessity is the mother of invention" or something may click all of a sudden. Both of these types of ideas have their own importance.

The NCSTC/ DST had started encouraging young minds towards innovations in much more vigorous manner in the form an international program 'Steer the Big Idea' in 2005 in association with Confederation of Indian Industry (CII). Some 10 young innovators were selected from across the country based on their innovative ideas and were supported for developing the idea into prototype. They were also taken to an International Innovation Fair held in Japan organized by Japan Institute of Invention and Innovation. It was an exciting program for the children. Now the program has been given new shape under the name 'Initiative for Research & Innovation in Science (IRIS)' incorporating two programs with common mission of promoting the spirit of innovation and science. The merger of Intel Science Talent Discovery Fair and Steer the Big Idea has given birth to IRIS that offers a variety of innovative activities for Indian children as well as their exposure to international innovation scenario.

3. S&T Temper and Method of Science

Merely acquiring scientific knowledge does not imply to have scientific temper. A scientifically qualified person may lack scientific temper, while as a contrast, even one who has not been a science student can manifest scientific temper. Scientific temper reflects one's logical, rational and analytical thinking, systematic and orderly way of his performance in all spheres of life, his reasonable behaviour and conduct in the society and of course a rational and informed and logical decision making power. The scientific temper and method of science portray one's overall personality, which is clearly visible through actions. Spirit of innovation in one way or the other can be seen as a conglomerate of all these attributes at one place.

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 to achieve excellence.

It may be possible to make it more vivid by citing an interesting example. One may come across an electronic engineer not capable of undertaking even a small repair work of his own transistor set. On the other hand, one can find persons, who have not undergone the regular training, but have acquired the knowledge and skill only with the application of technological temper, who can do the needful.

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. This is recognition of his technological temper. 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.

You may find a hand pump, which is not working or municipality's tap with leakage of water. Similarly, one can find a telephone, with no dial tone. This situation needs to be corrected. Here the role of State may be important, but above all, it is our attitude, the technological temperament, which the author is

 ISBN 978-989-95336-1-5

talking about. If we are able to develop a technological temper among masses, it can automatically lead to enhancing the level of innovativeness in the society.

4. Technology Day

Eleventh May 1998 was a very special day for Indian technology. We had three important 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 was, the three successful nuclear tests, known as Pokharan-II. In view of the series of our technological successes, the then Prime Minister had 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 technological innovation, technology communication and inculcation of a technological temper, we have so far celebrated technology day each year. Every year a focal theme is selected and children are exposed to a number of hands on activities that allows them trigger an interest in science and technology in general and in innovation in particular.

5. 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 kinds of technologies or technological ideas emerge 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. Similarly, specific area can be identified, where a certain kind of invention is needed to solve a specific problem, such issue or problem can be brought to the technologists/ engineers/ scientists, etc., enabling them to develop suitable invention/ innovation.

It has been a general observation that in the age group of 15-25, the creativity of children and youth 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 size city/ town in India, who are interested in creative endeavours and putting things together in novel ways. A mechanism can be worked out to harness the potential of such individual innovators. It has also been seen that such persons are not necessarily interested in textbooks or curriculum, but they posses a proven ability of doing technical things.

Obviously, sometime they cannot secure good marks in their examination, but at the same time, their technological endeavours can prove 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., and are able to try their head and hands.

Another vivid example is noteworthy here: A farmer Mr. Sunda Ram Verma of Rajasthan state has developed an eco-friendly technique for keeping termite away from his farmland. A fine morning he noticed that the Eucalyptus wood has a peculiar characteristic. The Eucalyptus wood attracts the termite from all around. He placed a number of Eucalyptus twigs around a termite manifested field and surprisingly found next day that all the termites were vanished from the field, as they found their was to reach the Eucalyptus twigs. Then Mr. Verma removed the twigs and burnet them along with termites. Thus a simple observation and experimentation was resulted into an economic and eco-friendly innovation. Incidentally, chemical treatment of termites costs not only money but also risks human health.

6. India's Innovation System

The Department of Science and Technology, Govt. of India has established the National Innovation Foundation (NIF) of India in February 2000, with the main goal of providing institutional support in scouting, spawning, sustaining and scaling up grassroots green innovations and helping their transition to self supporting activities. To help India become an inventive and creative society and a global leader in sustainable technologies without social and economic handicaps affecting evolution and diffusion of green grassroots innovations is the mission of NIF. Its objectives, amongst others, included : evolving strategies and conducting, coordinating and supporting research, design and development efforts in the country on grassroots innovations so as to attain and maintain technological competence and enhance self reliance, building linkages between excellence in formal scientific systems and

 ISBN 978-989-95336-1-5

informal knowledge systems and creating a Knowledge Network to link various stakeholders through applications of information technologies and also otherwise, and promoting wider social awareness, and possible commercial and non commercial applications of know-how generated as a result of above and encouraging their incorporation in educational curriculum, policies and programs.

The Ministry of Science & Technology, Govt. of India has launched a novel program known as "Technopreneur Promotion Programme (TePP)" jointly operated by Department of Scientific & Industrial Research (DSIR), Technology Information Forecasting and Assessment Council (TIFAC) and Department of Science & Technology (DST) to tap the vast innovative potential of the citizens of India. TePP offers a crucible to promote individual innovators to become technology-based entrepreneurs (Technopreneurs). Indian citizen having original idea/ invention/ know-how can apply. Proposals from individual innovators to convert original idea/ invention/ know-how into working prototype/ processes are invited and considered for support. That apart, Indian Institute of Technology has its own outfit in the name of Foundation for Innovation & Technology Transfer. National Research Development Corporation, Council of Scientific & Industrial Research also support, promote and recognize innovation.

7. Conclusion

Technological innovations are visible in various farms, rural and 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 in their names for their invention. As a contrast, some people seek patent rights, though their innovations may not be patentable. Therefore, 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 into the society. In the light of new IPR regime spearheaded by WTO, this may form a major component of technology innovation programme.

Since the process of technology innovation and inculcation of a technological temper stimulate the new product development, the people must be made aware about intellectual property rights to protect their innovations and developments. Innovations are increasingly seen as a means of economic growth and are instrumental in facing competition poised by globalisation. A strong trend of internationalisation of innovations can be observed the world over and its growing role in global economy. This trend is reflected in the increasing number of offshore research and development centers especially those located within emerging economies like China and India. Any society cannot flourish in today's rapidly changing world without a strong and sustained innovation system and the creative hands on science experiments have a crucial role to play in this direction.

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E-Learning Implications Regarding the Hierarchic Intelligence: Practical, Analytical and Creative

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Abstract. Our communication wants to systemise a series of considerations related to the e-learning implications in high school teaching, from the point of view of a recent teaching theory: the hierarchic theory of intelligence (analytical, creative and practical).

Having projected and implemented a interdisciplinary course to the superior cycle of high school, we were able to analyse objectively and to the point the opportunities and the limits of e-learning instruments in the process of teaching-learning and evaluating certain contents which refer to several curriculum areas (Language and Communication and ICT), in order to achieve interdisciplinary skills: optimisation of oral and written communication by the use of new informational techniques. The e-learning course *Techniques of writing (non)literary texts by means of ICT* stimulates the pupils in a continuous and efficient learning process, promoting the development of important skills available for the entire life, of using new technologies in order to communicate, organizing skills and cooperation and interrelation skills.

The course was projected due to the necessity to diversify the learning experiences of our pupils, who need to be encouraged to express their different styles and strategies of learning. We also tried, through this approach projected in an interdisciplinary manner, to correlate the contents and the learning activities with the actual challenges of every day life. We started from the premises that an interdisciplinary course would lead to rich and varied learning experiences, which should increase and stimulate our pupils' intelligence, some of whom proved to be young people capable of high performance.

Keywords. E-Learning, Styles and Strategies of Learning.

A View of Teresa Ambrósio's Work and Life (1936-2007)

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Abstract. This article explores the life and work of Teresa Ambrósio, a contemporary Portuguese leading woman scientist in the field of educational science. Following a sociological perspective, an overview of her personal, academic, political and scientific life is presented, trying to insert her main functions and achievements in a wider context of the history of the country and the specific society where she lived. The article seeks to illustrate how her personality, political and social environment, as well as both challenges and supportive colleagues, friends and family shaped the citizen, the politician and the scientist woman who left an outstanding legacy for the Portuguese educational thinking. The paper also aims to provoke a critical reflection on how Teresa Ambrósio, a mother of four, overcame traditional barriers women scientist face. It will also be shown how the interaction with other scientists and personalities she met have contributed to "interlace" a life that she described as a track, zigzagged pathways built up for, by, with the others.

Keywords. Woman Scientist, Educational Science, Political Change, Social Change, Knowledge Sharing.

1. Introduction

Teresa Ambrósio was a contemporary Portuguese leading woman scientist in the field of educational science. In this article, following a sociological perspective, an overview of her personal, academic, political and scientific life is presented, trying to insert her main functions and achievements in a wider context of the history of the country and the specific society where she lived. The article seeks to illustrate how her personality, political and social environment, as well as both challenges and supportive colleagues, friends and family shaped the citizen, the politician and the woman scientist who left an

 ISBN 978-989-95336-1-5

outstanding legacy for the Portuguese educational thinking. Thus, selected periods in Ambrósio's life and work are placed in a broader cultural-historical context.

One of the aims of this paper is to provoke a critical reflection on how a mother of four overcame traditional barriers women scientist face, at a time when female percentage at universities, both academics and students, was much lower than it is nowadays. It will also be shown how the interaction with other scientists and personalities she met have contributed to "interlace" a life that she described as a track, zigzagged pathways built up for, by, with the others.

2. Her personality

Teresa Ambrósio was a passionate woman who would stand up for her ideology, her values and her beliefs. Those who knew her intimately describe her as sad and passionate at a time – *If I were musical, I would chose Wagner, quite dramatic, touching at times some pieces of Mozart*, she would write in 2003 (FACES DE EVA). Her sadness encompassed her physical fragility, two traits that she did not show unless in her intimacy. *Melancholic (...) but happy*, despite *the anguish of doing everything, of being everything, of finding myself*, deep inside, her objective was *the recognition of the difference of being a woman in full, singular, hence free and responsible, loved and lovable.*

She possessed an accurate awareness both of her own limits and of her capabilities, in the sense that she sometimes felt unable to change mentalities and behaviours that did not meet her ideals. Notwithstanding that, her passion, her moral courage and intense desire drove her to a hunger of justice and to the fulfilment of the causes she believed in, no matter how difficult the obstacles she had to face might be. Barriers or closed doors challenged her to surpass and open them, and this trace of her personality has sometimes brought her sorrow and nuisance.

In fact, obstacles were challenges for her and she would constantly open new ways to apply scientific rigor to the social phenomena. Exceptionally cultivated, detached from material belongings, she was an example of an independent woman, who valued critical discussion and struggled for her ideals. As a woman of vision and intuition, she was able to seized up the way changing would occur, a perception that her systemic view of the world helped her capture the complexity of social phenomena.

Other than shaping her religious and moral development, and ruling her teaching practice by a most pronounced ethical and social implication, her personal characteristics made her an outstanding citizen woman who participated and influenced the Portuguese society not only in science, but also at the political and institutional level. Her influence on the Portuguese educational thought was remarkable, as well as her epistemological approach to research in educational science.

In the latest years of her life – maturity, as she would say – she also felt *the need of silence and time, for myself and by myself*, although she also felt a need of others – *those who are close and those who are far away but who are part of this globalise world that I embrace*.

I believe that not only her family, colleagues, students and friends who felt affection for her but also those who sometimes opposed her ideas will always remain impressed by the courage and dignity she lived both her life and her death.

3. Her life

Maria Teresa Vieira Bastos Ramos Ambrósio was born in Vila Nova de Ourém, a small town in the centre of Portugal, in a rural medium class family of five children (one boy and four girls), all of them having followed a career. Her father, who had been educated by the Jesuits, in Santo Tirso, ran a small business. Straightforward and with high moral standards, he was endowed with a good character. Teresa was the apple of his eyes, he always laid all his hopes on her. They were very attached to each other. Her relationship to her mother, a rather strict woman, was not so close. As a matter of fact, they had never got on really well.

Very young, Teresa was sent to a private school where she completed her secondary studies. After that, she went to Lisbon to study Chemical Engineering at Instituto Superior Técnico (IST). Later she decided to change the IST for the Faculty of Sciences, where she graduated in Physics and Chemistry. At the Instituto Superior Técnico she met an exceptionally cultivated woman who would have a deep influence on her political thought – Maria de Lourdes Pintasilgo – an example of an independent, struggling woman, capable of developing discussions to find an ideal.

4. Political intervention as a university student

At the time Teresa Ambrósio was a university student, Portugal endured Salazar's dictatorship. Teresa joined JUC – the Catholic University Youth – one of the several movements who

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conspired against the political system in force. As a matter of fact, besides the communist, socialist and other political ideologies, also in the catholic milieu a movement was growing which would later be known as the "progressive Catholicism", politically engaged in the struggle for social justice and human freedom, and later for peace in the Portuguese colonies in Africa (Rosas, 1994).Already in 1946, the Catholic journal *Trabalhador* (the Worker), whose director was a priest, had been locked up by Salazar's political police for its "Marxist style" and for "damaging the nation's soul" (idem). Also the first Congress of Catholic Men, in 1950, and the second Congress of the Catholic Youth Workers, in 1955, as well as the "Week for Rural Portuguese Studies", in Fátima, where Oporto bishop denunciated the "undeserved misery of the rural world", were a demonstration of the growing awareness, by the Catholics, of the regime's inequities. As for the Catholic University Youth, having started their ideological separation from the regime since their first Congress, in 1953, they undertook, by the end of the year 1956 and beginning of 1957, an active intervention on the students' fight against a recent law which strongly diminished the autonomy of academic associations. Later, in July 1958, D. António Ferreira Gomes, the Oporto's bishop, would send Salazar a letter where he sharply criticized the authoritarian political regime, social injustices and the absence of freedom. Since then, although the Catholic hierarchy remained, in general, aligned with Salazar's policy, Christian "communities of base" started to develop attitudes of intervention and resistance (Rosas, 1994). Teresa Ambrósio, a member of JUC, was one of those activists, along with Maria de Lourdes Pintasilgo, Rogério Martins, Adérito Sedas Nunes, Xavier Pintado and Vítor Constâncio, among others.

5. Professional life and first studies in France

Teresa Ambrósio's professional life encompassed her political intervention. After her graduation, she started working in the public planning sector, between 1966 and 1969. In 1965, a Cabinet of Studies and Planning of Educational Action had been created, in the Ministry of Education, which would later be designated by Cabinet of Studies and Planning (GEP), directed by Fraústo da Silva. In 1970, Fraústo da Silva invited Teresa Ambrósio to work in that Cabinet as the head of the planning sector for the schooling network developed during the educational reform of Veiga Simão, the new Ministry of Education. There, the first projects derived from educational research were systematically held in Portugal. Also in the scope of this Cabinet, several educational studies and research works were developed, namely in cooperation with OECD – Organisation for Economic Co-operation and Development. Teresa Ambrósio frequently attended OCDE meetings in Paris, where her voice started to be listened to and her opinions taken into account.

Later Fraústo da Silva, who would become the rector of the New University of Lisbon, invited Teresa Ambrósio to collaborate in the launching of this university, where she would become an academic after her doctorate in Tours, France.

Meanwhile, she had got married and had four children. Her desire to meet new scientific thought made her inscribe in a Master Degree in Sociology of Development at the University of Grenoble, in France. This demanded a great deal of effort and willingness: her children were still very young and it was difficult to afford Teresa's studies abroad, especially because she often had to travel to and stay in France. It was no easy task for a Portuguese woman in the 1960s. Fortunately, Teresa Ambrósio could count on family – her two sons and two daughters used to stay with her husband and her parents in law, when she was absent.

As far as the political context of the country is concerned, Salazar had been replaced, in 1968, by Marcelo Caetano, who showed some "openness" compared to the strict authoritarian Salazar's regime. Even so, mainly since 1970, the regime was widely contested, both by all the intellectual and proletarian leftwing and by the progressive Catholics, who were against the war in the colonies, and whose opinions were expressed, for example, in the «vigil for peace», in a Lisbon chapel, between 30th December 1973 and 1st January 1974: an occupation of the temple with a hunger strike by part of the presents and several speeches against the war in the colonies. All this contestation had a difficult economical background – inflation growing higher and higher – and a degradation of the social climate.

On April 25th 1974, José Veiga Simão was the Portuguese Minister of Education. By the organic law of his Ministry, a global reform of the structures and services of the Ministry of Education, especially of its central administration had been undertaken. Veiga Simão took on the principle of *educational democratisation* in order to "educate men and women in freedom and responsibility for Common wellbeing". Besides the creation of new schools at all educational levels, between 1970 and 1974, new teacher training methods, new educational curricula, new courses and new teaching methodologies were implemented. There was also a huge increase of

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the secondary education and a diversification and expansion of higher education. Under his reform, in August 1973, the New University of Lisbon, Aveiro and Minho Universities and Évora University Institute were created, as well as Polytechnic Institutes in Coimbra, Lisbon, Oporto and Santarém. In April 1974, the New University of Lisbon, where Teresa Ambrósio worked, was in full regime of installation, having Fraústo da Silva as the rector. A change in Teresa's personal life had occurred in the meantime – she divorced when her four children were still very young.

6. The 25th of April – the door wide open

The Portuguese revolution of the 25th April 1974 gave Teresa Ambrósio the opportunity to actively participate in the political and social change of the country. She became a militant of the Socialist Party and was one of the few women to be a member of the constituent assembly. She was a Deputy for the Socialist Party between 1975 and 1983, and was the president of the Parliament Commission for the Female Condition, besides, she was the vice-president of the Socialist Party Parliament Group and of the Parliament Commission for Education.

Founded in 1973 in Bad Munstereifel, the main constituents of the Portuguese Socialist Party were Marxists dissidents from the Portuguese Communist Party, followed by a second core part of historical republicans almost all of them linked to the Freemasonry, and a third group constituted by the Catholics from the 1960s coming from the JUC (University Catholic Youth) and JOC (Labourer Catholic Youth), linked to the Catholic Church social doctrine. In the Socialist Party, Teresa Ambrósio worked with and was influenced by Francisco Salgado Zenha, who would also work with her in the IED (Institute for Studies and Development that she had created.). Again she would work close to Maria de Lourdes Pintasilgo, an outstanding woman also in the socialist party namely in issues related to education and female condition.

As Reis (1994) remarks, significant changes were occurring in the structural composition of the Portuguese society, which contributed to the institutional disruption in 1974. With democracy new movements emerged and those previously sketched were reinforced. One of the most important is the changing in the women's social status – female professionalism, changing in marital relationships and a remarkable break of birth-rate. Another dynamics in the Portuguese society is the women's search for personal independency and professional achievement. Maria Teresa Ambrósio's personality and willingness to deepen her knowledge and to struggle for personal and professional achievement in a society which, in many aspects, was still a men's world, decided to continue her studies, this time at Tours University where, in 1986, she concluded her PhD in Educational Science, brilliantly passing a *Doctorat d'Etat*. At that time she was working at the New University of Lisbon and had met her second husband, the architect Martins Barata, who would be her companion for the rest of her life.

Evolution in the Portuguese society made women become more and more active in their professional life, while, on the other hand, they had to take care of their personal life, often divided between their jobs and their household, their children, their domestic life. Maria Teresa Ambrósio was aware of all these difficulties, inasmuch as she had decided to live a full life, both professionally and at the personal level. This explains why, when she was the President of the National Educational Council, she was one of the subscribers of the manifesto supporting the international project "For an active society", the mentor of which was, in Portugal, Maria de Lourdes Pintasilgo. This project, in the scope of the IV Communitarian Programme for equality of opportunities between men and women, 1996-2000, aimed to find innovative ways to conciliate family and professional responsibilities both for men and women. Themes for reflection were: "changing the way we think and discussing the way we live", "discussing the social roles traditionally assigned to men and women" or "equality of opportunities to participate both in public and in private life".

Teresa Ambrósio was the only woman so far to chair the National Educational Council (Conselho Nacional de Educação) between 1996 and 2002.She was also a consultant both for the European Communities and for the UNESCO for the areas of Education, Higher Education and Training, member of the International Francophone Association of Educational Research and a member of the Executive Council of the European Network *Modelisation de la Complexité* (Complexity Modelling), represented in Portugal by *Atelier 34*. She was also a representative member of the Lisbon Academy of Sciences and gave her collaboration to the Portuguese Foundation for Science and Technology for the evaluation of many projects, and research scholarships, as well as research units, coordinating panels in the field of Educational Science. She participated in CNAVES (The National Council for the Evaluation of Higher Education), and was one of

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the leading founders of AMONET – The Portuguese Association of Women in Science.

7. The woman scientist

At the scientific level, Teresa Ambrósio was first influenced by Yves Barel, an economist, historian, philosopher and epistemologist of social science, the director of her Master in Sociology at Grenoble University of Social Sciences, France. Barel introduced Teresa to the systems analysis. She started to have a new scientific interest – the complexity approach for the understanding of social phenomena, an interest that would prevail until the end of her life. Barel advised her to meet Georges Lerbet, at the Tours University, this scientist would become a major reference for Teresa Ambrósio and he would also be the director of her PhD thesis in Educational Science. Through Lerbet, other influences – many coming from a scientific collaboration – emerged: Edgar Morin, Jean-Pierre Dupuy, LeMoinge among others. Teresa Ambrósio participated in the Cerisy Conferences, France and she was a member of several international scientific networks. Mainly francophone, she would be open to other trends, coming from other countries and cultures.

8. Main scientific concerns

Teresa Ambrósio believed in the power of education in general and lifelong learning in particular to enhance Human Development, which she defined as *the ultimate goal of every policy that contributes for dignity and training of human capacities following the values of the global ethics that the contemporaneity has already acquired as an historical civilisation patrimony*. The ethical dimension of her thought made her often criticise the *economical functionality, with a short time logics of technological assimilation assigned to school systems* and she warned about the urgency of diffusing the contemporary educational thought to avoid that society can be guided, in a blind way, for a purely utilitarian vision of education. She would remind that human beings are far more than human resources and that human development is more than human resources development. Calling for values as *long-lasting and historical beliefs of communities*, she stood for the necessity to *recreate ethics of discussion* for the exercise of active and responsible citizenship that values politics, giving it a new logic and establishing its autonomy towards the economics.

She also emphasised the role of networks in knowledge sharing and knowledge creation – formal and informal networks, scientific networks and those networks that grow within civil society – NGO (she was one of the main founders of AMONET – the Portuguese Association of Scientist Women), volunteer associations and others, which grow stronger and stronger not only as places of work and where people help one another, but also as spaces for knowledge sharing and creation of knew knowledge. Teresa Ambrósio advocated that *knowledge* is the great capital of humanity, not only as economic capital, contributing to technological innovation, but also as a basis for our survival as human beings and, because it is so, knowledge should be shared by everyone.

In fact, contemporary societies are built around a set of imbricate networks – local, national, regional and global – that actually are learning networks and can support both individuals and groups that can find there a set of resources to reach their different goals and allow them to view life as a continuous and advantageous learning process.

Although technology is not enough and a more intensive and organised participation of society as a whole is needed, it is unquestionable that information and communication technologies have opened new potentialities to the creation of other knowledge sharing places – virtual networks. I think Teresa Ambrósio conceived networks as "knowledge trees", in Humberto Maturana's terminology, without hierarchies, in dynamic and creative unities, which favour linkages, interchange, connections and the sense of belonging.

However, a network is complex – as Teresa Ambrósio used to remind – it has multiple causalities and interdependences, it is linked to the context in which it is inserted and to the singularity of the System-Person, with its *capacity for intentional action*. Because of that she viewed European and international networks as *sources for questioning accumulated knowledge*, tested, enriched and constructed in logic of nonlinear rationality that could originate *interlaced meta-networks*, comprising *individual systems, people, enlarged groups.* Applied to the scientific field, the same logic is shared by Le Moigne, who refers the need to strengthen a collective practice of scientific reflexivity, based on permanent places of exchange and debates that allow researchers from different expertises to share their experiences and their queries about the science they do. Along the same line and bearing in mind the complexity of social and human phenomena, Teresa Ambrósio argued for the need to find bridges to favour dialogue between centres of research, because of the interdependence of a set of problems.

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Especially in the latest years of her life, she was passionate by the theory of complexity and systems thinking. Her scientific interests mainly concentrated on the relationships between education and sustainable human development, as well as in the processes of personal and communities' growth. She considered that, in the present knowledge society, educational systems are evolutionary systems, complex, unpredictable, bringing about the need to build frameworks for the intelligibility of their problems and behaviours through research, debate and social regulation. Aiming to apply research findings to real action, she believed in democratic participation both by society in general and by citizens responsible for the decision of possible pathways, under a permanent process of reflexivity leading to informed action. In our time of uncertainty, risk and unpredictability, she believed this procedure would design the governance models fitted to the future of Education, which she viewed as Education for the future.

She argued for the necessity of a vision of change and of the sustaining mechanisms of such change, not only at the organisational and institutional management levels, but also of the new processes of teaching and learning, of new disciplinary themes and fields, of new knowledge emerging from everywhere. Such issues should, she argued, be taken into account for global, dynamic, systemic, pluralistic evaluating criteria in the new Higher Education.

Another field of research that Teresa Ambrósio coordinated was lifelong learning. She believed that the new paradigm of lifelong learning implies a deep effort for the pedagogic and scientific reorganisation in what concerns disciplinary and interdisciplinary contents, educational, intellectual and professional development strategies. Such strategies should be supported by a reorganisation both at the institutional level as a whole and at the level of traditional management frameworks of the institution. More than institutional reforms she advocated new spaces of change, of innovation, where new orientations can be experimented for the higher education/research/training and where the intervention of new academic actors, entrepreneurs and politicians can be promoted.

9. Conclusion

Teresa Ambrósio was an outstanding woman scientist in the field of sociology and educational science. She fully lived her life, both personally and professionally, taking responsibility for her citizenship duties as well. A huge part of her time life was dedicated to the cause of Education and Democracy in her country. She gave her example, her stimulus and guidance to many students and teachers of the Universidade Nova de Lisboa (New University of Lisbon), especially to the researchers of the Unit of Research Education and Development. As she once said, she knew she would leave *many other paths interlaced* with her own one – *professional, political, familiar and emotional*. She directed several research groups at the New University of Lisbon (Unity of Research Education and Development) and her contribution to innovative research approaches in the field of Social and Educational Science has undoubtedly marked the scientific Portuguese panorama. Her capacity of synthesis, foresight, scientific intuition and vision through complexity were remarkable. She left a significant number of publications in the field of social and educational science. In 2003, when asked to write her self portrait, she wrote: *I am Teresa Ambrósio, I was born in 1937, in Vila Nova de Ourém and I will die in a date to be named.* It would be on the 11th September 2006.

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Women in University Lifelong Learning: The Hidden Discrimination

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Abstract. Having as an explicit objective to *promote equality of opportunities* in the access to higher education, *attracting new publics, in a logic of lifelong learning,* following the Bologna Process and the General Law for the Portuguese Educational System, the Portuguese government promulgated the law nº 64/2006 from March 21st, which regulates the access to higher education by individuals aged 23 and older, who do not own the necessary academic qualifications, but have gained competences and skills through non-formal or informal learning activities.

At the European Community level, political discourse on lifelong learning reveals concerns about equality of opportunity, namely in what gender is concerned. Universities are urged to actively participate in this process and open their doors to adults willing to update their knowledge and competencies. Under this logic, higher education institutions have to undergo a dynamics of adjustment of their cultural and social organisation in order to harmoniously welcome these new publics, in a self organising process aiming to integrate lifelong learning in University strategies and mission.

Taking into account the present globalisation context, this paper starts with a brief analysis of the interdependency between the economic world, international institutions and governments that are responsible for the definition of national educational policies, which has led to an evolution of the concept of lifelong learning. Then, preliminary findings of a research about the process known in Portugal as the «23 and older», at Universidade de Lisboa (University of Lisbon), which includes all its faculties and courses are presented. This is part of an ongoing study covering all Portuguese universities. Although mainly based on quantitative data, the study is intended to apprehend the complexity of this process, in order to get a global, synthetic and qualitative understanding of the dynamics, the evolution probabilities, and the different levels of reality, keeping in mind the heterogeneity of the elements, their interdependency as well as their interactions. One of the main goals is to identify gender inequalities, both in the access to this LLL opportunity and in the choices of courses. The article evolves to a discussion of the research findings, drawing upon relevant literature on the issues under consideration.

Keywords. LLL, Higher Education, Candidate Profile, Gender Discrimination.

1. Context of the research

Definitions of lifelong learning (LLL) and its relationships with other concepts – Continuing Education and Adult Education are still somewhat elusive and differ according to different national contexts (Reichert & Tauch, 2003). In higher education, debates and reflections about LLL are basically the continuation of the debates on Continuing Education and on Adult Education, although recent definitions emphasize learning in every context and life cycle. However, within universities, this kind of learning mostly remains marginalised and seldom is part of the strategies, processes and decision making of these institutions. The access pathways to higher education have remained the traditional ones, and the lack of tradition and of accumulated

 ISBN 978-989-95336-1-5

knowledge on the recognition and accreditation of informal and non-formal learning activities became additional obstacles to the entrance of these new publics in higher education (Gonçalves, 2004, EUCEN, 2005).

Besides, in the western countries, the economic world, international organisations, such as OECD, UNESCO and the World Bank, as well as the European Union and national governments, press higher education institutions to train the human resources that the work market needs, on the one hand, and to give an outstanding contribution to a more equitable society, by offering equal opportunities, thus diminishing social exclusion, on the other hand. Ultimately, it can be argued that higher education institutions have to make an effort to integrate LLL in their processes and strategic policies, in order to position themselves in an expanding market and the added value of their knowledge and expertise become clear (Jarvis, 2001).

In the Portuguese context, if demographic decrease is not to be mentioned, the number of students in initial higher education has been growing, with evidence for the percentage of women that surpass men's (Silva, 2006). However, the number of early school leavers is still very high and the most advanced age levels of the Portuguese population remain with low qualifications.

2. Methodological procedures

The study included all candidates, whose data were analysed carefully safeguarding anonymity. There was recourse to triangulation of different documents and data obtained through the responsible entities, for reliability and credibility criteria. Such triangulation also helped to identify linkages and interactions which take place at different levels – individual, institutional and political – in order to understand how new contexts can be created to favour the success of change, given the present uncertainty and the difficulty in capturing individual strategies that can change due to phenomena which are mostly uncontrollable.

The study began by an overall characterisation of the whole of the candidates to every faculty. First findings aroused questions which demanded a more acute analysis, by faculty and courses, to try to answer the following questions: what is the age distribution by courses? Is course choice linked to gender? A more detailed analysis was then carried out, which required the study of data relating to the totality of the candidates. At this stage, the following categories were considered: gender, age, chosen course and nationality. Whenever the relationship between professional activity at the time of application and the selected course might contribute to a better understanding of the reality under analysis, such correlation was carried out. Findings have shown significant differences. 203 candidates were accepted, that is to say, 49 percent of the totality. Finally, in order to obtain a profile of approved candidates, by faculty, a comparison between approved and non-approved within each faculty was made.

3. General characterisation of the candidates

The average age of the 470 candidates to Universidade de Lisboa was 38. Their professional activities are mostly in the services area (42.1 percent) and public services (21.5 percent), the percentage of liberal professions being low (8.7 percent). Due to a very poor numerical representation, unemployed, retired and individuals who are in prison were grouped under a sole category, representing no more than 5.5 percent. Distribution by gender shows a higher number of male candidates – 58.6 percent. Residential area is mainly what is called Grande Lisboa area (Lisbon and surroundings) (93.1 percent) and nationality is, in general, Portuguese (94.7 percent), with a representation of 3.0 percent from PALOPs (individuals from the ancient Portuguese colonies), other nationalities having a mere residual significance. The analysis of academic qualifications shows that the great majority of the candidates is qualified with secondary education (40.1 percent), followed by those with the 9th year of schooling (compulsory education) – 38.5 percent – and "licenciatura" (higher education degree comprising 4/5 years) or a higher level – 7.3 percent. The lower percentage belongs to the candidates without compulsory education – 3.0 percent. On what concerns the most demanded courses, Law was the one with most candidates (34.3 percent), then Psychology, with 12.0 percent, all the others being bellow 6.0 percent.

4. Characterisation of the candidates by faculty

4.1. Faculty of Arts

There were 27 candidates, with an average age of 34, most of them coming from liberal professions – 35.7 percent (a significant number, when compared to the totality of these professionals for all the faculties) followed by employees in the service sector (28.0 percent) and public services (17.9 percent). The number of those who declared to be employers in the services sector equals the non-respondents. The

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courses which were most demanded were Painting and Communication Design (both with 35.7 percent), followed by Sculpture (17.9 percent). Most candidates have secondary education (35.7 percent), compulsory education coming after (32.1 percent), then bachelor degree (10.7 percent) and "licenciatura" or higher level (3.6 percent). The high percentage of non-respondents (10.7 percent) should be mentioned.

Gender characterisation

Gender analysis shows 46.4 percent women and 53.6 percent men. Women candidates to this faculty are Portuguese and most chose Painting (six in 12 candidates). Four are aged between 26 and 28, four between 33 and 38 and the others are aged from 45 to 65. The eldest ones are mainly attracted by Painting.

Male candidates present a different profile, not only relating to the course choice, but also in age levels. Thus, Communication Design is the most demanded course (seven in 15 candidates), then Painting (5) and Sculpture (3). They are significantly younger than women (only three are aged from 40 to 48), the majority of them being in their twenties (nine). Excepting a candidate from Guinea, they are all Portuguese.

It became evident that the average age of the candidates to this faculty shown in the above general characterisation is determined, to a great extent, by women's higher level of age.

4.2. Faculty of Science

In a total number of 58, the average age of the candidates to the Faculty of Science equals the previous one – 34. Women are much less represented here than men – 23.3 percent women to 76.7 percent men – and, unlike the Faculty of Arts, candidates' professions are mainly in the services sector – 55.0 percent, followed, by far, by public services, with 13.3 percent and commerce employees do not exceed 10.0 percent. The most demanded course was Informatics Engineering (55.9 percent) and, in a much lower degree, both Biology (16.9 percent) and Biochemistry (6.8 percent). Also in this faculty the most common academic qualification is secondary education (50.0 percent), then the 9th year (compulsory education (30.0 percent) and bachelor degree (8.3 percent). Only 5.0 percent of the candidates do not own the 9th year of schooling.

Gender characterisation

Women selected mainly Biology and Biochemistry courses (four for each course), three selected Informatics Engineering, one chose Geology, one Information and Communication Technology and one chose Mathematics. Other than the Portuguese candidates, there is one from S. Tomé and another one from Brazil. As for ages, just two are more than forty (41 and 42), the other ones ranging from their twenties (eight) to thirties (four).

On what concerns men, the most demanded course was Informatics engineering (30 choices in 40 candidates). In this course, while in the case of the three female candidates there is no relationship between their present profession and Informatics engineering, such relationship amounts to 66.7 percent in male candidates. The second course most demanded by men was Biology, the other ones having not a significant concentration of choices. Only nine male candidates are more than 40 years old, an exception being one 64 years old man wishing to enter Energy and Environment.

4.3. Faculty of Law

This one was, by far, the faculty with the larger number of candidates – 163, with and average age of 37, slightly higher than the two previous faculties. The percentage of men almost doubles the women's (64.0 percent of men compared to 36.0 percent of women). Professional activities are mainly in the service sector (42.9 percent), then public services (1.7 percent), army and security forces amounting to 12.4 percent. The group of unemployed/retired/imprisoned have, in this faculty, an expression higher than in all the others and it is also the only one where two imprisoned (one man and one woman) have registered. A mention should be made to the residential area of the candidates: this is the faculty where the percentage of residents in the Lisbon area is the lowest (87.6 percent). It is also to be mentioned that this is the only faculty which has evening courses for working people, exception made to the course of Philosophy, in the Faculty of Letters. The academic qualification with a higher percentage is secondary education (36.6 percent), then compulsory education follows (33.5 percent), and finally higher education degree («licenciatura»), with 8.1 percent, the same percentage as that of non-respondents.

Gender characterisation

Analysis by gender reveals that from the 65 female candidates to Law, 20 are above forty years old and 25 are linked to professional activities that, in one way or another, are related

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to this course. They are all Portuguese, excepting one from Cuba.

From the 102 male candidates, 40 (about 9 percent more than women) have professional activities connected with this course. Forty-two male candidates are older than 40, the eldest one being 71. Just 27 male candidates are still in their twenties, meaning that the majority of the individuals that applied for Law are not as young as those you made application for other faculties. Similarly to the other courses, male candidates are almost all Portuguese, excepting two from Angola, one from Bulgaria and another one from Brazil.

4.4. Faculty of Letters

This is the faculty with a higher average age – 39. Feminisation rate rises, here, if compared to courses in other faculties (44.2 percent). They come mainly from the sector of services (36.1 percent), then from the public services – 25.9 percent, liberal professions – 10.9 percent and unemployed/retired – 6.8 percent. The courses with the highest amount of applications are History, with 17.7 percent of the candidates, Geography (15.0 percent), History of Art (10.9 percent) and Philosophy (9.5 percent). It is the faculty where more candidates from the PALOPs can be found (4.8 percent). The academic qualification with more expression is compulsory education (39.5 percent), closely followed by the secondary education (36.7 percent) and by far by a higher education degree («licenciatura»), the same as those with a bachelor degree – 5.4 percent each. Only 2.0 percent of the candidates do not have compulsory education.

Gender characterisation

It seems worth noting that a few years ago the courses of the Faculty of Letters were closely linked to educational professions, mainly to secondary teaching. However, none of the candidates (either man or woman) is a teacher.

Thirty-two women (almost 50 percent) are older than 40 years, (between 40 and 59). No more than 15 are still in their twenties. Other than the Portuguese female candidates, there are two from Mozambique, three from Angola, one from Cape Verde, one from Guinea, two from Brazil, one from Bulgaria and another one from Spain.

Age factor is more evident among men – excepting a non-respondent, from the 82 male candidates, 36 are older than 40 (between 41 and 77), and 16 are older than 50. Exception made to an Angolan and a Spaniard, male candidates are all Portuguese.

4.5. Faculty of Dentistry

It is in this faculty that the youngest candidates can be found (30 is the average age). After the Faculty of Psychology and Educational Science, this is the second faculty where female candidates exceed the male ones (54.5 percent women). Professional activities range from services – 63.6 percent, commerce employees – 18.2 percent and public services – 9.1 percent (the same as industry employers). They all live in the Lisbon area. As far as nationality is concerned, 90.9 percent are Portuguese and 9.1 percent are Brazilians. As for academic qualifications, higher education equals compulsory education (27.3 percent each), followed by «licenciatura» or a higher degree (this is the faculty where the highest percentage of such qualifications can be found – 18.2 percent), and finally attendance of higher education or intermediate course, with the same percentage as bachelor degree – 9.1 percent.

Gender characterisation

Female candidates to this faculty are young (25-33 years old). Four, in a total of six, are already linked to the activity of dentistry and wish to enhance their qualifications. Excepting a Brazilian woman, candidate to the course of Dental Prosthesis, they are all Portuguese and chose the course of Oral Hygiene.

As for men – five candidates – three are linked to the activity to which they are candidates and their ages are comprised between 24 and 39. Unlike women, they applied mostly to the course of Dental Prosthesis, just one applied to Oral Hygiene. They are all Portuguese.

4.6. Faculty of Psychology and Educational Science

Average age equals the one of Law – 37. It is in this faculty that the highest rate of feminisation of candidates can be found – 59.7 percent. They are mainly services employees (38.7 percent), although public services have also an expressive rate (19.4 percent). There are 14.5 percent of commerce employees and 8.1 percent unemployed/retired, which is a relatively high percentage – The analysis of the academic qualification shows a numerical superiority of the candidates with compulsory education (43.5 percent), followed by secondary education, with 32.3 percent. Higher education degree («licenciatura»), with 11.3 percent, makes this faculty the one which, after the Faculty of Dentistry, presents a greater number of candidates qualified with a higher education

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degree. Psychology was the main course chosen by both genders.

Gender characterisation

The five female candidates to Educational Science are aged as follows: three are between 43 and 50 and the other two are between 35 and 39. One is from Guinea and all the others are Portuguese. Thirty-one women chose Psychology. Twelve are older than forty (42 to 67). Only nine are still in their twenties. Excepting a Brazilian, they are all Portuguese.

Just one man made an application for Educational Science – he is Portuguese and 48 years old. All the other 24 were candidates to Psychology. Nine are more than 40 years old (44 to 63) and no more than 10 are still in their twenties. They are all Portuguese, excepting one Romanian.

5. Admitted and non-admitted – what makes the difference?

Two hundred and three candidates were admitted, representing 49 percent of the totality. By comparing admitted and non-admitted candidates, the following profiles, by faculty, were obtained.

Faculty of Arts – The candidates who have been admitted are young (27 is the average age, well below the 37 of the non-admitted ones). Minimal entrance age was 24 and maximum was 66. The percentage of men (77.8 percent) is much higher than that of women, and the majority chose Communication Design (44.4 percent). They are all Portuguese and live in the Lisbon area. As for academic qualifications, the rate of frequency of higher education equals both bachelor degree and compulsory education, although there were a high number of non-respondents. However, when the percentage of the non-admitted is considered, the great importance of the lowest qualification can be observed – compulsory education, with 43.6 percent, followed by secondary education, with 37.5 percent. Data show that candidates with the highest qualifications were the most admitted.

Faculty of Science – Also in this faculty, admitted candidates are younger than those not admitted, though in a not so significant way (28 to 30 years old). Maximum age of admitted candidates was 64 and minimum age was 24. The superiority of male candidates, in what concerns admission, is even more evident – 78.9 percent. It is worth noting that 10.5 percent of the admitted candidates do not live in the Lisboan area. The two courses which have been more selected, with an equal percentage (31.6 percent), were Biology and Informatics Engineering, followed, by far, by Communication and Information Technologies (15.8 percent). Informatics Engineering is also the course where the greatest number of non-admitted can be found – 59.4 percent, a much higher percentage than that of Biology (12.5 percent). When these data are crossed with the specific examinations required for each course, the higher importance of Mathematics to access Informatics Engineering than Biology can be noticed. Candidates to Biology had Mathematics and Biology examinations, while candidates to Informatics Engineering had only Mathematics examination. So, while candidates to Biology had to answer to one question on Maths and another one on Biology, candidates to the second course had two questions on Maths. Besides, both exams contemplated a third question where candidates had to make a dissertation about a relevant event for the scientific field where they wanted to enrol – Biology, for those who chose this course. That is to say: these data suggest that Mathematics remains a discipline which strictly limits the continuation of studies in areas where it is considered essential. It is worth mentioning that for the courses of Energy and Environment and Applied Statistics, where the specific examination was Mathematics, no candidates were admitted. Admitted candidates to this faculty are all Portuguese and, among the non-admitted, there are 6.2 percent from the PALOPs and 3.1 percent from Brazil.

Faculty of Law – Age factor does not show much relevance to differentiate admitted candidates from the non-admitted ones. The first ones have an average age of 36, while the second are 37. The oldest is 65 years old and the youngest one is 24. In what concerns nationalities, 97 percent are Portuguese, 1.5 percent from the PALOPs and the same last percentage for «other one». Once again men are in superiority, showing a percentage of 65.7 percent of admissions. Unlike the previous faculties and courses, a percentage of 6.0 percent can be found under the unemployed/retired category. This is also the only faculty where there are more admitted candidates living outside the Lisbon area – 13.4 percent. The qualifications of the huge majority of the admitted candidates are secondary education (41.8 percent), then compulsory education (23.9 percent), and in the third place higher education («licenciatura»), which amounts to11.9 percent.

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Faculty of Letters – Admitted candidates are significantly older than those non-admitted. Maximum age of admission was 77 and minimum was 24. This is, as a matter of fact, the faculty with the highest levels of age of the admitted candidates. Will it be because a greater maturity is demanded by courses of letters? Will it be because such courses are more appealing to individuals with higher age levels? Male gender still prevails here, with 63.0 percent of the admissions, the female gender having a greater percentage of non-admissions – 58.9 percent. From the admitted ones, 5.5 percent live outside Lisbon area. Also in this faculty there are 8.2 percent of unemployed/retired. Relating to the courses, most choices concentrated on History and History of Art, with an equal percentage – 16.4 percent. Philosophy follows with 15.1 percent and Translation with 12.3 percent. After the Faculty of Arts, the Faculty of Letters admitted more individuals coming from PALOPs – 5.5 percent. As for academic qualifications, most admitted candidates have secondary education (39.7 percent), followed by compulsory education (35.6 percent) and «licenciatura» (8.2 percent). Only 1.4 percent of the admitted candidates do not have compulsory education. The age of the candidates have to be considered, inasmuch as the present compulsory education – 9th year of schooling started in 1986.

Faculty of Dentistry – This is the only faculty where the percentage of the admitted women equals the men's (50 percent). However, the number of non-admitted women is much higher that the men's (66.7 percent). All the candidates are Portuguese and live in the Lisbon area.

Faculty of Psychology and Educational Science – This is the only faculty where admitted women (69 percent) exceed men. 93.1 percent are Portuguese, 3.4 percent from PALOPs, the same percentage as those from Brazil. Psychology is, by large, the most searched course (79.3 percent of admissions), while Educational Science did not surpass the 20.7 percent. As a matter of fact, all the applications to this course were admitted. The majority of the admitted candidates have compulsory education (44.8 percent), followed by secondary education and «licenciatura» with the same percentage (20.7 percent each). Finally, and also with the same percentage (6.9 percent), come attendance of higher education and bachelor degree.

6. Conclusions and discussion

Findings demonstrate that, however illusive, inequalities of access to University lifelong learning remain at several levels: gender, formal schooling qualification, as well as residential areas and minorities groups. As far as gender is concerned, it has been observed that, compared to men, women candidates are fewer and they are also those who fail more in the access examinations. In fact, it has been observed that, compared to men, women are in minority as candidates and they are also those who fail more in the access examinations, most of the admitted women have secondary education, those with less formal education remaining with more difficulty to have access to higher education. Furthermore, they have different profiles from male applicants on what concerns age, previous qualifications and chosen courses. The general admitted candidate profile is young, male, employed, resides in the Lisbon area and owns the highest qualifications. Faculty of Dentistry and Faculty of Psychology and Educational Science are two exceptions: in the first case, the percentage of admitted females equals the males, and in the second case it surpasses males. However, the number of non-admitted women is much higher in both courses. It is worth mentioning that in the Faculty of Dentistry candidates of both genders are the youngest of all faculties.

Actually, in the Portuguese context, there has been an evolution in choices of girls towards a balance with boys' choices. A comparative study about gender imbalance among MST graduates, comprising 33 countries, showed that Portugal has one of the best positions, with more than 40% of female graduates (Coyne, 2005). However, this evolution in former education cannot be found in lifelong learning, taking into account men and women's applications to the different faculties and courses, such difference becomes most evident.

Exception made to the Faculty of Dentistry, where women candidates are very young (25 to 33 years old), most of them already inserted in a professional activity connected to the course they chose, findings suggest that gender still determines course choices. In fact, men are mostly attracted by courses which are more likely to be absorbed by the present conditions of the work market – they have a much higher representation in the Faculty of Science, where they mainly chose Informatics Engineering, in Faculty of Arts, they apply more to Communication Design, while women feel attracted by Painting. Women seem to be most attracted by courses in Faculty of Letters, Arts

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and Psychology and Educational Science, although Psychology seems to be appealing to both genders. The present study meets the finds of another one, conducted in the UK at undergraduate level, that demonstrated that men overwhelmingly outnumber women in engineering and computer science, and "nearly three times as many women as men are studying languages, four times as many study education, and women also predominate in the humanities, creative arts, and social science" (Francis, 2006:59).

It also became evident that men mostly chose courses linked to their present professional activity. Will this mean that women lack professional ambition? Or else does it reveal the belief by women that even if they excel in their competences higher professional positions will remain held by men?

A contribution to understand why women candidates are, generally speaking, fewer than men might be found in the traditional concept of family that still prevails in Portugal, at all levels of society (Gonçalves, 2006). In fact, a great number of women have to harmonize their family duties, especially if they have children or elderly ones to care for, with their own lifelong learning. As Brine refers, policies that take seriously the differential benefits of lifelong learning need to protect the family-work balance and create conditions of work and learning that facilitate lifelong learning. Furthermore, "the availability of the learning opportunities is an insufficient condition, as it does not create the structurally located dispositions involved in participation (Clegg and McNulty, quoted by Brine, 2006: 26).

These discrepancies are somewhat contradictory to the European concern relating to equality of opportunities of access to lifelong learning, "both in terms of gender mainstream and making learning genuinely available for all, without discrimination (...) not least because of the way in which knowledge and competences impact on citizens' life opportunities" (EC, 2001:9). In fact, lifelong learning has been considered a key aspect of our learning society, and any commitment to social change and social justice will fail if lifelong learning remains obviously gendered. However, other inequalities persist contributing to a perversion of the legislator's intention, especially when it is considered that in the overall, the most qualified candidates were the ones to be admitted. If we bear in mind that the political discourse about lifelong learning, frequently connected to democratising notions of citizenship, agency and participation, and to promises of new opportunities for marginalised groups, helping individuals and communities become capable to respond to a new, globalised world (Blackmore, 2006), this evidence calls for a deep reflection.

In the present global context, it seems to be urgent a reflection on who are the losers and the winners to this endless running for competitiveness, for the prevailing logics of competition can undermine social solidarity, maintaining deep inequalities or even developing new ones.

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Delaying the First Born on Scientist Women. The Replacement of Generations

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Abstract. Demographic change in Europe (and in the world) had origin an imbalance between generations which could render social system unworkable. One possibility of solve, or at least, minimize difficulties will be to help the increment of the birth rate.

As specialists say that the delay of the first born influence negatively the woman fertility, and looking to the problem, European Parliament had begin a campaign to improve childcare. As part of women population which faces this problem are the young wanting to have a research scientific career.

On our talk we will point out the situation.

Keywords. Generations, Age, Birth, Children, Dialog, Intergenerational, Research, Scientist, Solidarity, Women.

1. Introduction

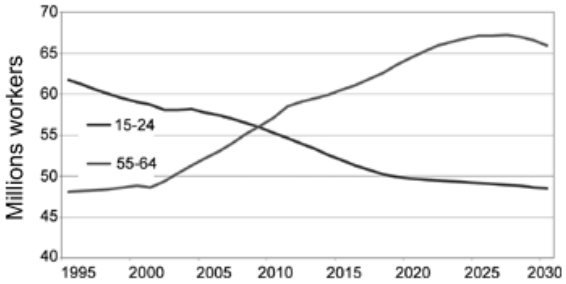

Figure 1. Size of the youngest (15-24) and oldest (55-64) working age groups (EU 25 – 1995-2030). Around 2009, the descending and ascending curves representing these two population groups will cross. In 2050, there are expected to be 66 million workers aged 55-64 and 48 million aged 15-24. The average age of workers will decline from 2010. This raises the urgent need to improve the employability of older workers to prepare the labour market for ageing

European Community had born under the ideal of Solidarity. During their first years it had been given some special attention to the

 ISBN 978-989-95336-1-5

economic problems of the less developed European countries. Nowadays a demand of social solidarity is growing in all European countries concerning the consequences of the ageing population.

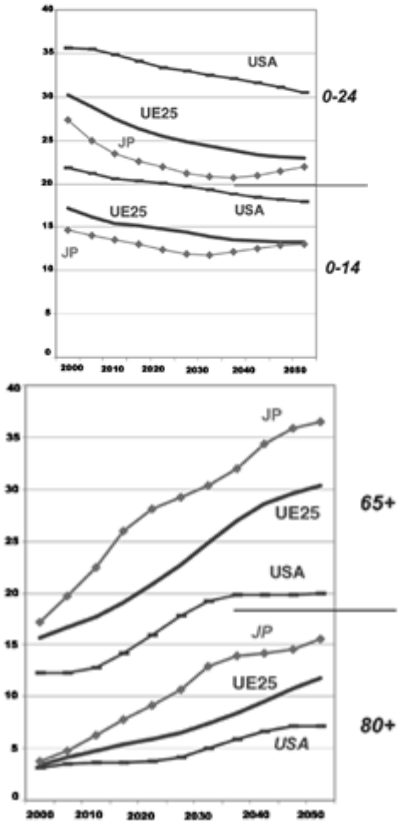

Figure 2. The European generation gap EU-25, United States and Japan – 2000-2050. In all three cases, a major decline in young people is likely to occur, while the share of the oldest age group will continue to increase, bringing an increased demand for care

2. Women influence

This movement began from women influence who, on their jobs, on particular those on the health field, realized the luck of care conditions for elderly people and the several future problems that all European countries will have to face concerning that the birth rate is failing and the population is ageing. Indeed, a major decline in young people is likely to occur, while the share of the age group will continue to increase.

Just as an example we will point out that it was a woman, Ursula Lehr, who promotes, in collaboration with Jose Luiz Vega Vega, the dean of Psychology Department of Salamanca University the First European Master on Gerontology. She studies Philosophy, Psychology and History of Art. Being professor of Psychology at the University of Cologne and Bonn and professor of gerontology at Bonn she found the Institute of Gerontology at the University of Heidelberg and became former German Minister of Youth, Family, Women and Health from 1988 until 1991. As a member of the German Parliament she served on the Committee of Education and Science and the Committee of Family and Senior Citizens. Lehr founded the German Centre for Research on Ageing (DZFA) at the University of Heidelberg in 1995 and was its director until 1998. She also presided over the German Society of Gerontology and Geriatrics between 1997 and 1998.

Ursula Lehr is now a member of the European Academy of Yuste, the Academy of the Yuste Foundation of the Spanish Imperator Charles V, and on the talks she gave there it became clear how important it is for the social stability of the European Community to develop heath care of elderly people, intergenerational relations and solidarity to minimize the problem.
And of course to increment intergenerational relations we have to have several generations and do not let minimize the percentage of children, and it was also another woman, Isabel of Portugal (sec XVI) who organize the Misericordias, institutions that take care of poor people and people with difficulties.

3.The causes

The Council of Europe had published a study drawn up for the European Population Conference 2005 which states that principal factors responsible for infertility are modernisation and individualisation as well as the desire to study, pursue a career and achieve a certain standard of living before starting a family. Life in large towns and cities and a decline in religious beliefs are further contributory factors to this fall in the number of children.

Nevertheless other demographers, sociologists and political scientists believe there are much more parameters playing role.

The Dialog project, a major European study that aimed to provide a comparative analysis of attitudes to demographic change says that the number of children born does not reflect the number of children people actually wants. Indeed people would like to have more children and very often became feeling frustrated when they are older.

A partner of Dialog, Director of Population and Social Policy Consultants says that “this trend is hardly surprising given various social conditions:

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the prolongation of studies,
difficulties in finding stable employment
high-degree of work stress
inequality between men and women in both the professional and private sphere

The labour market continues to be organised on the basis of gender criteria and social policies do not give enough support to families.

When a woman waits until her late thirties before having her first child, she is likely to have lower fertility rate. In addition, many people get used to a life without children or are content with just one child.

Level needed for the replacement of generations. To have children while pursuing a career is a pertinent issue. Nevertheless studies show that it is neither society nor government that decides fertility. It seems to be the couple himself who makes the choice.

Nowadays (according with Eurostat) there are about 72% active women in Austria, Germany, Portugal, Scandinavia, United Kingdom and the Netherlands.

In these countries many measures had been taken to solve the problem: special taxes regimen, childcare facilities, flexible working hours, education and housing policies, among others.

Let us hear Charlotte Höhn, Director of the Federal Institute for Population Research:

"The situation is not identical everywhere. The birth rate remains relatively stable in Scandinavia, despite the fact that neither the church nor marriage are major factors in these countries. This prompts us to ask questions about the causes.

For many years now Scandinavian countries have implemented an active police to promote gender equality. There are well-developed childcare facilities, which make a decision to have children much more easily. By contrast, when you look at a catholic country such as Poland, you see that the birth rate has been falling over the last decade or so, since crèches, whether public or private, have closed for economic reasons. In these transitional countries that are facing high unemployment and relative economic precariousness, material concerns count for more than family values".

4. Portuguese policy

In Portugal, the most of research science women belong to the university career. They have the same work time of men who are their colleagues except that they may do not work during four months after to have a child period (called *licença de parto)*and he maximum of five months if the woman receive only 80% of the salary. Nevertheless if they want to go on with the research career (at a university or not) they will have to present thesis and curriculum during same period as men.

So, scientist men are always over time to scientist women.

A reflex of this circumstance is that on the Academy of Sciences of Lisbon the most prestigious academic place we have only two academic women on the Science Department.

Recently in a Meeting on Coimbra University organized by the Portuguese Association of Women in Science (AMONET), a young scientist Maria Mota who obtained the UNESCO Prize, confessed to be able to finish his research after two have her first baby by having the support of the director of the Laboratory (also a woman, Profª. Catarina Resende) who could understand her need of flexible time-table. Other cases of punctual help where related by other young researchers on another meeting organized by the vice president of AMONET Prof. Lidia Ferreira in Lisbon on the Technical University,

But we heard also other master and Ph.D. science women who regretted do not had possibilities to continue her research life or job after had been mothers from luck of government and familiar help.

These cases are concerning all sciences and subjects, not only those who need a laboratory presence, but also others including that on mathematics that need an exhaustive library consulting and a large concentration.

5. Solidarity

Besides women who had to give up their scientific careers women are always giving her time to the care of her home, elderly familiars and children, while men, even if they are father's, feel free to take only care of his own career until arrive to his top.

His visibility on places of top is much higher than the one of women, we may take reference from the composition of the European Community Directory: one woman and five man.

We agree that Europe is trying her best to increment birth rate and we know how difficult it is to have laws without corruption.

Europe is asking for solidarity, a generous but serious one to help young people to increment the birth rate, giving them freely part of our time, affective and social support, firing with enthusiasm their decision.

So, we women working on science should fight for better legislation and at the same time to give a positive help, at least to the young people working with us, whose difficulties we know.

 ISBN 978-989-95336-1-5

We should remain that we will need them when we will get old.

6. Acknowledgements

I should like to thanks the Association Hands on Science on the person of the President of this Conference Prof. Manuel Felipe Costa to invite me to prepare it and to trust my work on nice solidarity collaboration.

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The Trio: Research Institute, University and School to Promote the Interest for Science

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Abstract. This paper is trying to stress the stimulus effect produced in the last year in the frame of the project “Hands on Science” by the symposia organized in the different high schools in Romania. These national symposia represent a life school for all the attendees, since every edition means a better quality of the presentations, the opportunity to listen different other topics, different new forms of expression and add new features to your own expertise.

Keywords. Knowledge Based Society, National Symposia, Real and Virtual Experiment, International Project, High School, University, Scientist.

1. Introduction

It is not unusual that the task of the EC is to try to build a knowledge based society, nowadays when despite of a long history of civilization it seems, that rather revenge and hate are more prominent than wisdom, peace and progress. It could be necessary people to understand that extending the knowledge, could be a way to avoid wars and all kind of divergences in the world, to stop the terrorism and save human lives, to promote collaboration, understanding and peace.

All around the world in the last decades the interest for sciences in the schools decreased thus a strategy had to be adopted in US and Europe in order to stimulate the interest of the scholars for sciences. This strategy means the collaboration between all the actors involved: schools, families, ministry of education but the universities, research institutes and the industrial companies, as well.

It is not by chance that the national responsible for this project in Romania is a research institute the National Institute for Lasers, Plasma and Radiation Physics in Bucharest: the reason consists in the fact that in this branch of activity it is easy to notice the decrease of the quality of the students graduated from the faculties of sciences. The formation of young scientists is an activity to be continued in the research institute.

Why not to try to contribute to the development of the future scientists from the very beginning and have an easier task later?

Why not to try to discover the gifted scholars for sciences earlier and guide them correctly and support them in a professional way?

Why not to validate the experience of a scientist working with the new generations in due time?

The paper will point out some of the good results developed in Romania in this context and stress the contribution of each of the above mentioned actors. In this respect it is necessary to recall that before the fall of the iron curtain Romania had a policy favourable to the development of education in science – the curricula for mathematics, physics, chemistry, and informatics were much consistent and the graduated students became soon good experts. As considering the “brain drain” phenomenon, quite important in the last 17 years, Romania offered for the European work market specialists in computer science, while Hungary in comparison experts in economy and sociology [1]. The structure of the economy could absorbs engineers, chemists and physicists but the tremendous change after 1989 had consequences on the interest for a job in different other fields. The work market is ever changing since 1989 and the process is not yet stabilized.

Nevertheless it is worth to mention that the experience in informatics of the young experts

 ISBN 978-989-95336-1-5

from Romania was much appreciated at the world level – the famous Nokia bought Intellisync, to which belonged the local company SoftVision and Brains Group (UK) by merge with Alfa Global Solutions (AGS) founded the company Endava for East Europe in Cluj – city from Transylvania Romania, while Microsoft has subsidiary in Bucharest. Siemens opened an office branch in software in Cluj. Soft companies from Cluj offers IT consultancy for Europe and USA regarding financial services and telecommunication and recently on media, as well.

The Romanian graduates in informatics had been absorbed by Canada, US, Australia due to their policy to select the experts.

After 1990 the shortage produced in the non efficient industry in Romania and the change in the economy scene produced the increase of the interest for economy and law study and the number of graduates was in excess. The interest for humanistic studies increased as well as for other new profession very limited before 1989: media, modelling, financial space, management etc.

This short presentation of the situation is to allow understanding the necessity to establish equilibrium and try to compensate the decrease of the interest for science study.

2. The national Symposia "Hands on Science"

The aim of the network is to promote the development of education in science and scientific literacy, the innovative hands-on experimental approaches to science and technology in school teaching, as well as rising the attractiveness of science in education.

In the last scholar year we assisted to a tremendous interest from behalf of the different teachers to organize national symposia, the first having in mind the model of the international conference attended last September in Braga. The Romanian delegation to this conference, consisting both of senior and young scientists, high school teachers and scholars, one of the largest in this conference had an active contribution: oral presentation, participation in two round tables, two tutorials experiments in Science Fair etc. It was the first time the high school teachers attended an international conference and the scholars, as well and this interesting experience had a stimulus effect.

The very large diversity of topics and kind of activities: oral presentations, experiments, demonstrations, contacts between the attendees of all the ages were of high stimulus for each attendee.

The delegation was happy to notice a great success, as one of the participants, the X-th class scholar Vasile Valvoiu from "Zinca Golescu" High School Pitesti [Figure1] who presented the paper "Biohazard's Solar System 2.0" a proposal of edutainment software to explore the universe in 3D virtual, interactive environment running on a medium performance PC received the trophies of Science Fair.

The passion for software of the scholar is not new as he was the winner of more than 35 prizes at different national and international contests among the last ones a special prize at the "National Conference of Virtual Learning" in 2005 (out of 172 authors and 84 papers) and the 3rd Prize and bronze medal at the International concurs "INFORMATRIX" an educational soft in 2006 (out of 84 finalist teams from 24 countries).

For a student in the high school the prize represents the recognition of a hard work he developed to improve the software and this is stimulating him in the activity to come. He was master on his work, the presentation was on line, showing the facilities of the edutainment software and managed very well to convince the audience about this contribution. He was able to have the presentation in English, establish contacts and friendship relations that shows the capability of the young people to be easy integrated in Europe.

Figure 1. The winner of the trophies Science Fair in Minho Universidade Campus - Braga

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To attend the international conference in Braga was much stimulating for the teachers, who being back begun to organize the national symposia. The project was starting quite hesitating at the very beginning, as teachers were not convinced about their own possibilities, but only the start was difficult.

These national symposia represent a life school for all the attendees, since every edition means a new experience, an improved quality of the presentations, the opportunity to listen different other points of view, different new forms of expression and add new features to the own expertise.

The problems approached by the scholars are various, most of them being close to the life aspects: control of the quality of some foods, of the water, environment aspects, pollution, meteorological phenomena as tornados, the heating of the planet.

Fig 2. Tests of the food quality (High School Costin C. Kiritesccu – Bucharest)

The extra curricula activities developed by the scholars with the teachers in the frame of "Science clubs" represent a challenge both for scholars as for teachers, because of the variety of aspects this common cooperation offers: for scholars the relevance of some special gifts, the refinement of the expression possibilities, more authority and mastery of the topics approached, for teachers on the other side to be closer to the scholars, to open new and various ways of communication and impose the professional authority.

The symposia are attended by participants from different other cities, who bring the report of their original activities. The teachers are stimulated and encouraged to be original and every national symposium seems to be different and to enlarge the expertise of the attendees. The comments are transmitted to the network, so each new organizer could benefit from the positive aspects or avoid the negative ones.

Now it is possible to say that a real competition is in progress, as each symposium organizer has the ambition to bring the proof of its personality, to add new ideas, to find new forms of expression, to extend the interest for science over the common curricula. In this ever developing progress there are not only the scholars and the teachers involved but the parents and even the grand parents and the results are amazing because of such large implications.

The possibility to change the information to discuss, to attend the presentation, experiments, exhibitions, posters, artistic shows on scientific topics all represents suggestions to improve the symposia, to innovate, but most of all to stimulate the pupils to attend extra curricula activities.

The "Media Technical College" in Bucharest organized the 6th symposium in this scholar year, dedicated to "Light" registering a participation of 175 people from Bucharest and different other cities, some very far located. The symposium offered the opportunity to have various forms of presentations related to this generous topics "light" from physics, astronomy, ethics, arts and also literature. The various forms of approaches: oral presentation, drama, dance, songs, paintings, photos, experiments is the proof of the extra curricula activities, the ability to use the internet information and to focus on the selected subject.

Figure3 National Symposium "Young people for Europe of tomorrow" Spiru Haret Dobroudja College

The recent symposium organized in a college situated on Danube river Tulcea dedicated to the celebration of 124 years of education in this city was the opportunity for the attendees to have a nice trip in the Danube Delta to better know the

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flora and fauna of this unique place of Europe, to be in contact with natural reservation, to know the policy adopted at international level for such protected areas. The symposium entitled "Young People for the Europe of Tomorrow" show the interest of the organizers for civic education, as well and for the integration in the large family of European countries. Moreover Bulgarian scholars have been invited to attend the symposium, thus the regional cooperation and friendship relations are promoted in a very concrete way.

I have to mention that the participation is not only large as number, but also as regards the affiliation: scholars, teachers, parents, university professors (interested to contact gifted students in the science) scientists from the research institutes able to change information, to be helpful to each other, to establish new contacts, to organize new activities. Photo 4 shows an instant from the university hall in which was hosted the symposium in Pitesti, an opportunity for scholars to be closer to the next education level of education, the university and for the professors to be able to notice new future students. The symposia in Bucharest are attended as well by university professors from "Politehnica" University interested to discover gifted scholars in science.

Fig 4. Symposium hosted by the Technical University from Pitesti, Faculty of Mechanics and Technology

The web site http://.education.inflpr.ro was organized to illustrate the main activities to be developed in the frame of the project "Hands on Science" in Romania. All the events are announced and the comments are distributed to the teachers from different other cities to be interested to become the actors of new events.

The "Center for Education in Science and Training" coordinated by Dr. Dan Sporea – the national representative of Hands on Science in Romania was organized in this research institute, having the mission to support the education and training in science for everyone (primary/secondary/high school/vocational) using real and virtual experiments. The training of specialists, education and public information in the fields associated to the NILPRP activity by means of lifelong learning, as well as the coordination of the educational network "Hands-on Science"- Romania represent other objectives of the center.

The research institute has more connections with the universities from abroad and many contacts all over the world. The participation in different international conferences and meetings represent other opportunities to keep informed and to disseminate the good practices in the education and training in science [2].

The contacts of the research institute with the companies producing scientific instruments and apparatus are important to develop reciprocal contacts, there are different companies: Microsoft, Vernier International, (http://www.vernier-intl.com/). National Instruments, Volvo, etc) disposal to sponsor the education to offer support and contribute to the formation of new experts to be absorbed by the working market.

The different experimental kits developed in the universities and companies are distributed in the schools to be used for real experiments and develop the skills for this training among the scholars.

It is important that these three main actors: school, university and research institute to keep and develop contacts, since the education is gradual and there is only the cooperation to assure the best results.

This continuous collaboration is a stimulus for each of the actors to improve himself and the community as well, because they are in competition and have the opportunity to demonstrate their skills, innovative thinking, and active spirit to approach new unconventional methods of teaching. To develop experiments all together, to find solutions, to project new set-ups, to comment and discuss the results this means not only get expertise but it is an opportunity to take responsibility, to manage in unpredictable situations to improve the working style, to be more motivated to face new situations, to be able to report upon the contribution in a large working team..

3. Conclusion

The results of the development of the project "Hands on Science" in the last scholar year, both the enthusiasm of scholars and teachers and of

 ISBN 978-989-95336-1-5

the scientists as well, represent the proof of a positive initiative, to be extended.

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Hands-on Experiments Using the Physiology Educational Kit from Vernier International

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Abstract. Inside an updated educational system it is compulsory the mix of theory with practices. The physiology educational kit from Vernier meets the measures related to the heart's activity. The blood pressure sensor and the Go! link Device's together with a software can present graphically on the display the systolic and diastolic pressure, in various created situations. The E.K.G.sensor together with Go! link device and the 3 attached electrodes can display the electrocardiogram by means of the computer.

I am going to present a series of measures related to the heart's activity made with the educational kit received from Vernier on the demonstrative experiments. Due to the blood pressure sensor and the Go! link Device's together with software there can be achieved measures of the systolic, diastolic, medium arterial pressure and the patients' pulse in various created situations and also for different sexes, all this information being automatically grouped by a computer and presented graphically on the display. The tracking of the cardiac rhythm can be analyzed after having performed some types of physical exercises.

The parameters that characterize the circulation blood system are:

- the blood flow
- blood pressure
- peripheral resistance

The blood flow is the blood volume that goes to the vascular system within a certain moment of time. It is constant when the body is relaxed, but it can vary on the base of the organism condition or needs. Under the stress conditions, the visceral nerve accelerates the cardiac rhythm. The cardiac flow is the pumped quantity of blood per minute by each ventricle. The systolic volume is the pumped blood volume by a ventricle during one heartbeat, as an average of 70 ml.

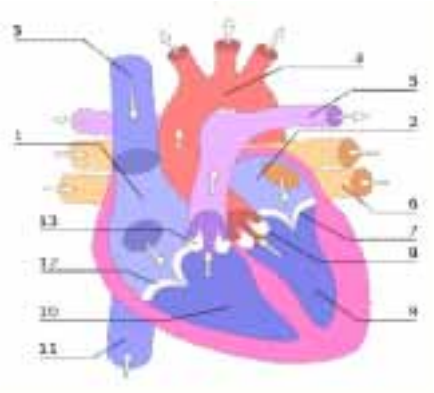

Figure 1. Heart section: 1. Right atrium, 2. Left atrium, 3. Superior vein, 4.Aorta, 5. Pulmonary artery, 6. Pulmonary vein, 7. Mitral valve, 8. Aorta valve, 9. Left ventricle, 10. Right ventricle, 11. Inferior vein, 12. Tricuspid Valve, 13. Pulmonary valve

The heart beats 70 times per minute. The cardiac cycle lasts almost 0,8 s. Atrium systole extends over 0,1 s, the ventricle systole lasts 3 time more, meanwhile the relax time reaches 0,4 s. During a physical effort, the blood quantity coming out from the heart on each cycle rises with 10-35%. The heart rhythm can be doubled or even tripled. Due to their volume difference, the pressure variations of the left ventricle are 5 times more important than of the right one, but both of them pump the same blood volume. The blood circulates due to the pressure differences that pump it to the vascular system. When the organism suffers a stress, the visceral system issues the non-adrenalin that makes heart beat faster. When the body is relaxed, the parasympathetic system slows down the cardiac rhythm issuing the acetylcholine.

The blood circulation is slowed down by the friction of the blood inside the blood vessel walls,

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what is called peripheral resistance. The brain needs a constant blood flow, of approx. 0,75 l/min. The heart muscle continuously contracts of approx. 150 min^{-1}. On the right atrium's wall there is the sinusoidal node that controls and adjusts the electrical impulses. The sino-atrial node is placed at the flowing place of the superior vein. The nodal tissue has the property of self-exciting and of leading the impulses created at its level, it is also called the heart's conductor system. The nodal tissue is the only connection between the atria and ventricles myocardium. The heart presents proper veining, intercardiac. The speed of the electrical impulses through the atrial myocardium and the ventricular one is of 0, 3 – 0,5 m/s.

Between the atrial and ventricle activity there is a delay of 0,1 s. This allows the atria to contract before the ventricles and to pump the blood to the ventricles before their contraction (systole). Thus, the atria function as primary pumps for the ventricles. The heart is endowed with a specialized system that generates rhythmic impulses in order to produce rhythmic cardiac contractions and in order to quickly lead these impulses all over the heart. When this system functions normally, the atria contract with approx one-tenth second earlier than the ventricles, being able to perform an additional filling of the ventricles, before these should pump the blood to the lungs and to the peripheral circulation.

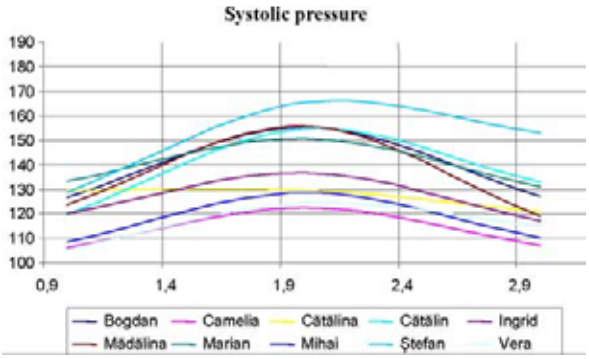

Figure 2. The graphics of the systolic pressure depending on time

The excite-conductor system of the heart is made of:

- Sinusoidal node (called also the sino-atrial node or S-A node),
- Internodes ways, that leads the impulses from the sinusoidal node to the AV node,
- The atrio-ventricle node (or AV node) where a delay of atria impulses takes place before these should pump to the ventricles,
- The right and left branch of His fascicle made of Purkinje fibres that lead the cardiac impulses from the atria to ventricles.

The time since the sinusoidal impulse entered the AV fascicle branches and till it reaches the terminal ramifications of Purkinje net, is of 0,03 s, so, from the moment the cardiac impulse entered the Purkinje system, the excitation takes place instantly all over the surface of the ventricle myocardium.

Along the cardiac impulses disseminate inside the heart, the electrical power is spread in the tissues around the heart, and a small part of them reach at the surface of the body.

If we put some electrodes on the skin, on each side if the heart, the electrical power can be registered due to a device called electrocardiograph. This receives electrical signal and registers them on a sheet of paper called electrocardiogram. This procedure can be easily used if we use EKG sensor from Vernier together with Go!-Link device with computer interface.

The electrocardiogram is a method of heart investigation based of the registration of the electrical phenomena that take place during the cardiac activity.

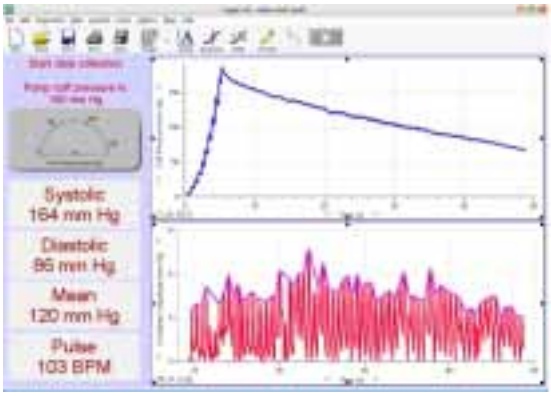

Figure 3. Computer's graphic

A normal electrocardiogram is made of P wave, a QRS complex and a T wave. The P wave is determined by the electrical potential generated by the atrial depolarization that precedes the ventricle myocardium contraction. Both P wave and the components of QRS complex are considered depolarization waves. The T wave is determined by the potentials generated on the moment the ventricle is recovered from the depolarization condition. This wave is a repolarization one and it appears at

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approx. 0,25-0,35s after the depolarization and the repolarization process lasts approx. 0,15s.

Figure 4, Computer's graphics and photos

When an electrode is directly paced on the heart, and another one somewhere on the body, the voltage of QRS can be of 3-4 mV. When the electrocardiogram is registered with electrodes on both arms or an arm and one leg, the voltage of QRS is of approx. 1mV from the top of R wave till S wave, the voltage of P wave is between 0,1-0,3 mV, and the one of T wave between 0,2-0,3 mV. The period between the beginning of P wave and the QRS represents the interval between the beginning of the atrial activity and the beginning of the ventricle activity. This period of time is called PQ and it is of approx. 0,16s.

The cardiac frequency can be easily determined on the electrocardiogram, due to the fact that the interval between the two successive heartbeats is the opposite of the cardiac frequency. The E.K.G. sensor together with the Go! link device and the 3 attached electrodes can relieve the electrocardiogram by means of a computer, displaying the 5 components of a regular heartbeat that includes P wave, QRS complex and T wave.

The arterial pressure varies with a few units on each measure. If does not vary more than 3-5 units, the variation is not relevant. During the effort, the arterial pressure and the pulse raises normally. After an effort in general, the arterial pressure is expected to be lower because the lactic acid that is inside the muscles as the product of the metabolism has the function to expand the arteries that is why the arterial pressure diminishes in comparison with the initial measure. This variation depends of the subject's physical condition.

The subject whose arterial pressure diminishes quickly to normal after the effort has a good physical condition. But, if the arterial pressure and the pulse do not come back to normal within 3-5 minutes, the subject does not have a good physical condition or he can have an abnormal cardiac condition that leads to this extended reaction of coming back to normal.

These extraschool activities have as a target:

- The ability of understanding and interpreting the phenomena in interdisciplinary correlation, using the laws, principles, and the proper language for the biology, chemistry and physics
- The motivation appraisal for science and the support the technology offers.
- Putting aside the spoiled visions upon the phenomena that lead to a "pseudo-knowledge", and the creation of a general culture on scientific base. The knowledge of the risk factors in case the diseases that might appear on heart functioning and their moving away for having a healthy life.
- The computer has become requisite due to the fact that stimulates both the theory and the experimental activities by performing direct connection between them.

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 ISBN 978-989-95336-1-5

Science Fairs as an Annual Students Project

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Abstract. Science fairs are events currently organized in order to increase students' interest and curiosity about science. While improving their science awareness students develop fundamental competencies while pursuing their scientific projects. In this communication we present the organization steps of a science fair developed to and by students, 12 to 15 years old, as an extracurricular activity, from December 2006 to late June 2007, at the basic school Externato Maria Auxiliadora in Viana do Castelo, Portugal.

In this event it was proposed to the students to chose and explore a science project to be developed by themselves, individually or in group, aiming the presentation of its results at a school' science fair to take place at the end of the school year and where a jury would select the best scientific project.

Along the year it was given the opportunity to the students to search information relevant to the development of the project. The laboratory of the school was open to students that prefer to work at school in their free time. Students tested different hypothesis about their themes and draw their own conclusions. Finally they create a poster, a presentation of their experiment/work, and prepare themselves to answer the questions of colleagues and other visitors of the science fair.

This activity promoted, along the year, a better relationship of the students with science, increasing their curiosity, and understanding of different daily life phenomena. This activity also increased their research, information selection, organization and team work capabilities.

The main goal of this work was to explore and understand the better way to develop this type of events and to find how it's possible to have some success among Portuguese students. With this experience it was possible to learn some aspects of science fairs that need to be taken in account for a better work with students. We hope this study may be useful to basic school teachers planning to organize science fair or similar events at their schools.

Keywords. Science Fair, Hands-on, Basic Schools, Physics, Chemistry.

1. Introduction

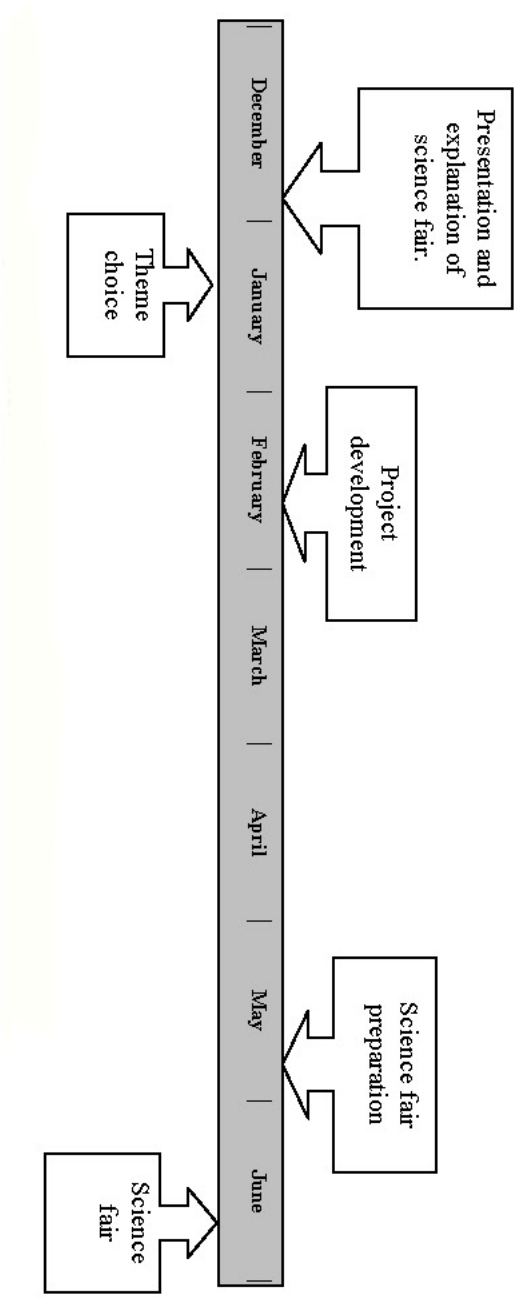

Figure 1. Chronogram of science fair project stages during the school year

In School Education the teacher, the classes, the study' organization, the school, the social environment… everything is important and will condition the effectiveness of student's learning process. However if we want our students to learn and care about science, we have to stimulate and offer them the opportunity to put in

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practice what they are learning or have learned, because for the vast majority of students the better way to "learn is by doing" [1].

Young students had to be stimulated to science and one of the fine ways to do it is by developing scientific projects, like in science fairs, because they offer a better comprehension of science and nature developing skills, fundamental in science but also in the every day life, and promote a more critical opinion in face of problems [2]. Despite the importance of this kind of activities, in Portugal events like these are still rare, and there is almost no specific literature that could help us in this organization process. There for it was decided to study and organize a science fair in Externato Maria Auxiliadora. The final objective was to promote, in the last week of school' classes, a science fair were students present their work at the school and community.

2. Annual Project Phases

The science fair organization was divided in five different stages. The deadlines in Figure 1 aren't strict, and not every student developed their project in the same period of time.

The first step, at the end of December 2006, was to present the idea of doing a science fair project to the students, so they can be able to think about a project during Christmas vacations. When we explained to the students what a science fair is all about and proposed them to participate, curiously most of them already knew the meaning of science fairs in spite they never participate or attended one. Most of them show interest in participate, despite the fact that they will have to work in their spare time.

Figure 2. Students working (laboratory)

At the beginning, the science fair projects were only expected to be performed by students with ages between twelve and fifteen years old, due to the fact that they had already a certain background level of knowledge of science at the extent we expected to be needed or advisable for the type of activity we envisaged. However, some younger students show interest in the science fair project, having some good ideas, and it was decided to let them participate.

At the restart of classes, early January, it was defined in the school to schedule three hours per week, during lunch time, for the participating students to work on the project at school. The students had access to the school computers and laboratory, to do their research and test theirs projects, like we can see in Figure 2. However, most of the students prefer to develop their project at home, only working at school when they needed some guidance.

The first weeks were dedicating to research, allowing the students to gather some information about previous ideas, to finding new ones, to "know" more about their subjects.

Since middle of February the project development phase begun. The time available in the schedule were only dedicated to the development of the project. In this stage, students assumed the role of a scientist: they search, observe, experiment and explore and try to prove different hypotheses [1]. The student enthusiasm on working in this kind of projects has leaded some of them to develop more than one science fair project.

The last stage before the science fair is the preparation of the presentation they should deliver at the science fair. Most of the students started to prepare their presentation at the end of May. They create posters to post on the science fair day, like we can see in Figure 3. The structure of the poster was optional, but all of them should contain the identification and a general idea of the experiment. Obviously it should be attractive and the ideas should be presented clearly and correct scientifically [5].

Figure 3. Students preparing the science fair presentation

3. The Teacher's Role

The first guidance that the teacher needs to develop this type of activities to lead the students

 ISBN 978-989-95336-1-5

to a science field interesting to them [3] ,in which they can select an every day life phenomenon that they don't understand but would like to know more about, or select a previously known experimentation, yet without repeating a previously done work [1].

Despite the enthusiasm shown by the students, it's important to refute their, frequent, previous idea that developing a science fair project is to replicate an experiment previously seen on television or on the internet.

The first obstacle is when or if the students realize that is not simple to reproduce an experiment. Also when it is necessary to improve the work most of the students don't know what to do. So, it's necessary to follow and encourage the students, especially when there project don't work, or when it doesn't happen what they expected.

The role of the teacher is thus to help students to work and reason and don't let them give up. Whenever possible the professor should guide the students to perform better and improve their projects even more [4]

Another important aspect is not forgetting to remind the students that they have to finish there project before the deadline, because most of them think that they have… always… enough time.

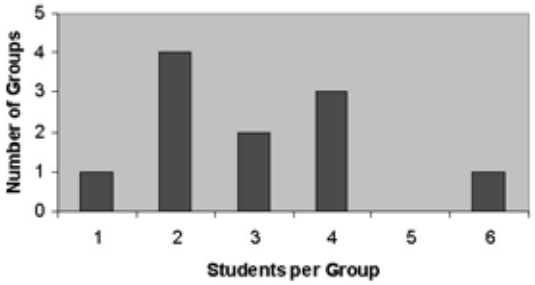

Figure 4. Distribution of students per group

The teacher needs to be "always" asking the students how the work is doing, so they don't forget that they have to finish it and feel supported… but not "pushed". This attitude is to prevent that, when it appears some aspects that the students don't expect or if they can't finish the project on time, they don't lose their motivation interest and goals. The teacher encourages the students, so they can see that we care about their projects and their efforts [3].

It's very important to help the students preparing the science fair presentations too, because they can learn more when they have to teach the others, and if the explanation is attractive and clear everyone can learn with it… and the students will feel it!

4. The Science Fair

At the science fair, there were fifteen experiments presented by eleven groups of students organized as we can see in Figure 4.

The difference between the number of groups and the number of projects were due to the fact that some groups developed more than one project, as is possible to see in Table 1. This fact diverted the students from the initial objective of the science fair, which is the understanding the science behind the experiment, leading them to a somehow under-development of each individual project.

Table 1. Name and number of projects per group

Group	Nº of elements per group	Project
1	1	Volcano
2	2	"Fluver"
3	6	Imploding can Volcano Resonance frequency
4	4	Coca-cola effects
5	2	Lamp
6	3	Curie effect Solar watch
7	4	"Glass of champagne"
8	2	Perfumes Changing colour solution
9	3	Compass
10	4	Bearing car
11	2	An egg in a bottle

Not all groups that participated in the process through the year lead the work until end, and were not present at the fair, mainly because they had no enough time, for instance, due to the fact that they started later than other groups. Some of them were actually obtaining some results but didn't want to participate because the project wasn't entirely concluded. This fact in one hand could show their levels of exigency on them selves but also, eventually for some students, that their main worry is to reproduce the experiment, disregarding the fact that the most important thing was their learning process.

The projects presented at the fair were distributed between chemistry and physics subjects, as it can be seen in the graph of Figure 5.

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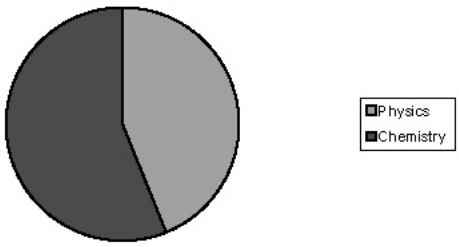

Figure 5. Distribution of the projects between the science fields

One important aspect of this science fair was the participation of one student with special needs. He decided to develop the project individually (yet with some help from other students, on their own initiative), and presented it at the science fair, quite successfully, in spite the low expectations of everyone. This student needed to be helped in a lot of matters during the year but it was possible to verify his increasing interest and a large evolution along the way.

Figure 6. The winning groups (perfumes at left and the bearing car at the right)

The science fair projects needed, finally, to be evaluated. A jury was formed the included school' teachers in different subjects, and they were unanimous on choosing the winning group. Despite of having a lot of well done projects the two winning groups demonstrate a larger interest in their project: the perfumes and the Bearing car, Figure 6. They didn't worry only on to replicate experiments but researched their topics, investigated, innovated and were even able to talk about fails and discoveries (unlike some others that mainly worry about the final result). One of the most important aspects was that they were able to explain their project in an exceptionally clear way and with scientific accuracy.

5. Conclusion

It was clearly proven with our experiment that a science fair project develop different positive attitudes in the students involved. Even students that didn't participated had shown interest and curiosity about science and science fairs.

One difficulty detected is the fact that students mainly value the "experiment it self" and valued not enough the research they had to perform and the doubts and ideas they came up with and explored, often not realizing the fact that they acted like scientists.

The students acquire with this type of activities a greater interest and knowledge on Science. They developed also a positive curiosity about the science fair projects made by other students, about daily life phenomenon and other themes discussed at classes.

Student's participation in the regular classes improved clearly, in general, after they started to develop their science fair project. This happened not only because the relationship between student and teacher changed by working in an informal way, but also because students started to develop more interest about class' issues.

Science fairs' activities promote creativity, autonomy, research capabilities, and scientific knowledge.

Students understand better what science is and that it is present in everything that surrounds them.

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Thermonuclear Power Plant Model

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Abstract. This paper describes a model of a thermonuclear power plant with a very detailed electrical substation. The model includes facilities such as an operational railroad, a train shed, a container crane and two diesel oil filling stations. The result is very eye-catching and most suitable for the classroom or science-fair events. A brief technical explanation on the components of real-world nuclear power plants and electrical substations is also given.

 ISBN 978-989-95336-1-5

Keywords. Power Plants, Nuclear Energy, Electrical Substations, Science-Fairs.

1. Introduction

Scale models may be very useful aids to science teaching or divulgation. This paper describes an eye-catching 85cm x 40cm N scale (1:160) model of a thermonuclear power plant with electrical substation (Figure 1 and Figure 2) built for educational purposes. It has been successfully used in classes and in science-fair events. Section 2 lists the main materials used to build the model.

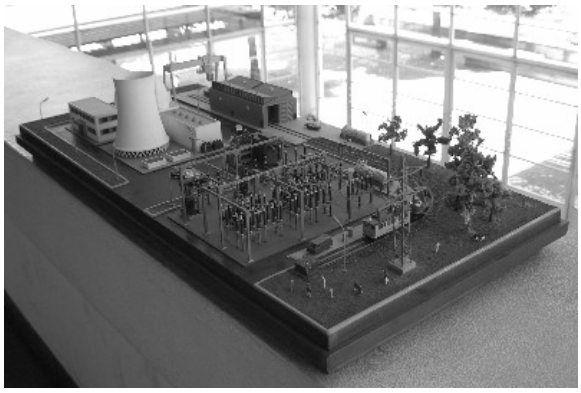

Figure 1. Thermonuclear power plant model

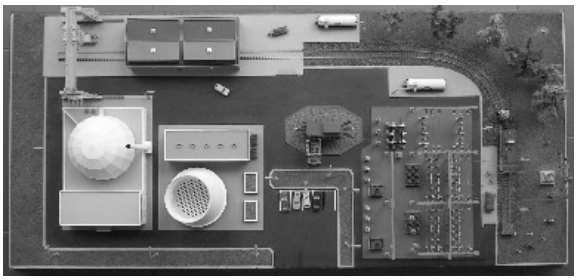

Figure 2. Top view of the model

Section 3 presents the model components and gives a brief technical explanation on the main components of real-world nuclear power plants and electrical substations. Section 4 gives some details on an operational railroad integrated in the model. Section 5 contains the conclusions of the paper and a list of references is given in Section 6.

2. Materials used to build the model

The main materials used to build the model were the following:

- 1 *Heljan* nuclear power plant kit, ref. 1718,
- 1 *Revell* transmission substation kit, ref. 2018,
- 1 *Revell* power transformer kit, ref. 2015,
- 1 *Brawa* metallic high voltage towers set, ref. 2659,
- 1 *Peco* train shed unit kit, ref. NB-80,
- 1 *Vollmer* container crane kit, ref. 7905,
- 1 *Kibri* diesel oil filling station kit, ref. 7430,
- 1 *Fleischmann* N scale electric locomotive, ref. 7968,
- 1 *Seuthe* smoke generator, ref. 100,
- 6 *Fleishmann* N scale model cars,
- 1 *Fleishmann* N scale van,
- 1 *Busch* transfer traffic symbols, ref. N 7197,
- 1 *Preiser* set of 6 N scale workmen, ref. 09105/79105,
- 1 *Preiser* set of 6 N scale cows, ref. 09155/79155,
- 16 nuclear waste containers,
- 1 loudspeaker magnet,
- 1 *Bachman* N scale bogie,
- 1m of *Peco* N scale flexible track,
- 1 N scale railroad sandbox,
- 2 reed relays,
- 6 switches,
- 15cm of brass tube with diameter 0,95cm,
- 5 sets of 3 *Viessmann* N scale brass street lamps, ref. 6690,
- 5 sets of 3 *Viessmann* light bulbs (16V, 30mA, 1,8mm), ref. 6228,
- 8 miniature 12V light bulbs,
- 6 LEDs,
- 7 N scale trees.

Other materials include a wooden base, balsa wood, plastic glue, white glue, enamel and acrylic paints, cardboard, light cardboard, double-sided adhesive tape, green and multi-coloured sawdust, electric wire, a power transformer and the electronic components used in the circuits that monitor and control the train movements.

3. Model components and real-world nuclear power plant components

The model has a main building with nuclear reactor, an electric generator house, a cooling tower (Figure 3) and an electrical substation (Figure 4). It also includes facilities such as an operational railroad, a train shed, a container crane (Figure 5) and two diesel oil filling stations (Figure 6).

The main building has its own interior illumination and a smoking chimney that actually works. The original plastic chimney was replaced with a brass one equipped with a smoke generator. The train shed and the cooling tower

 ISBN 978-989-95336-1-5

bottom also have interior illumination. Street lamps illuminate the other facilities and a red signalling lamp lies at the top of the crane. The substation is very detailed, with a three-phase power transformer, section breakers and other components. Some workmen, cars, a van, nuclear waste containers, trees and even a few cows complete the environment. The rest of this section contains a brief technical explanation on the main components of real-world nuclear power plants and electrical substations.

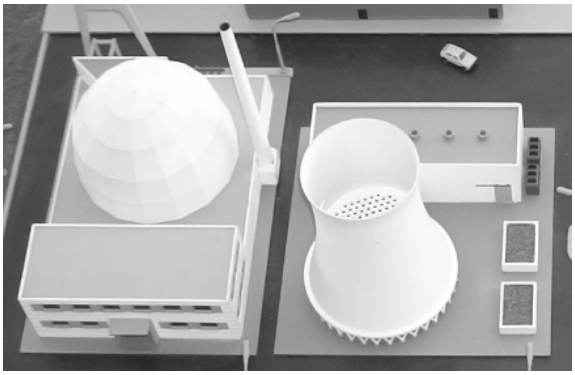

Figure 3. Main building with nuclear reactor (left), generator house and cooling tower (right)

3.1. Nuclear power plants

Nuclear power plants are thermal power plants that convert heat produced by nuclear fission into electricity. They contain a nuclear reactor, where nuclear fission takes place, a heat transfer system, which heats water until it is converted into steam, a steam turbine mechanically connected to a synchronous generator, used to convert steam pressure into rotational movement, thus producing electricity, and a steam cooling system, to convert steam into water again. Overall efficiency of these power plants is between 30% and 40%, due to inherent low efficiency of thermal machines [1].

Nuclear reactors are devices were controlled nuclear chain reactions occur, generating heat that will be converted into electricity. There are several types of nuclear reactors.

The **Pressure-Water Reactor** (**PWR**) is the most common type of reactor in power plants around the world [2]. Water is used as a coolant and neutron moderator under such a high pressure that it does not form steam. Some reactors use light water (ordinary water, H_2O). The others use heavy water (water with deuterium isotope, D_2O). Two cooling circuits are used: in the primary circuit, the coolant is kept at very high pressure, transporting heat from the nuclear core to a heat exchanger and a pump keeps the coolant flowing, in the secondary circuit, another pump inserts water in the heat exchanger, were it turns into steam, which will be conducted to the steam turbine. Then, the steam coming from the turbine is condensed into water again.

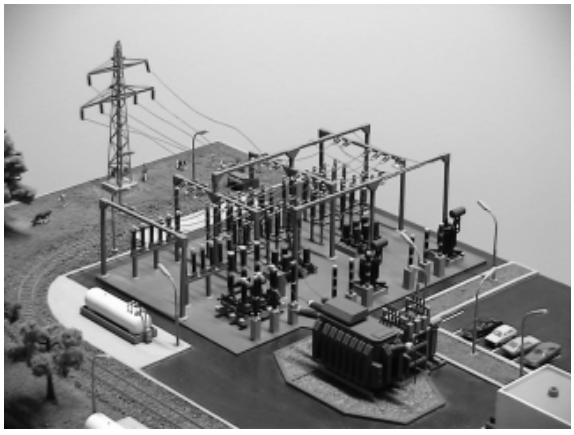

Figure 4. Electrical substation

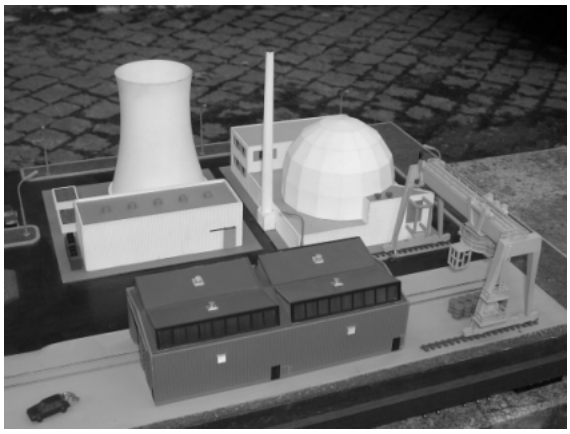

Figure 5. Train shed and container crane in the foreground

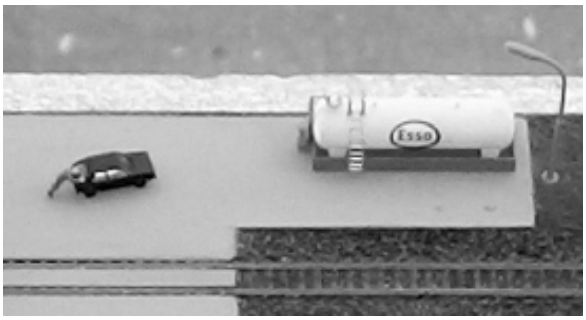

Figure 6. Diesel oil filling station

PWR reactors have some advantages: they are very stable, because they have the tendency to produce less power as temperature rises, they may use natural uranium dioxide as fuel, although heavy water must be used in this case,

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the turbine is unlikely to be contaminated by radioactive materials, because it is in a secondary cooling circuit, and control rods are inserted from the top, making them easy to insert in the reactor if power fails. On the other hand, there are also some disadvantages: the primary coolant circuit must be kept at very high pressure, raising the risk of accident due to a fracture in the circuit, most of these reactors can't be refuelled while in operation, a sudden coolant temperature descent would raise power production, causing emergency shut down of the reactor.

Steam turbines are used to convert steam pressure differential into mechanical rotation movement. They consist of a high-pressure (HP) turbine, a medium-pressure (MP) turbine and a low-pressure (LP) turbine, usually mounted on the same shaft, connected to an electric generator. Each turbine has many radial blades that deflect the steam, producing torque. The size of the blades (and, therefore, the diameter of the turbine) depends on the steam pressure: the blades of LP turbines are the longest and the blades of HP turbines are the shortest.

The **condenser** is responsible for diminishing low-pressure steam temperature until it condenses into water again. Enormous quantities of fresh water are needed to carry the heat away from the condenser. The cooling water may be driven from a river, or from a cooling tower, and its temperature typically increases 5ºC to 10ºC.

Cooling towers are needed when the power plant is located in a dry region, or when the heating of water streams is undesirable. The cooling towers freshen up the condenser by means of evaporation. The circulating water is exposed to the surrounding air by means of creating an artificial rain inside the tower: the hot water coming from the condenser is fed to the top of the tower where there are lots of small pipes with holes, then, the water is dropped on an open reservoir placed on the tower's bottom, where water may be pumped to the condenser again. A small part of the water is lost in the process, but can easily be replaced from a stream.

3.2. Electrical substations

An electrical substation is the part of an electrical energy system where line voltage and current levels are modified using power transformers, in order to diminish system installation and operation costs. There are three types of substations, along and electrical energy system: the generating substation, the transmission substation and the distribution substation.

Electrical power plants generate electricity by means of synchronous machines working as generators, called alternators. For technical reasons, these machines output voltages are limited to a few kV (18kV, for example). So, it is necessary to raise the generated medium-voltage to the high-voltage levels necessary to transmit the energy economically. This transformation is accomplished by **power transformers** existing in generating substations. The model described in this paper has a substation of this type, however, all types of substations are similar.

Besides power transformers, substations usually contain the following equipments: circuit breakers, air-break switches, disconnecting switches, grounding switches, surge arresters, current-limiting reactors, grounding transformers, and measurement transformers [1]. The model contains some of these elements (Figure 7, Figure 8 and Figure 9).

Circuit breakers are designed to interrupt normal or short-circuit currents. They may be remotely operated by a human supervisor, and they automatically open when electric parameters (current, voltage, etc.) become off their limits. There are five types of medium/high-voltage circuit breakers: oil, minimum oil, air-blast, sulphur hexafluoride and vacuum circuit breakers. Each type has some advantages and some disadvantages.

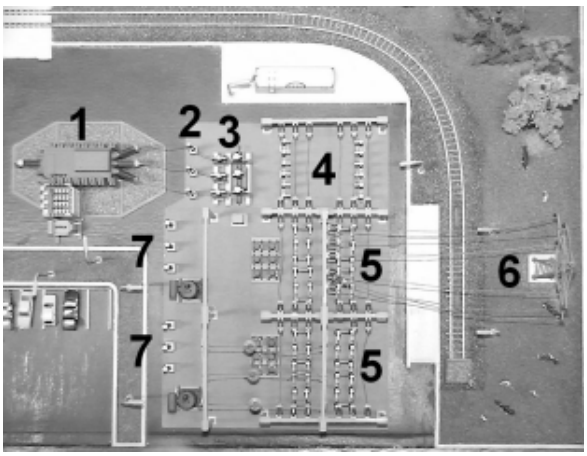

Figure 7. Electrical substation layout: 1 – main transformer with underground feeder, 2 – measurement transformers, 3 – main circuit breakers, 4 – main bus, 5 – main bus air break and disconnecting switches, 6 – outgoing main power line, 7 – outgoing secondary lines (not mounted)

Oil circuit breakers have a steel container and their moving contacts are immersed is insulating oil. When a fault occurs, a spring is released,

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and the contacts are opened. An electric arc is produced, which volatilizes the oil around the contacts, producing a turbulence that renews the oil around the contacts, thus extinguishing the arc. These circuit breakers are relatively simple, but have the danger of explosion and use oil that is very aggressive to the environment.

Minimum oil volume circuit breakers use the same working principle, but they have an explosion chamber around the contacts and moving pistons, which inject high pressure fresh oil in the chamber where the arc is formed. They are more efficient than the first type and require lesser quantity of oil, reducing environment hazards and explosion risk.

Air-blast circuit breakers have the moving contacts inside a chamber where very high-pressure air is blown into when the contacts open, causing the arc to be extinguished. The high-pressure air is stored in containers, near the circuit breakers. This type of circuit breakers has enormous cutting power and is used in the highest voltages. However, the noise of operation is so loud that exhaust systems are required and they cannot be used near residential areas.

Sulphur hexafluoride (SF6) circuit breakers are totally enclosed, having their moving contacts sealed inside arc chambers filled with insulating gas SF6. They usually have moving parts, which renew the SF6 in the arc extinction chamber when the contacts open. This type of circuit breaker is usually used when space is critical, because they are the smallest type. Operation noise is also relatively reduced.

Vacuum circuit breakers use a working principle that is different from the one used by other types of circuit breakers: their arc chambers and moving contacts are sealed in vacuum, instead of some insulating material. They need very little maintenance, as the contacts never become polluted, and they are also very silent. However, their maximum rated voltage is about 30kV. They are used in places of difficult access, for example in underground distribution systems.

Air-break switches have a moving blade that engages a fixed contact, both mounted in insulating supports, operating in free-air. These switches are able to cut transformer excitation currents and line no load currents. They have arcing horns, where electric arc is formed when they are opened, the arc moves upward, becoming longer, and eventually extinguishing itself.

Disconnecting switches are similar to air-break switches, but they can't interrupt any current at all: they must be operated only when no current flows through them. Disconnecting switches are intended to provide visible isolation of other components (transformers, circuit breakers, lines, etc.). These switches are constructed in the most simple and reliable way, without springs or other complicated mechanisms. When they are opened, gravity tends to maintain them that way.

Grounding switches are devices used to assure that lines are definitely connected to the ground (for maintenance security, for example). They have a moving blade similar to a disconnecting switch, for each phase. Obviously, they are operated only when line voltage is zero.

Surge arresters are intended to protect several devices – namely, transformers – from over-voltages that may occur due to thunderstorms or switching surges. They are connected to the ground and provide a low impedance path for discharging surges directly to the ground, avoiding any damages in other more sensitive equipments. At normal voltage operation, they should remain with high impedance.

Current-limiting reactors are connected in series with the power lines, in order to increase short-circuit impedance and control short-circuit current gradient. The voltage levels involved are very high and overall impedance is low. So, without current-limiting reactors, the short-circuit currents would be enormous and circuit-breakers wouldn't be capable of cutting them. That would result in severe damages in many expensive and slow to repair components of the power grid.

Grounding transformers are used when it is necessary to create a neutral wire on a three-phase, three-wire system, transforming it in a three-phase, four-wire system. Usually, these transformers are three-phase autotransformers connected in zigzag, with the middle point connected to the ground. This helps keeping system balanced in the case of connecting single-phase loads between one line and the neutral.

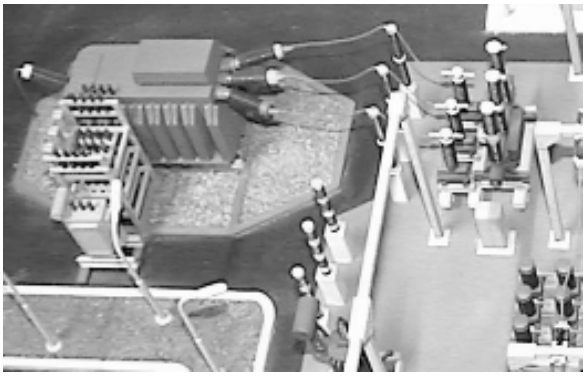

Figure 8. Close-up on main transformer (left) and circuit breakers (right)

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Measurement transformers are used to reduce voltage and current to safer levels, in order to measure or monitor voltages and currents on the transmission lines and to provide electrical isolation between measurement and power lines.

There are two types of measurement transformers: voltage transformers, whose primary winding is connected in parallel with the lines, and current transformers, connected in series with the lines.

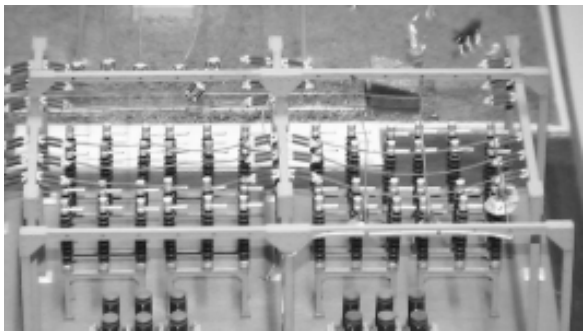

Figure 9. Close-up on main bus air break and disconnecting switches

Figure 10. Locomotive with container carrier

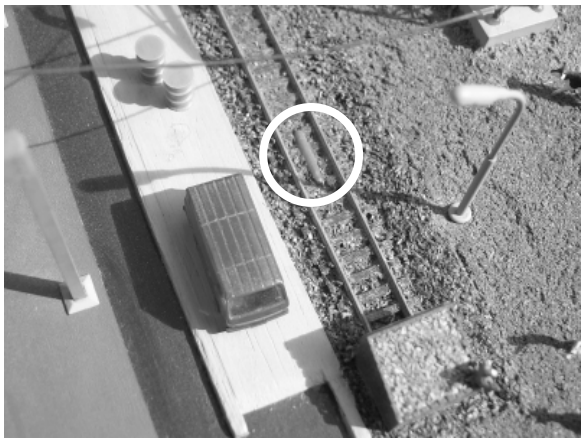

Figure 11. Reed relay placed between the rails

4. Some details on the model railroad construction and operation

The model railroad is used by a locomotive that pulls a container carrier (Figure 10). This latter was built by fastening a loudspeaker magnet to a model coach bogie. Two reed relays placed on each extremity of the track (Figure 11) are connected to a logic and timing electronic circuit (Figure 12). This circuit controls a locomotive motor drive [3] connected to the rails. The motor of the locomotive is powered via its wheels. When the container carrier passes over a reed, its contacts close, the logic and timing circuit makes the train stop for a few seconds, then, the train sense of motion is reversed and the train is set to move again.

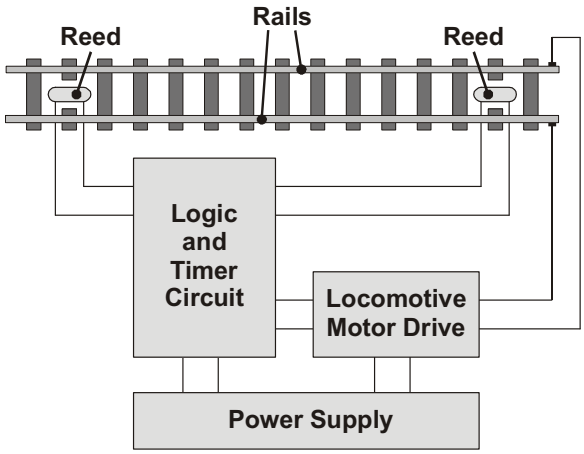

Figure 12. Train control system

5. Conclusions

A model of a thermonuclear power plant with electrical substation, built for educational purposes, has been described. Some construction details were explained. A brief technical explanation on the main components of real-world nuclear power plants and electrical substations was also given.

The model is very eye-catching and most suitable for classes or science-fair events. It has been successfully used in both kinds of activities.

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Children's Perceptions on Endangered Species and Threatened Environments: Results from Unique and Universal Project

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Abstract. A sample of twenty-one fifth grade Turkish students who participated in the first year (2005) of the Project was considered for the present paper. Turkish students' perceptions were reflected here by considering their responses to pre- and post- administration of the data collection instruments. Their responses to knowledge test, attitude questionnaire, and open-ended questions taking place in the focus-group interview were analyzed in this paper. The results revealed students' conceptions about endangered species, particularly Yanardöner plant, their attitudes toward the endangered species and threatened environments and their motivation to act for helping protect those environmental values.

Keywords. Endangered Species, Threatened Ecosystems, Environmental Literacy

1. Introduction

Taking children to field trips can expand their understanding of concepts by letting them observe social and ecological systems, and concepts of world around them [1], because field trips help them obtain first-hand experiences in using scientific strategies (e.g. observing, collection and analyzing information, and drawing conclusion). Out-of-class experiences and activities, e.g. field trips, give pupils the opportunities to involve in direct contact with the various aspects of the environment [2] and engaging in these outdoor opportunities promote the pupils to develop affective (responsibility, sensitivity, self-confidence…etc) and action skills (responsible behaviours) as well as cognitive skills (knowledge) [2, 3]. Field work studies / field trips also allow pupils to observe, record, analyze, preset and interpret their own analysis and investigation [4]. Children can easily grasp the language of the nature and the cause-effect relationship within the nature when they are given chance to go to the natural environments (regions). This also helps students internalize the theory and abstract concepts taught during the classes.

As it is apparent in the findings of the existing research studies done with primary school students in Turkey [5, 6], lower grade students had some misconceptions about the ecological and environmental sciences concepts because of the previous experiences, peer talk and wrong orientations. Taking them to field trips and giving them chance to meet natural environment and to observe, collect data …etc can overcome their misconceptions.

U&U project aims at filling the gap between theory and the practice. Taking the children to the field trips and allowing them to have not only hands-on but also minds-on experiences, promotes the students to develop environmental literacy which is one of the ultimate aims of the environmental education. When students start to learn how eco-system functions and about environmental action strategies, they can start to develop responsible environmental behaviour (REB) [7]

1.1. International U&U Project

U&U project that aims to be global and tries to reach children from different countries was started in September 2005 with the coordination of METU Foundation School, Turkey. Today, the Project is in its second year with the growing participation of different countries. The primary school students from Turkey, Romania and USA participated in the project in 2005 and then 2006. A group of Bulgarian students indicated their desire to participate in to the Project in 2006.

With this project, it is aimed to reach the children from all around the World and help them become aware of global values which are endangered species and threatened (regions) environments in this project. Within the project, students are taken to the field trips, wetlands and lakes (nearby to their schools) under the guidance of their coordinator teacher, and they are encouraged and guided to observe cause-effect relationship in the natural environment. Students witness the possible problems in those areas and try to find ways for solving and preventing these problems.

 ISBN 978-989-95336-1-5

1.2. Purpose of the study

The main purpose of the study was to reveal Turkish elementary school students' perceptions on endangered species and threatened environment. This paper presents in-depth analysis of findings of the case study focused upon Turkish children's perceptions on these topics.

2. Methodology

Turkish students' perceptions in the first year (2005) of the Project were reflected here by considering their responses to pre- and post-administration of the data collection instruments. The results revealed students' conceptions about endangered species, particularly Yanardöner plant *(Centaurea tchihatcheffii)*, also called as love flower, which is endemic and endangered, their attitudes toward the endangered species and threatened environments, and their motivation to act for helping protect those environmental values.

2.1. Sample and Sampling

Even though U&U was an international project including three elementary schools each from Turkey, Romania and USA (in 2005), this paper only focused upon a group of students from Turkey.

Twenty-one fifth grade Turkish students constituted the sample of the present study. These students were selected based upon their volunteer participation from coordinator school [coordinator of the U&U Project], METU Foundation School, Ankara, Turkey. All the fifth grade classes were contacted and asked for their participation in the project. A total number of 21 students (10 female, 11 male) showed an interest to participate in the project.

Along with a consent form, an invitation letter was sent to their parents. Parents kindly proved the consent form for their children's participation in the project, and accepted the invitation letter to attend in field trips and some of the student presentations.

2.2. Data Collection Instruments

Six different data collection instruments developed by the researchers were used. Each of the instruments pertained to any components of environmental literacy structured by Volk and McBeth [8].

The Knowledge Test including eight open-ended questions was designed to investigate primary school children's knowledge about endangered species and threatened regions, and to determine their source of knowledge on these topics.

The Attitude Questionnaire was designed to investigate primary school children's attitudes toward endangered species and threatened regions. The instrument consisted of 13 closed-ended items on a 4 point Likert-type scale (1-strongly disagree, 2-disagree, 3-agree and 4-strongly agree). For each item, the students were required to explain the reasons behind their tendencies and responses.

The picture form was designed to determine to what extent the students know the characteristics of the endangered species they were studying. The students were asked to draw a picture of Yanardoner Plant. The students were also required to indicate the characteristics of this species.

During the field trips, two different *Field Tests* developed by the coordinator teacher were used. The first one was designed to determine students' knowledge about the scientific experiments (identifying problem(s), determining variable(s), collecting data, interpreting data and presenting the results/findings) carried out during the field trips. The second one was designed to determine the students' knowledge of the endangered species upon which they focused.

The Interview Schedule including thirteen open-ended items was designed to investigate the students' perceptions on endangered species, threatened regions and the contributions of the project to themselves.

2.3. Data collection process

In order to assess students' outcomes and attainments, and to determine the extent to which the objectives of the project were attained, the instruments were administered to the students at the different time intervals during the project.

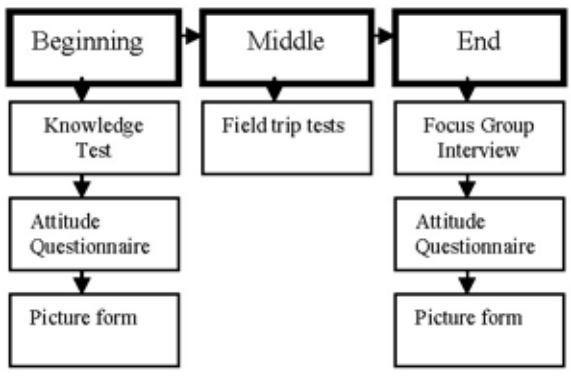

Figure.1 Data collection instruments used during the project

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The data collection process was realized in three main steps, *at the beginning, in the middle, and at the end*. How and when these instruments were administered was explained below.

(a) Data Collection at the Beginning:

At the very beginning of the project, that is, before instructions and field trips were started, knowledge test, attitude questionnaire and picture form were given to the students and asked to fill out them in the classroom environment in order to determine students' initial knowledge about and attitudes toward endangered species and threatened environments. This process was realized to determine whether students had initial experiences, knowledge, conceptions and feelings about threatened regions and endangered species.

Having administered these instruments, regular meeting hours were scheduled by the teacher and the students and the meetings were organized with students as two class hours in each week. Then these meetings were held regularly with the participation of the students during the project. During the meetings, the Mogan Lake and surroundings were introduced to the students in an interactive environment. From time to time, the students were required to make searches in the internet and library and bring what they found to classroom to discuss on it / them with their peers.

(b) Data Collection in the Middle:

During the process, field trips were organized to the selected threatened region, which was Mogan Lake nearby the school. In addition to the threatened region, students were asked to select one of threatened and/or endangered species living around the selected region. The Turkish students selected the Yanardöner Plant *(Centaurrea tchihatcheffii)* which is located only around Mogan Lake and is one of the endangered and endemic plants to Turkey.

Before and after the field trip, field trip tests aiming to determine students' initial (pre-) and further (post-) knowledge about endangered species and threatened regions were given to the students.

First test was given to the students at the beginning and at the end of the experiments that the students carried out by themselves with the water samples taken from Mogan Lake. This test was basically about determining their problem solving skills (including the steps of identifying problem(s), determining variable(s), collecting data, interpreting data and presenting the results/findings). The students were also required to reflect what they found in their experiments and interpret those findings.

Second test was given to the students during examining the Yanardoner Plant located around the Mogan Lake. The students were required to fill out the test based upon their observations, presentations done in the meetings and the search they did before the field trips.

(c) Data Collection at the End:

After meetings and the field trips were completed, the picture form and attitude questionnaire, which were administered initially, were again given to the students in the classroom environment. Alternative to knowledge test, focus group interview was carried out with the students who were put into groups of five, two groups of five students, two groups of four students and one group of three students. The timetable for focus group interview was scheduled with the students and conducted in three weeks. Focus group interviews were carried out with these groups separately in the science laboratory in which the students felt themselves acquainted and comfortable.

2.4. Data Analysis

Since the project was under pilot testing, the instruments prepared were also piloted and tried to be validated. The data collected at the very beginning was analyzed initially and the necessary changes like wording were made for the last administration. Furthermore, most of the items in the interview schedule were developed based upon students' responses to knowledge test.

Since the instruments included not only open ended but also closed ended items, both qualitative and quantitative data analyses methods were employed. Once all the data was gathered from the participants, the data analysis procedure could begin.

Since the attitude questionnaire includes closed ended items with explanations, the responses given to those items were analyzed by use of descriptive statistics, particularly mean, standard deviation, percentage, and frequency. The explanations of each item were content analyzed. Before analyzing the attitude items, the reverse items were first manipulated. The total score of attitude questionnaire ranges from eleven to forty-four. The higher the students' score, the more positive their attitude toward endangered species and threatened regions.

Students' responses to open-ended questions in the knowledge test were written in the

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separate sheet and their responses were content analyzed.

Their initial and last drawings with the explanations on Yanardoner Plant were matched and the differences were noted in the separate sheet.

Interview with the students were recorded in the cassettes and later transcribed verbatim. Five focus group interviews were coded, and the themes and/or categories were emerged from these codes.

In order to ensure confidentiality of the students, the names were not given here. Instead, the initials of the students' names and surnames and their gender are stated in the quotations and pictures.

3. Results

The findings of the study are discussed here in four main titles, (a) students' knowledge, (b) attitudes, (c) skills and (d) responsible behaviours.

3.1. Students' knowledge on endangered species and threatened environment

The students believed that there were some factors threatening to endangered and rare animals and plants. They claimed that unconscious behaviours toward the environment, destruction in living areas, air and water pollution, uncontrolled pesticide usage in agriculture, excessive hunting, urbanization, and deforestation threatened to the natural balance of the environment and endangered and rare animals and plants. Similar to species, the students also believed that some of the natural regions were threatened because of lack of regular control and protection, pollution, disposal of uncontrolled industrial and chemical waste, urbanization, uncontrolled construction, fires, using poisonous pesticides in the agriculture nearby these natural areas, natural processes themselves, hunting, and disposal of sewer.

Although there have been some protection measures taken to preserve these regions in the World and in Turkey, the students believed that these precautions and protections were not sufficient to deal with the problems. Students were more concerned about the insufficient warnings and the information about these regions and lack of awareness that people held. Students claimed that the people did not have adequate awareness and consciousness about these important regions, and the people were not sufficiently informed about these regions.

As their responses indicated, students' knowledge about other endangered species and threatened regions were limited. Even though some of the students knew about limited number of species and regions, they did not know why these were threatened.

Students reported that they got informed about the threatened regions and endangered species through the use of following sources, the internet, their teachers and schools, science books, encyclopaedias, documentaries, their parents, newspapers, the U & U project itself and the environmental club associated with the project.

As a source of their knowledge about the topics, the students asserted that the classroom instruction, classroom activities and textbooks were partially enough and/or not sufficient, because of the time limitation and structured content in the curriculum.

The students' pictures of and explanation on Yanardoner Plant indicated that their knowledge about this plants with regard to shape, characteristics, living and germination condition were limited at the very beginning of the study. However, at the end of the study, students were observed to have much more knowledge about this plant. Their drawings and explanations were more detailed. Four pictures of Yanardonar plant were selected among all drawn at the end of the study (*see picture 1*). The following four pictures reveal that students drew their pictures by considering detailed characteristics of the plants (shape of the petals, leafs, stem, roots and pistils).

The focus groups interview aiming to obtain students knowledge and opinions in-depth at the end of the study pointed out that the project meetings and field trips dramatically impacted students' knowledge on the selected topics. As reported by the students in the focus group interviews, they learned so many information regarding as Mogan Lake and the Yanardoner plants. They indicated that participating in field trips to Mogan Lake, preparing posters and presentations on these topics, making discussions with peers and parents, and searching in the internet contributed them to increase their knowledge and understanding on these topics. Their limited knowledge observed in the knowledge test was turned to be sufficient about endangered species, in particularly Yanardoner plant, and Mogan Lake and water quality assessment for these age group students.

At the very beginning of the project, the students were only talking about environmental problems which physically appeared in the natural areas (in particularly, Mogan Lake). It was emerged from the students' responses in interviews that they started to talk not only about environmental problems, but also about

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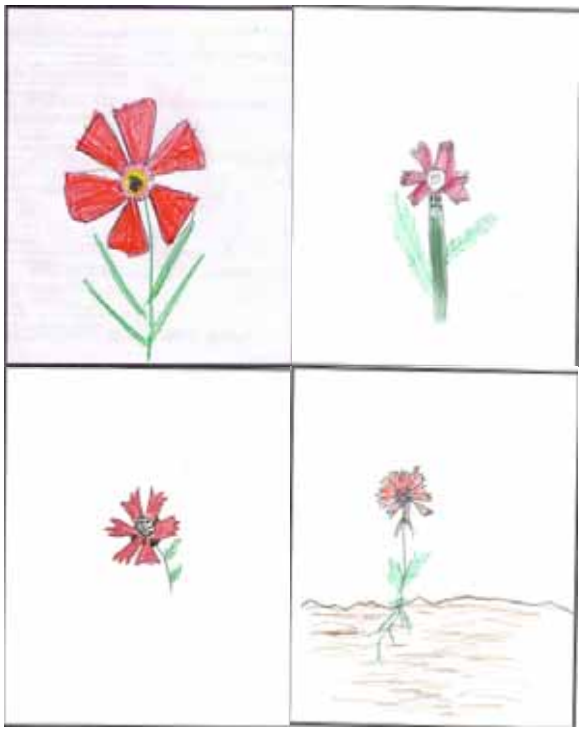
environmental issues which were more social and political in nature. These issues could be identified as disagreement associated with an environmental problem and its proposed solutions [9, 10].



Picture 1. The pictures drawn by four different students at the end of the study

3.2. Students' attitudes toward endangered species and threatened environment

Students' initial and latter attitudes toward endangered species and threatened regions were given in table 2 comparatively. Their attitudes were generally positive.

Students' pre-attitudes were appeared to be similar to their post-attitudes. The total mean score of the students from the attitude questionnaire is $\overline{X}$ (pre) = 43.87 (Sd = 3.75) and $\overline{X}$ (post) = 45.05 (Sd = 3.11) indicating their positive attitudes. The paired t-test between pre- and post-total scores indicated non-significant result, t (15) = -1.542, p>.05. Table 1 summarizes the paired t-test results.

Table 1. Paired t-test result (valid case 16)

	$\overline{X}$	Sd	t-test	Sl
Pre	43.87	3.75	-1.542	.144
Post	45.05	3.11		

The correlation between students' pre-total score and post-total score was significant at .05 significance level, r (16) = .614, p<.05.

There were observable changes only for the items numbered 5, 11 and 12. These changes suggested that the project meetings and searches in the internet and in written documents helped them become aware of protection studies done for these regions and species, and changed their attitudes slightly.

#	Item	Response ***	At the beginning	At the end
1	The endangered plants and animals are needed to be protected.	Agree	20	18
		Disagree	-	-
2	The pesticides are needed to be used under control of agriculture engineer.	Agree	17	18
		Disagree	1	-
3**	The wild animals are needed to be killed.	Agree	2	2
		Disagree	17	16
4	I am very excited when I am doing search and examination about endangered species.	Agree	17	18
		Disagree	3	-
5**	Unplanned industry, population growth, and urbanization have no negative impacts on endangered species.	Agree	4	-
		Disagree	16	18
6	Humans' doing nothing on protecting endangered species and threatened natural areas makes me unhappy.	Agree	19	17
		Disagree	1	-
7	The natural resources are needed to be used carefully and cautiously	Agree	19	18
		Disagree	-	-
8	Attending a project aiming at protecting endangered species and producing a solution make me happy.	Agree	19	18
		Disagree	-	-
9**	I am approving that human makes change on the natural areas so as to build a new building, park areas and business office based upon their needs.	Agree	3	1
		Disagree	15	16
10	Each individual in a society need to do something for protecting the endangered species.	Agree	16	18
		Disagree	2	-
11	The projects aiming at protecting the endangered species and threatened natural areas in the world are adequate.	Agree	1	7
		Disagree	16	10
12	The projects aiming at protecting the endangered species and threatened natural areas in the Turkey are adequate.	Agree	1	4
		Disagree	16	13
13	Thinking on solutions for preserving endangered species and threatened natural areas make me happy.	Agree	17	18
		Disagree	1	1

Table 2. Students' responses to attitudes items (n=21)*

*** Some of the students did not respond to some of the items in the attitude questionnaire.**
**** These items (# 3, # 5 and # 9) were reverse items.**
***** "*Agree*" indicates a total number of "Agree" and "Strongly Agree" responses, and "*Disagree*" indicates a total number of "Disagree" and "Strongly Disagree" responses**

Students' affirmative attitudes were supported with their responses to "why questions" subsequent to each closed-ended items. Students were more concerned about the rights of the living organisms. They believed that the rare and endangered species and wild animals were needed to be protected because they also had right to survive like human beings, and they were a part of ecological cycle. If those species were destroyed and killed, the natural balance and ecological cycle would be accordingly ruined. As student stated, these species were also important because they created a natural beauty in the natural environment. Some other students were concerned about economical and tourist values of these species. To the students, because of these all reasons, they have to be protected and the agriculture done within the growing and locating area of these species should be carefully planned, and the pesticides should be used under the control of agricultural engineers. Similar to protecting species, they

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believed that ensuring the sustainability of the natural and ecological balance of the natural regions was also necessary for all living organisms.

Even though a few students said boring, most of them reported that being in the project and doing research on and thinking on the solutions for protecting endangered species made them excited and happy, because by doing this, they believed that they could get informed about endangered species and try to find ways for saving their life. One of the students reported that "*When I am in the project, I feel myself like super-man. That is, I can save the life of living things*". Furthermore, they indicated that involving in these studies and projects would support endangered species' life, and some other students reported that we needed to protect them because we needed them for natural cycle.

They believed the importance of every citizen's being responsible of helping protect endangered species and threatened regions, and resolve the problems and issues. Otherwise, these species would be extinct and the natural balance would be ruined. They believed that this was necessary not only for the natural environment but also for human being them. When the natural balance was destroyed and the natural sources were depleted, this situation would directly influence the life of human being and make the life worse. As it was indicated in students' responses, they inferred dual relationship between natural environment and life of human being.

Some of the students proved that a construction(s) in natural regions could be done because we needed it, but they thought that these constructions should be done carefully so as not to interfere with natural balance and ecological cycle. The other students were totally against constructions in the natural areas, because they thought that these constructions would totally ruin the natural balance and destroy the animals' nests.

Thinking on the solutions and behaving accordingly for protecting endangered species and threatened environments made the students happy because they believed that they saved animals' and plants' life, and acted as an actor for ensuring the sustainability of the natural balance and ecological cycle.

It is apparent that some students' negative feelings (such as toward pesticide usage, feeling unexcited, the effects of uncontrolled construction, individual responsibility, and the protection studies in Turkey and in the World) observed at the very beginning were turned to be positive at the end of the project.

3.3 Students' problem solving skills

At the very beginning of the study, in the knowledge test, the students were asked about what the water quality parameters were like that they were going to test / measure by using water samples taken from Mogan Lake. A few of them indicated that they knew the meaning of one or two of those scientific terms, but nearly all of them reported that they did not know how to measure them.

During the project, the students were taken to the field trips in which they were required to observe and test three types of parameters in order to get qualitative and quantitative data. These were: (1) physical parameters of water quality such as temperature, depth, and turbidity, (2) chemical parameters of water quality such as DO, pH, nitrates, phosphates, iron and copper and (3) biological parameters of water quality, such as phytoplankton, zooplankton, insects and amphibians.

The field tests initially administrated supported to the findings of knowledge test. Under the guidance of their teacher and field assistance, each group of the students (two students in each group) were required to make observations around the Mogan Lake and determine the pollutants, take water sample from the Lake, analyze these sample by making use of easy-to-use experimental equipments, and share and discuss the results of their experiments with their peers.

The field trips and discussions among the students pointed out that the students started to critically and deeply analyze the problems in Mogan Lake through their observations, discussions, collaborations and the use of hand-on science experiments, and think about solutions of the problems in this Lake more critically.

Once the observations around the Lake and experiments with water sample were completed, the students were taken to the other area nearby the Lake. This area is the only place in the Turkey in which Yanardoner Plants are growing and germinating, and planted and protected by the biologists and scientific organizations. The students were instructed here by one of the scientist who is working on these plants. The students were required to make observation inside and outside of the protected areas and write down their observations to the second field tests given to them. Students' responses showed that students scrutinized the plants (petals, stem, roots…etc) and observed the living conditions of the plants. It was apparent in the responses that their investigation and problem solving skills were improved.

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3.4. Students' responsible environmental behaviour

At the end of the project, the students were observed to be highly motivated toward taking responsible action so as to protect endangered species and threatened regions. They indicated that even though there were some protection studies for preventing the problems in Mogan Lake and around, they were few and not sufficient to overcome all the problems. They claimed that the precautions taken for protecting particularly for Yanardoner Plants were not sufficient, either. They believed in the importance of taking responsible environmental behaviours for protecting those species and regions. The findings pointed out that Turkish children were willing to participate in the protection studies jointly coordinated by local ministry and Non-governmental organizations for the purpose of ensuring the sustainability of those species and natural regions which were located nearby their school.

Some of the students mentioned that after participating in the project, they started to go to Mogan Lake with their parents so as to pick up spilled garbage around the lake and talk to the people who came to that place for a picnic and spilled their garbage in the Lake. Furthermore, some other students talked about these topics with their families, schoolmates and relatives in order to let them know the importance of these regions and plants as environmental values.

Some students indicated that they were planning to prepare presentations and invite the people to the speeches, and to contact with other people, local NGOs and local governmental officials to encourage them to start a project and increase the awareness among the society.

4. Conclusions

An in-depth analysis of twenty-one Turkish students' responses to six different data collection instruments supported that environmental behaviour, one of the ultimate aims of EE, was associated with environmental value [2, 11], environmental knowledge [7, 11], environmental awareness [3], environmental sensitivity and self-confidence [2]. Furthermore, this study also pointed out that the more the children had awareness of the environmental problems and issues, the more they were motivated to take responsible action and act accordingly.

The children voluntarily participated in the project because they indicated that they would like to save the plants and animals, and natural regions. At the end of the project, they were observed to be fully motivated and have self-confidence to take some responsible action for protecting Mogan Lake and sustaining the life of Yanardoner Plants.

The findings in this study were parallel to the findings of the study done by Palmerg and Kuru [2] in that the students were appeared to have three groups of conceptions, egocentric, guardianship and eco-centric conceptions.

Turkish children were willing to participate in the protection studies jointly coordinated by local ministry and Non-governmental organizations for the purpose of ensuring the sustainability of those species and natural regions which were located nearby their school. The children believed in that destruction in living areas, air and water pollution, pesticide usage in agriculture, excessive hunting, urbanization, and deforestation were negatively influencing the natural balance of the environment. They believe in the importance of taking responsible environmental behaviours for protecting those species and regions. Three different types of behaviours were observed in students' actions and plans in order to help prevent and resolve the problems in Mogan Lake and around, physical action (eco-management), public and individual persuasion, and political action.

As far as their responses to attitude questionnaire were concerned, their attitudes toward the endangered species and the natural environment appeared to be high.

This study showed the importance of field trips for developing environmental awareness and knowledge, positive attitudes and responsible environmental behaviours. For this reason field trips should be included in extra-curricular activities in schools.

5. Acknowledgements

We would like to indicate our appreciation and gratefulness to Martha Barss and Ancuta Nechita for their cooperation and dedication to U&U Project. We also would like to thank to the METU Foundation School and Prof. Dr. Ali Yıldırım for their continuous encouragement, motivation to carry out the project, and finally special thanks to 5th grade students and their parents as well as those in other schools, who have been volunteers in this project.

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Children Struggling for a Sustainable Future: Impressions from Unique and Universal Project

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Abstract. The purpose of the present paper is to discuss the recent developments in the U&U Project and portray the impressions of the students, their parents and project teachers regarding as the contributions of the Project to individuals, society and the school curricula. As far as students' responses are concerned, after being involved in the project, they started to be aware of their responsibilities for helping protect endangered species and threatened environments. Parents indicated that the project helped their children love the environment and accordingly take actions for projecting endangered species and threatened environments. Teachers mentioned about the valuable contribution of the project to the students and their families.

Keywords: Endangered Species, Threatened Regions, Environmental and Scientific Literacy.

1. Introduction

This is the second year of our global U&U Project which uses hands-on science activities to make water quality assessment model of local lakes, combined with monitoring endangered species. The coordinator of the Project is METU Foundation School from Ankara, Turkey. In this project, it is aimed to reach the children from all around the World.

The pilot study of the U&U Project was realized with the inclusion of three primary schools, each from Turkey, Romania and the United States of America in 2005 [1]. Having been presented in the 3rd International Hands-on Science Conference [2, 3], three more primary schools, each from Bulgaria, India and Portugal showed interest to participate in the second year of the Project.

The U&U Project mentioned here aims at developing students' knowledge of and attitudes toward threatened regions (natural environments) and endangered species that are

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unique and universal, and ultimately enhance their action strategies and citizenship behaviours through field trips and outdoor activities in pre-selected natural regions. During field trips regularly organized to local lakes, students are encouraged to take water samples from the lake, do experiments with those samples and interpret the results of their experiments, observe the cause-effect relationship in natural settings, and improve their problem solving skills under the guidance of their coordinator teacher [4, 5].

This year, 2006, team members in coordinator school are in the process of designing and creating water monitoring science kits and portable laboratory out of cheap re-used everyday materials for their peers around Turkey. They will share findings and designs with Board of Education and encourage them to incorporate these outcomes into primary school curricula, which was started to be developed in 2004 [4]. It is also believed that the outcomes of the project will be used as instructional purposes and will promote teaching for both hands-on science and environmental sciences at primary schools nationwide, and thus worldwide.

1.2. Study Site

Eymir Lake (see Figure 1) is the wetland ecosystem that has been chosen as the second year's target area of the U&U project to be studied by the first author and the team in Turkey. Eymir Lake is a shallow and eutrophic lake located 20 km south of Ankara. It has 4000 m length and 300 m width. The streams from Mogan Lake, which was the previous year's study site, flow through a concrete canal between Mogan and Eymir Lake, and then enter to Eymir Lake [6]. Severe problems have aroused related to water quality in Eymir Lake in recent years.

Picture 1. Eymir Lake photographed by a Turkish student in the team

1.3. Study Species

Dikkuyruk Bird (scientific name, Oxyura Leucocephala) (see Figure 2) was chosen as target subject within the second year of U&U project in Turkey.

Recent counts indicate that the population of this species has undergone a very rapid decline in the last 10 years in the world, which qualifies it as endangered.

Picture 2. Oxyura Leucocphala

There has been considerable attention paid to the species in Turkey since 1989 which has led to conservation measures being taken [7] Oxyura leucocephala is the only stiff tail duck indigenous to Europe. Formerly found throughout southern Europe and much of central Asia, the breeding areas of white-headed ducks are now highly fragmented principally due to over-hunting and habitat loss. The European range is now limited to Spain and the eastern Mediterranean (wintering only). They live around Aegean, Kızılırmak Delta and west side of Central Anatolia in Turkey.

Picture 3. The Romanian children preparing a bulletin board for the project

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2. Methodology

2.1 Sample

In the second year of the Unique and Universal Project, 86 students from four different counties participated in it.

2.1.1. Turkish sample

Fourteen 5th graders and two 6th graders at the METU Development Foundation School and their parents participated voluntarily in the project. The study group consisted of eleven and twelve year old boys and girls. Two sixth graders, who have experience from the previous year, have acted as the leaders of this year's team throughout the whole studies [4, 5].

2.1.2. Romanian Sample

Twelve students from 5th grade and ten students from 6th grade, who already have the experience from the previous year, from School Number 5 in Satu Mare, Romania also took part in the project.

Picture 4. The American team of the U&U project

2.1.3. American sample

Six students from 6th grade and five students from 7th grade from Roland Park Country School for girls in the USA were the third partner in the project.

2.1.4. Bulgarian Sample

Forty students between the ages of 8 and 11 from Vasil Aprilov Elementary School in Bulgaria joined the project in this year. The students were involved to a different degree according to their age. From first to 4th grade the students studied the habitat of the small Cormorant and took part in the cleaning of the area. Some of them prepared presentations on posters. The students from the 6th grade studied the small Cormorant.

2.2. Project Action Plan

At the beginning of 2006/2007 educational year, the school administration and the coordinator teacher of U&U project had several meetings in order to evaluate the previous year's works and set up the administrative frame of the team. Volunteer teachers and students were recruited at school. Afterwards, the team proceeded as follows:

(1) constructed annual activity schedule,
(2) recruited peers
(3) had organizational meetings, every Thursday, after school for two hours,
(4) contacted with Biology department of METU University, and Nature Society for getting help,
(5) tested twelve different water parameters and collected data during the field works,
(6) invited parents to the field works, shared their experiences with their parents.
(7) videotaped the field trips and experiments for using them as educational material in the classroom,
(8) observed and researched characteristics of study sites, species, and shared their experiences and findings of the studies with other partner schools via e-mails,
(9) invited new volunteers in the school and in other countries (Spain, India, Bulgaria, and Portugal) to the project and delivered presentation about last year's work to the new comers,
(10) contacted with METU University to organize an environmental fair on 23 rd of April, which is National Children Day in Turkey, in order to give joint declaration for sustainable environment with partner schools since the students are the future leaders of the world. A national campaign has been considered to be launched on 23rd of April
(11) produced worksheets and power point presentations about Oxyura Leucocephela and Eymir Lake for the first graders and fifth graders at school
(12) will deliver another presentation about this year's subject Eymir Lake and Oxyura Leucocephala, at the beginning of new educational term on 2007
(13) will construct international web site and publish findings,
(14) will visit governmental bodies and NGOs to get funding,
(15) will create science kits and portable labs,

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(16) will get in touch with Board of Education and encourage them to incorporate these outcomes into primary school curricula [4].

Picture 5. The Turkish students at field work

Table 1. Example of water quality monitoring data and test results (2007)

School : ----- *Teacher* : -------- *Name* : -----

ACTIVITY NO : 1
Student Data Sheet
Test Site A
The first trip
Study Site: **Eymir Lake**
Time: **11.50 a.m.** *Air Temperature*: **6 °C**

WATER QUALITY TEST CONDUCTED	*TEST RESULTS*
COLOR	Dark green
DEPTH	80 cm
WATER TEMPERATURE	9 °C
CLARITY / TURBIDITY	30 cm from the surface
pH	9
DISSOLVED OXYGEN	6 ppm
NITRATE	2 ppm
AMMONIA	0.5 ppm
PHOSPHATE	1.5 ppm
IRON	1 ppm
COPPER	0 ppm
PRESENCE OF COLIFORM BACTERIA	Positive

2.3. Conducting hands-on experiments as part of field work

During the field work organized to Eymir Lake, the following water quality parameters were observed and measured, and the results of these measurements were interpreted by the students / team [5, 8, 9, 10].

(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.

During all the testing activities and observations, La Motte test kits and sampling equipment were used [9].

Picture 6. Romanian Team observing pool frog at field work

The portable field laboratories containing all the equipment and chemicals were provided by La Motte Chemical Company, our laboratory equipment sponsor.

Picture 7. Testing water quality at Eymir Lake

The interrelationship between water and living species was observed and then interpreted by the students. Before and after field trips, the students were given field trip tests in order to get their pre and post knowledge and skills.

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During the field visit, the parents of the students joined in the process of taking water samples from the Lake, in order to measure the physical and chemical parameters of the water quality.

The observed physical characteristics of the chosen endangered species were also discussed and throughout the pilot study, the research about the endangered species and the target regions were exchanged amongst the students from Turkey, Romania, the USA and Bulgaria [5].

Picture 8. The Turkish students observing daphnea

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 the final step

2.4. Data collection

In order to reflect what they think about the Project, an open ended question was asked to students and partner teachers about the contributions of the project. Furthermore, the students and their parents were required to write letters. Those ones written by parents to coordinator teacher for overall assessment of the project and those ones that students wrote to each other for introducing their study area were given in the result part. In addition, partner teachers were required to indicate their overall opinions about the project.

3. Findings

This part was designed to indicate the recent developments in the Project, and teacher, students' and their parents' opinions about the contribution of the Project.

3.1 U&U Project in Media

Until now, the findings of and news about the U&U project took part in 3rd International Conference on Hands-on Science (September, 2006), Nature Society's Seminar Proceeding (December, 2005), Science and Technology Periodical (March, 2006), Science and Kids Periodical (June, 2006), Indian Express Daily (November, 2006), Cumhuriyet Newspaper (May, 2007), and METU Foundation Schools Bulletin (2007).

The project was a cover subject of one of the newspapers published in Turkey, Cumhuriyet. In the article, project team members' and coordinator teacher's views about the project were reflected. Picture 9 shows the cover page of this article. Students were appeared to be concerned about the water quality and quantity, the pollutions and pollutants in Eymir Lake. They mostly mentioned about the findings of their experiments with the water sample from the Lake. For example, B.O. mentioned about the results of dissolved oxygen experiments, C.A and B.B. mentioned about the findings of pH experiments. They also mentioned about the importance of preserving and conserving water resources for our planet [5, 10].

Picture 9. Cumhuriyet Newspaper May 2007, [Future Scientists have studied Lake Eymir]

Picture 10 shows two pages of the article published in Science and Kids periodical in Turkey. An author of this article participated in one of the field trips, and did an interview with the coordinator teacher. She reflected her

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impressions and interview results in her article [1].

Picture 10. Science and Kids Periodical, June 2006

In one of the international newspaper published in India, the project was introduced briefly. The following picture is from that newspaper, Indian Express Daily.


Project to sensitise school kids to ecology

Children to study wetlands, their eco-systems and share data; DPS only participating Indian school

Picture 11. Indian Express Daily, November 2006

3.2. Project corners

Each school in the project prepared a project corner in their schools.

Picture 12. U&U Project Corner at school in Turkey

In this corner, they put the pictures of their study area and endangered species, field trip pictures, and the letters sent by their peers in other three countries [note: students in each group sent a letter to each other]. Through this corner, they introduced the project to the other students in the school. Picture 12 shows one of the project corners which was prepared by Turkish students.

Picture 13 shows another project corner prepared by Romanian students. In addition to their study area and endangered species, they also put subject areas and endangered species that have been studied by other students from other three countries in the Project.

Picture 13. U&U Project Corner at school in Romania

3.4. Samples of Student presentations and worksheets

The U&U team students in Turkey produced worksheets about Oxyura leucocephala for the 1st and 5th graders at school. Each member also prepared two presentations: (1) the first one was about a presentation of Turkey for their project partners and peers in other three countries and (2) the second one was a research about their project partners' endangered species. The students in other countries prepared only one presentation for introducing their countries to other students in the project and sent to them through mutual e-mail group.

Picture 14. Presentation cover produced by two team members

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3.5. What did students / parents / teachers say about the project?

At the end of the educational year, the students and their parents, and coordinator teachers in each of four countries in the project were asked to write their opinions about the project implications and their outcomes.

3.5.1. Students' opinions about the project

Students' opinions reflecting their thoughts on the U&U project are given below. In order to ensure confidentiality, their thoughts were given here by stating student-1, 2 and so on rather than giving their actual name.

Student (1): "…I was scared when I first started this project thinking that it was going to be a difficult one but I soon realised that there was nothing to be scared at all. On the contrary, I enjoyed it so much. I believe that we will be enlightening the future when we are grown up…"

Student (2): "…I would like to proceed with this project in the next years. This project is a team work and, in my opinion, this is the most important aspect of it I will never forget my teachers and my team friends throughout whole my life…"

Student (3): "…When I get old, I will tell the people about this project. It has changed me a lot…"

Student (4): "…As being one member of the future generations of the world, I found it very meaningful to try to say 'Stop! to Global warming especially in such a period when it has become a real threat for our world! The knowledge I have gained in this project will lead me throughout whole my life…"

Student (5): "…In my opinion, this educational project is a big step forward both for Turkey and for the world and to be a part of this project is great honour for me…"

Student (6): "…To be able to do something about the environment makes me tremendously happy. This is why I feel very well while being in the project. Besides, studying in the project for two years is another source of excitement and happiness for me…"

Student (7): "…As for me, U&U project itself is a story of determination and success. I tried every possible effort to join all the project meetings although I had my volleyball practises. Now I am so happy and satisfied with what I have achieved…"

Student (8): "…I have one suggestion: This study should be added to the science curriculum because what we have learned so far is so crucial…"

3.5.2. Parents' opinions about the Project

Parents were invited to participate in the field trips and some of the students' presentations along with their children. They kindly accepted this invitation, and they were in the field trips with their children. To the open question about the contributions of the Project, they indicated so many points. Some of the examples of parents' opinions were given below.

Parent (1): "…What is most important for me about this project is the fact that the students performed tests at the heart of the nature. Although the whole process was quite long, it was so amusing and educating our kids and us.

The second important point is the fact that they learned to be a part of a team. They also learned how to share the knowledge globally..."

Parent (2): "…Our son has improved his research techniques by the help of this project. Even his 4-year-old brother started to look to nature from a different point of view and ask questions just by observing what was done at the field…"

Parent (3): "…This project enabled my son go through the scientific steps of studying, and improve analytical thinking skills. He, himself observed the nature, tested the water parameters and developed the responsible behaviour by sharing the findings with his friends not only in the project team but also in partner schools …"

Parent (4): "…Our children's age rate, in which their social, ethic and thinking skills are constructed very rapidly, is so crucial. The earlier they gain responsible manners towards environment the better it is. My daughter is so lucky because she joined this project as early as at this age…

On the other hand 'water' is one of the most significant and urgent issues on the World's agenda. The fact that U&U project focuses on this urgent issue and deals with it, is another good point. Our children have become more responsible citizens towards nature…"

Parent (5): "…My son's work within the frame of U&U project enabled him to improve his

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scientific thinking skills. He loved science, scientific steps and gained environmental consciousness…"

3.5.3. Partner teachers' opinions about the Project

The project partners were also asked about the contributions of the Project. Their opinions 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.

"I think that having students connect with other students from around the world focused on biodiversity issues are an excellent learning experience for all involved.

Students are faced with trying to communicate with others about a topic that is relatively new to them in a language that for many is unfamiliar – double learning opportunity. Even for my students it is an opportunity for them to imagine trying to write about their butterflies in a language they are just learning. They are very impressed with students' ability to write in English

My students are extremely excited about trying to create a habitat that will attract the butterflies and help them become less endangered. It is so effective for the students to be able to take action right here at school."

Dr. Zdravska Kostova (Project Coordinator, Bulgaria): Zdravska Kostova is an associate professor doctor in Department of Information and Teacher Training at Sofia University, Bulgaria. She participated in the project in 2006 and coordinated a group of students in one of the primary schools in Bulgaria.

"In my opinion the project is very significant for education and value development of children. In participating in the project first of all they get to know one another not only in the class and in the school but also from different countries. They are united by a common problem that will affect their future. The school becomes an interesting place where they learn, do interesting work. They feel themselves involved in solving real problems, therefore they feel important. They value their work as they see sense in it. They learn the school contents and achieve the learning standards easily because they see the significance of their knowledge. It is extra work for the teachers and that is why they have to be valued as well.

Children develop their competences and especially their computer skills and information competences. They learn new facts, make new conclusions and become more concerned about their behaviour and their environment. They look at nature with responsible attitude and develop critical approach to peoples' behaviour and to their own as well. I think that the project has its great significance."

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.

"If we take into account the extreme changes that occur in temperature, protecting the environment should be a priority in the whole world. Getting children involved in environment related issues makes them aware that there is a problem regarding endangered species. This way they will grow up knowing that they can have the power to change things. Children were interested in the activities they were asked to perform. Now they know that there are endangered species not only in Romania but in other countries as well and that brings them closer.

Picture 15. The Monarch Butterfly studied by the American students

Being in the second year in the project they felt more confident while participating at the activities. They worked together bonding as a team. I am proud of them because they showed interest in the topic and they were curious to find out new things. All in all, I think it's wonderful to teach children that they can give a helping hand in making the world a better place."

4. Conclusions

In the 2006/2007 educational year at coordinator school,

(1) Twenty meetings were held within the frame of U&U project.

(2) Three field trips were organized to Eymir Lake. Both students and their parents joined all the field works.

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(3) At each field work, twelve different water parameters were tested, recorded, and interpreted, and final reports were prepared by the students.

(4) The findings were shared with other schools.

(5) The worksheets about Oxyura Leucocephala were prepared by the team students for the 1st and 5th graders' usage at school.

(6) PPT presentations produced by the team students about Turkey and Romania were exchanged

(7) PPT presentations about the four subject endangered species were prepared by Turkish students and shared with the other schools.

As far as the first author's observations besides students' and their parents' thoughts are concerned, students have become far more confident on performing hands-on science at field. Their scientific and environmental literacy were appeared to be developed tremendously. They started to be aware of their individual responsibilities for helping protect global values. Parents indicated that the project helped their children love the science and environment and accordingly took actions for projecting endangered species and threatened natural regions.

Picture 16. The Pool Frog studied by the Romanian students

In this work, five different data collection instruments were used to assess the findings. The knowledge test, the attitude questionnaire, the picture form and during the field trips, two different field tests were already used. The findings will be assessed and reported by the beginning of the new educational year.

It is the authors' hope that all the outcomes of U&U project will be shared with Board of Education and encourages incorporating these outcomes into primary school curricula in Turkey and that the outcomes of this project will provide a useful source in educational and environmental climate worldwide.

The following pictures are the species, each of which has been studied by each group of the students in the project.

Picture 17. The Black Cormorant studied by the Bulgarian students

5. Acknowledgements

I owe a special debt of gratitude to Professor Dr. Jim Westgate. Without his support, I would never have been able to share knowledge and ideas with my American colleagues. Special thanks to Prof. Dr. Ali Yıldırım for his continuous encouragement and motivation. 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. Prof. Dr. Zdravka Kostova, from Bulgaria. And finally special thanks to my 5th and 6th grade students and their parents as well as those in other schools, who have been volunteers in this project.

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Anticyclones

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Abstract. *Anticyclones* is a group of students and a teacher from Escola Secundária Manuel de Arriaga, who has drawn up a project about robotic science. For the second time consecutively *Anticyclones* wanted to participate in the First Lego League (FLL), a championship for young people keen on robotics. The group work very hard, not only searching information about Nanotechnology, the theme of the last season, but also building up an autonomous robot using Lego pieces and, after all this work, they won the Season's Prize. On this conference they will show a NXT robot and what it can do. They will show a robot which can dance, stop when it runs against a wall, run faster when the light is more intense and a RCX robot which will carry some of the FLL's missions.

Keywords. Robotics.

An Intergenerational Research Motivation- Relation between Mathematics and Artistic Decoration of Animal Skin

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Abstract. Relations between Art and Science were always on scientists and artists minds. Perhaps first relations had been between Art and Geometry. William Ivins, Jr. (Metropolitan Museum of Art, USA) wrote in 1945 "Unlike science and philosophy, art has been kept insulated under a cheese glass of aloof exclusiveness". Many institutions and people had fight for Herbert Read theses, he took from Plato: Art should be the base of Education. From it we infer that already Antiquity philosophers considered strong relations between Art and Science. This work is concerning how deep scientists and artists were able to develop this idea.

Keywords. Art, Leopard, Melanin, Chemicals Stimulate, Reaction Diffusion, System Science.

1. Introduction

Relationships between the art and beauty of pictures, geometric or not, paintings, virus ways, cellular images, sculpture, music and mathematics had nowadays come up to the public bringing fine and true master pieces of Art.

Figure 1. Leopard [3]

A great part of these relationships had been known for many centuries. What is now new is that technology development brought great interactivity between Art and Science. On this interactive context the main purpose of my talk is to look at the artistic pictures of Keith Devlin's renowned book Life by numbers and point out

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how mathematics became a type of language which is very creative and nice, and how the curiosity of a child in an intergenerational relation could motivate such a deep question.

2. The search

2.1. The motivation

I will start my talk by presenting a poetic phrase by James Murray, a well-known mathematician from the University of Oxford (England), reproduced by Keith Devlin on the above-mentioned book:

> *When I ´m walking in the woods, I find it quite difficult not to look at a fern or the bark of a tree and wonder how it was formed -why is it like that?*

Figure 2. Zebras and giraffes stripes [3]

Murray is the father of a very beautiful daughter and frequently reads bedtime stories to her. One of them concerned a fantasy on how a leopard gets its spots through the five fingers of an Ethiopian tribesman who touches it with them. Although the young girl loved the story she was already clever enough to ask him how does the leopard really get its spots?

The two generations (father and daughter) began thus teaching each other. Trying to find a good explanation for her daughter, Murray asked his biologist colleagues about it but couldn't get a concrete answer then. He also asked them how tigers and zebra get their stripes.

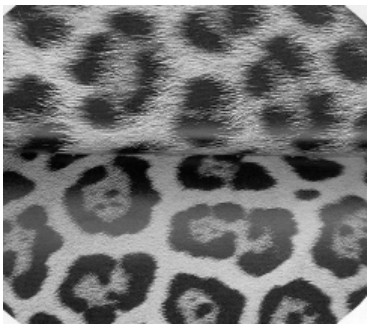

Figure 3. Comparing a leopard and a cougar [3]

Murray noticed that his biology colleagues knew that the cause of an animal's coat coloration is the same chemical product that makes fair skinned people develops a tan whenever exposed to the sun: a chemical substance called melanin, produced by cells just beneath the surface of the skin. However, they couldn't explain why the shape of leopard spots is so different from tiger and zebra stripes. He was also comparing the above leopard skin with a cougar's

Keith Devlin then tells us how Murray became more and more curious and deeply interested in explaining the fact to his daughter. He began researching with such enthusiasm that he wouldn't stop for twenty years until he could finally offer a mathematical explanation.

2.2. A mathematical model

Indeed he had developed a mathematical model related to the chemistry laws that rule diffusion and reactions. As an experimented mathematical researcher he assumed the following Axiom 1:

Some chemicals stimulate the cells to produce melanin.

From it he inferred that visible coat patterns are the reflection of invisible chemical patterns in the skin. If the chemical concentration is high, melanin coloration will appear, if it's low the skin will be mostly colourless. For Murray the question now was:
What causes the melanin-inducing chemicals to cluster into a regular pattern formation so that when those chemicals "switch on" the melanin to turn colour, the result is a visible skin pattern?

To obtain a question he applied a reaction diffusion system which is a system in which there

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are two or more chemicals in the same solution (or the same skin) reacting and diffusing throughout the solution as in a fight for territorial control. Then Murray assumed the Axiom 2:

> In the skin two chemical are produced: one stimulates the production of melanin, the other inhibits this production, and production of the stimulating chemical triggers production of the inhibitor.

From this he considered that some "islands" of stimulating chemical could appear surrounded by "fences" of inhibitors that originate the formation of melanin "spots". If the inhibiting chemical diffuses faster than the stimulator and a concentration of the stimulating chemical is formed, thus triggering the production of the inhibitor, the faster-moving inhibitor could encircle the slow diffusion stimulator. Further expansion is in this way prevented, and a "spot" of stimulator can form, encircled by a ring of the inhibitor.

2.3. An analogue case.

Trying to clarify the system, Murray presents an analogy: Suppose, he says, that you are in a very dry forest and the authorities are fear forest fires. They have helicopters and fire-fighting equipment stationed throughout the forest. If a fire breaks out (the stimulator), the fire fighters (the inhibitors) spring into action. Of course helicopters can move much more quickly than the fire (the inhibitor chemical diffuses faster than the stimulator)

However, the intensity of the fire (high concentration of the stimulator) is such that the fire fighters cannot contain the fire at its core.

So, using their greater speed they outrun the front of the fire and spray fire-resistant chemicals onto the trees, and when the fire reaches the sprayed trees, its progress is stopped.

Seen from the air, the result will be a blackened spot where the fire burned, surrounded by the green ring of the sprayed trees and beyond it the green of the remainder of the forest.

If a number of fires break out all over the forest, the landscape seen from the air will show a pattern of patches of blackened, burned trees interspersed with the green of the unburned trees.

If the fires break out sufficiently far apart from one another, the resulting aerial pattern could be one of black spots in a sea of green. On other hand if nearby fires are able to merge before being contained, different patterns could result.

So, the pattern will depend on various factors, in particular the number and relative positions of the initial fires and the relative speeds of the fire and the fire fighters (reaction diffusion rates)

With this model in mind Murray concentrated on the question: were there any rates that, starting from a random pattern of fire sources, would lead to recognizable patterns, such as usual spots or stripes?

Then he took the well-known partial differential equations of the type

$$\frac{\partial^2 f}{\partial t^2} = v^2\left(\frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2}\right)$$

which describe the way chemicals react and diffuse and assumed that he had only two chemicals reacting and diffusing at different rates. Putting these assumptions and equations into a computer Murray was able to turn them into pictures on the screen, showing the way the reacting chemicals dispersed. Then, by changing some constants (numbers) on the equations in the computer, he realized that he could transform a spotted tail into a stripe

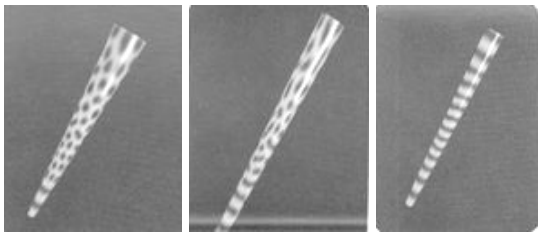

Figure 4 Transforming spots into stripes [3]

So, as Devlin describes, Murray was surprised that with only two chemicals his mathematical model could produce dispersal patterns looking exactly like the patterns on the skin of animals. He could then answer to his daughter that her question might be found by looking at reaction-diffusion systems.

2.4. Simulating

Murray then went on changing numbers on the equations which correspond to the area and shape of the skin region: for very small regions there was no pattern at all, for larger regions he got stripes, small spots of leopard's, large spots, reminiscent tail stripes, zebra stripes, the small spots of the cheetah, the large spots of the giraffe for very large regions he got no patterns at all. The next question he asked himself was:

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Besides the area and the shape of the skin region, should there be a reason for leopards to produce spots and tigers stripes, given that leopards and tigers have very similar sizes and shape?

Then Murray, as it is common in mathematical research, made a conjecture: This difference has to do with embryonic development.

He then made a computer simulation of a leopard embryo developing its spots conjecturing that the pattern we see on the adult animal will depend on the size and shape of the embryo when the process occurred.

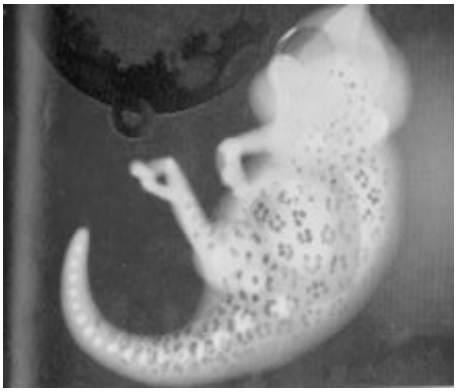

Figure 4 Computer simulations [3]

He also looked at other animals:

On the case of mice, according to Murray's model, no pattern is possible (the chemical reactions occur when the embryo is very small)

On the case of the zebra there is a four-week period early in the year-long gestation during which the embryo is long and pencil-like and, according to Murray's model, if the reactions occur during this period, the resulting patterns will be stripes.

3. Final considerations

Step by step, for twenty years, Murray established, regardless of some questions (that are still open problems) a quite clear relation between some mathematical equations and different artistic decoration of animal skin and it all occurred because of a little girl's question.

4. Acknowledgements.

I should like to thanks the Association Hands on Science on the person of the President of this Conference Prof. Manuel Felipe Costa to invite me to help to prepare it and to trust my work on a nice solidarity and collaboration.

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Problems and Opportunities of Ultra-Peripheral Regions

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In this work we suggest a debate on two subjects that concern Europe's cohesion in general and its peripheral regions in particular: on one hand, the possible imbalance between European regions' economic development and its cultural and social counterpart and, on the other, the problems that may occur with the ongoing transformation, over the past several years, of education and training policies.

The emerging picture across Europe, if we take as a good indicator the European Commission's index of accessibility, which measures for each region the time needed to reach other regions weighted by their economic importance, is one of a very high concentration of activities in central regions, which account for only 14% of the land area but a third of the population and almost half (47%) of the GDP. Population density in these regions is 3.7 times higher than in peripheral regions. In all but 11 of the 88 central regions (NUTS 2 level) GDP per head in 1998 was above the EU average, while all but 23 of the 111 peripheral regions had a level below the average. Average GDP per head in the central regions was twice as high as in the peripheral ones and productivity 2.4 times higher. In 1997, expenditure on research and development amounted to 2.1% of GDP in the former as against 0.9% in the latter. In 6 of the 7 ultra-peripheral regions, GDP per head was only around half the EU average (EU Commission, 2001, in the EU jargon – that we don't necessarily retain here – the 7 ultra-peripheral regions are Spain's Canary Islands, France's

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islands of Guadeloupe, Martinique, Guyane and Réunion, and Portugal's archipelagos of Açores and Madeira).

No matter the (always insufficient) results of the efforts for economic convergence – which in some cases doesn't have an obvious European dimension – we believe that, in the years to come, fostering communication and comprehension among Europeans must also be an important task for the Union. Europe should therefore give much more emphasis to measures promoting cultural and political cohesion. In these fields, we may consider that the concrete "European value added" attainable with the modest means of the EU budget could be far more substantial than what is now achieved in the rather thankless pursuit of economic convergence. And a possible solution was already devised with the Lisbon Strategy (making the EU, by 2010, the most dynamic knowledge-based economy in the world), that now seems to be more relegated from the political agenda. Then, we may consider that strategic policies like those directed to the promotion of scientific literacy may be more fruitful for Europe's competitiveness and for European integration than some of the traditional economic policies.

Secondly, we will argue that across Europe, and particularly on countries and regions in the periphery (on the edge) of the EU, particular difficulties may rise regarding the current reshaping of education and training policies. Prior conceptions of lifelong learning as primarily concerned with personal development and the constitution of ethical personhood and critical thinking have metamorphosed into a measurable series of qualifications attained with respect to lifelong employability.

The EC's stress on the necessity for constant mobilization and self-empowerment through lifelong learning leads to the growing exclusion of the poorer members in society, as European social cohesion is now advanced primarily through the formation of a flexible and mobile cross-border labor force rather than through the notion of personal development and the constitution of democratic participants in society. Rather than encouraging these types of social and educational integration that are practical and attainable for these groups there is an increasingly cynical narrative which equates greater European movement with greater European social belonging.

Keywords. EU Integration, Peripheral Regions, Education, Inclusion, Development.

Learning Science while Playing. The Indian Experience!

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Abstract. My research and collection of traditional toys for science learning while playing in India is supported by Portuguese Science Centre namely Fabrica in Aveiro as an exhibition for children and community which is planned to be inaugurated on 16th July 2007. In this conference I will try to display my research of traditional toys for science learning through poster presentation.

India is a country of diversities which can be seen in the way the people of India follow different religious and tribal traditions, languages, crafts and cultures. It is a country where there are 21 official languages and many dialects, a country where three of the world's greatest religions (Hinduism, Buddhism, and Jainism) emerged, where from north to south and east to west one sees a variety of cuisines, costumes and lifestyles. It is said that Christianity came to India in the second century A.D. and Islam soon after its birth, and they grew here in harmony with local culture and religious thought. This rich culture is also visible in the myriad of traditional toys that the children play with across India. There are static and dynamic toys, display and interactive toys, traditional and modern toys and so on.

Toys, be it of clay, wood or plastic, play a major role in the life of children. Many of these toys have scientific principles behind in them. While playing with these toys, children knowingly or unknowingly get to learn science. With the change in time, the toys have been transformed

 ISBN 978-989-95336-1-5

from natural materials to manmade materials like plastics. But even today, one can find the local, traditional toys in places like fairs, *haats (bazaars)* and villages. Interestingly, India also has a tradition of using specific toys at the time of different seasonal festivals.

In conclusion, through this research and display of my ideas I would like to convey the concept of science involved in these simple toys and activities how they can be used to communicate science amongst children and masses. Since few years these traditional toys are vanishing and the plastic has started appearing every where. So importance should be given to the local and traditional toys found all around us. This will help the local teachers and communicators to convey science with simplicity. Approach like this can help a country like India to reach to vast population.

Keywords. Science Toys, Science Education, Traditional Toys.

Science Education and the Present World

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Abstract. Science Education should adapt to the present world, very much organized around the information and the knowledge, where science and its technological applications are an essential factor of the human development, a part of the citizens' culture and fundamental for the progress of the peoples. This aspect involves a peculiar conception about the function that has been attributed to it so far, and the way we face it. Instead of a static, conservative, dogmatic scientific education, that considers the knowledge as an assembly of data before acquired, irrefutable facts to be propagated from teachers to students, this education proportionate to students some aspects of the fundamental culture for their personal development, faced from a global point of view, and not only in the cognitive aspect, that is, including personal capacities of equilibrium, of social insertion and of interpersonal relationships [1].

Science Education, to be actual, should be integrated in a perspective STS (Science - Technology - Society), or, also as it is referred many times, in a perspective STSE, for emphasize the importance of the environment preservation, in a logic of survival (we live in the decade of the education for a sustainable future, promoted by the United Nations). This obliges that we have to project learning for contexts of the real world. For such, curricula must be modified in the sense that will aim for an education faced to a scientific-technological literacy of all the citizens.

Beyond the explanation of what we understand by this kind of literacy, the scope of this communication is the scientific education that aims to develop pupils' scientific culture and citizenship and not to prepare them to be prematurely experts in some branch of Science, an education that contemplates three important aspects: Education in Science, through the acquisition and development of conceptual knowledge, Education about Science, that is to acquire some knowledge about the nature of the science, its methodologies and its relations with the Society, the Technology and the Environment where we live, and, Education through the Science, that is the research competences development, either theoretical or experimental, including the resolution of problems as well as situations that involve to apply the assimilated learning in new situations and contexts [2].

As coordinators of the Master in Teaching of Sciences of the Portugal Open University, we intend also to discuss our options to contribute for a post-graduated education that aims to prepare science teachers to be adequate to the actual world.

Keywords. Science Education, STS, STSE.

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Success and Engagement in Science Teaching with E-Learning

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Abstract. There's an old proverb: "I hear and I forget. I see and I remember. I do and I understand." This belief may point out the

 ISBN 978-989-95336-1-5

student-centered lesson importance for “Science Teaching”. As we know, teachers are guides for children to develop skills needed to test ideas scientifically or provide opportunities for them to investigate and manipulate things in their environment. But, is learning science only limited with classroom or teacher? What about students who have to be away from classroom? If a child is in a hospital or away from school, does he/she need to miss out the subject?

Many subjects in Science include lots of specific terms, processes, etc. It is hard for children to learn easily without getting bored or without having any problem during the learning process. So, what should be the best way to solve these problems, to provide a positive and enjoyable learning environment and let children experience the joy of science?

Keywords. E-Learning, Circus Environment, Acrobats, Clowns, Shows, Animals, Mythology, History, DNA Structure, Artificial Organ, Suitable for Different Syllabuses, Independent Learning, Time Saving, Integrity, Interdisciplinary, Success, Engagement.

1. Introduction

“Science Teaching” is a joy, and a challenge. As teachers, we struggle with the same questions whether we have been teaching for two years or twenty years: how can children learn science easily? How do we help them to develop the skills needed to test ideas scientifically? What should we do to help our children experience the joy of science through a different lens?

You can use many different teaching methods for involving children into the lesson. You can determine the level of your lesson by considering individual needs and differences or you can improve student ability to apply scientific knowledege and reasoning. But, what can be the best method which is powerful, flexible and interactive, gets students’ thinking, debating and learning, has the right level for all your students and gives interactive personalised learning opportunity? Additionally, this method should also save teachers’ time and effort, helps them to personalise learning to each child’s individual needs and embeds ICT into their teaching.

There is an effective way where science meets the real world with all these factors and more than them above. This can be the use of technology, a software, which teachs the content in an accessible and motivating way by serving teachers’ and students’ needs as a guide. Everything you need to teach or learn science can be more enjoyable, interesting, motivating and understandable. But, how can we do this? Since, it seems like a dream. Here are the few top reasons why science teachers can use it as a basic teaching resource or why children can use it as a basic learning resource :

Firstly, you can put learners at the heart of everything in science by using a motivating and an interesting learning environment. This dynamic software fits every specification with its amazing and motivating environment which is a kind of circus environment. As you know, in a circus, there are many different types of activities, shows which are carried out by acrobats, clowns, animals, etc. By using this, you can teach the content in an accessible and motivating way, use these activities to provide an easy way to make concepts clear, reinforce students’ learning of key ideas, make the science relevant and help your students to learn to question more, explore science for themselves and understand how science works.

Secondly, content of the subject is suitable for the national curriculum of many countries. Additionally, levels are prepared by considering the different types of biology syllabuses such as IB, IGCSE, AP, etc. It is a complete coverage of curriculum science specifications. It covers every aspect of the types of syllabuses mentioned above from core to supplementary material. Additionally, it is modules by modules and sub-topics by sub-topics. Each of them includes different types of questions which prompt extra thought about the topic and help the learner to test his/her understanding about the topic. According to this, we can say that it is also useful for the international exams such as SAT, PSAT, etc.

Thirdly, it delivers interactive lessons. It contains a wide variety of presentation materials to suit all types of learning and they can be linked perfectly to the children’s books easily to motivate them and help them understand the subject without getting lost.

Fourthly, it gets students’ thinking, debating and learning easily. It focuses on how science works in the real world and places strong emphasis on the active involvement of students by using relevant and engaging contexts.

Fifthly, it is exactly the right level for all your students. It enables flexible teaching and enjoyable learning atmosphere. As mentioned before, variety of activities and activities throughout consolidate ideas helps to get student attention easily, provide the motivation during the learning process, helps them test their understanding of the subject. They can identify their own strengths and weaknesses according to the activities and engage them in their own

 ISBN 978-989-95336-1-5

learning. Additionally, they also encourage class discussion where it is needed.

Sixthly, you don't need to be an ICT specialist. It is easy-to-use or ready-to-teach for the curriculum specifications.

It is not limited with the usage of material in the classroom. A child can buy it and use as a fundamental learning resource at home. If a child is in hospital or away from school, he/she needn't miss out the subject.

The last thing is that surveys have confirmed children want to know more about science stories that are in the news and that are relevant to them. This pioneering new course focuses on debating and discussing the history, philosophy and ethics of science, giving a stronger base to students entering higher education. It gives a support with high quality, endorsed teaching materials to motivate them and develop their critical thinking and analytical skills.

As a result, this e-learning material is useful and helpful for both students and teachers. For students, it gives opportunities for learning basic knowledge easily, applying all learned skills, self-assessment, authentic application, evaluation of work habits, working with the information, judging the quality of information and using it for a purpose. It is helpful for teachers to get attention and motivate children easily, save time, providing more effective lessons, promote children's abilities, creativity and familiarity with modern technology by considering individual needs and learning styles.

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Extra Curricula in Perspective of Environment Protection

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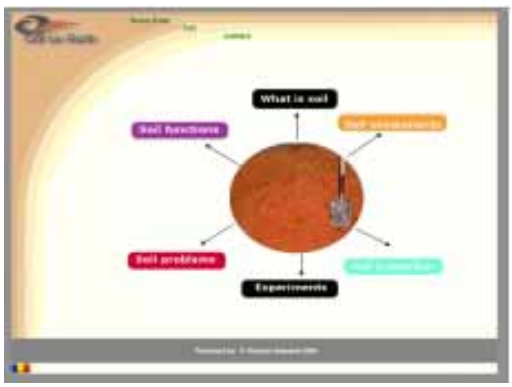
Abstract. As European citizens we all share an interest in protecting and improving the environment. One of the biggest challenges for teachers is educating people to understand the dual concepts of respect for environmental rights and for the intrinsic value of life and how to live accordingly. In other words to "think globally and to act locally" in order to find new lifestyles will be sustained in the future.

Our school struggles to provide opportunities for young people to become actively involved in environmental issues. That's why we are developing a program consisting in three different areas of environmental education:

- We create a learning field which presents information, tests of the three major resources: water, soil, air, and we make a study based on our laboratory work. In the end we create an attractive and interactive site about these three natural resources and their interactions with the living components. The site is bilingual – English and Romanian. At every stage, the pupils can choose the environmental element that appeals to them –water, soil or air (www.euromediu.ro). Each part presents some basic information, which is completed by pictures made by pupils and teachers.



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- Within the activities at "PRONATURE" Club, the students perform an interdisciplinary analysis of the environmental resources and ecological studies.

- We have also organized two important global environmental campaigns "FROGS' MARCH" 15-19 January 2007, regarding the global warming and the subsequent climate changes as well as "TO EUROPE through a HIGHER QUALITY LIFE", on 9 May 2007. These campaigns try to influence public decisions regarding environment protection in our area and also focus on transforming our pupils and future workers into mature and responsible citizens.

All our present and future work tries to develop social awareness concerning environment protection among the young generation and also attempts to draw attention on the serious problems in our region (there are two important rivers: the Danube river and the Siret river and there is also a great pollution source "Mittal Steel Group"). The local community must be able to establish a scientifically founded connection between water-environment- ecological economies.

We organize these activities for our young generation. They will understand that our European environment is under serious threat as a result of human activities. They will learn that people have the knowledge and technological means to do something for these trends, given the political will and vision. The pupils will thus become aware that they must develop a real and effective concern about the state of the planet. They can undoubtedly break the "traditional" link between economic growth and environmental damage.

Keywords. ICT, Environment, STSE.

Fun with Plants in Soil-Less Condition: An Indian Hands-On Experience

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Abstract. Vigyan Prasar is an autonomous organization under the Department of Science & Technology, Govt. of India, set up in 1989 to take on large-scale science popularization task in the country. Its primary objective is to promote & propagate as widely as possible a scientific and rational outlook in the society. In broad pursuit of its objective, Vigyan Prasar has initiated several large-scale programmes, activities and schemes in the country over the last decade. Vigyan Prasar also has a network of about 6000 Science Clubs spread throughout India.

An important component of majority of Vigyan Prasar's programmes is the development of low cost/no-cost training module in the form of Hands-on-activities for nurturing curiosity and excitement among children. These modules are more suitable for all developing countries like India having wide range of socio-economic and cultural diversity. The modules are based on an approach, which is decentralized, activity based,

 ISBN 978-989-95336-1-5

low-cost, participation-intensive and allows local environs to be used as learning and teaching ground. It has also been realized that through these modules (also called parallel or alternative approaches to science education) based on hand-on-activities, what we do or learn is directly and closely connected with real problem(s), situation(s), thing(s) and happening(s) in every day life. Through these modules, children can understand science as a complete process in a simple and enjoyable manner. Around 15 such modules have been standardized and teacher's training programmes have been organized throughout the country. Some of these training modules are "Scientific Explanation of so-called Miracles", "Low cost innovative Physics experiments", "Understanding Mathematics through Origami", "Telescope making and Astronomical Activities", "Use of PC for Scientific Experiments", "Exploring Nature" and "Hydroponics-Fun with Plants in Soilless Condition".

The module "Hydroponics-Fun with Plants in Soilless Condition" has been developed as a group activity for the Science Clubs. The paper highlights and analyzes the development of the module "Hydroponics-Fun with Plants in Soulless Condition" as a parallel or alternative approach used for science popularization and education in India as indigenous model. Under this module, about 25 hands on activities on the art and science of hydroponics have been developed. A manual has also been developed, documenting short-term and long-term hands-on-activities like how to make standard and non-standard nutrients solution for growing plants in soilless condition, pot making from waste material like fused bulb, ice-cream cups, mineral water bottles etc. bedsides experiments like "awakening the seeds & stem bud, and other living processes. This particular module is based on the philosophy that "Understanding Nature is an on-going process and failure is a part of it". In a workshop of four to five days, an attempt is being made to help the children to internalize the method of science in terms of process, measuring, classifying, controlling variables, experimenting, hypothesizing, observing, recording, inferring and interpreting data etc... Through this module, children venture into a very interesting and exploratory journey into the world of hydroponics.

Given the rich experience India has had in parallel and alternative approach of science popularization based on hands-on activities and given the overlapping concerns of Afro-Asian and European countries over the decreasing enrolment of children in science stream, the experience can be shared for cross-breeding and cross-fertilization of ideas for mutual benefits.

Keywords. Hands-on, Environment, STSE.

Bridge over Generations: Science Education for Society

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Abstract. The knowledge based society means not only high technology, up dated endowment, but high qualified people, able to handle it. The paper is dealing with the activity of the institute in the frame of the "Center for Scientific Education and Training" belonging to our research institute.

The special status of a scientific institute: contacts, participation in different international conferences, collaboration in international projects allowed the openness of the scientists and a facilitated integration. This opportunity is easy to be transferred towards the social society and in this respect the interest to support the education of the future qualified people is necessary to start from low levels of education. The project Commenius is facilitating the interaction between pre-university level of education and the research institute. The very promising steps to promote science learning in the schools, the ever increasing interest of the students and high school teachers is really impressive.

The development of the institute in the near future, the acquisition of new facilities will allow the approach of new activities in the domain of human resources not only as scientists but as high level technicians. The expertise of the scientific institute is ever extending towards the civil society.

Keywords. LLL.

 ISBN 978-989-95336-1-5

Education for Sustainable Development: the Contribution of Geographical Education

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Abstract. The concept of "sustainable development" is not universal but it varies in accordance with the communities, with their economic, social and environmental realities, with their values and attitudes linked to their cultural characteristics. In this way, we will show evidence that sustainability and development problems can be only be solved by means of an active participation of informed citizens. Citizens that seek to know the realities at different scales, local, regional, national and even global, the consequences at different levels of the different styles of life of the populations and the answers that the individuals and the organizations can give to different problems essentially of local scope.

In this paper, first the evolution of the concept of sustainable development will be presented, as well as the different ways is has been used: as a theoretical concept in term of structurally relating environment and development problems through case-effect and cyclical relationships, as a set of goals, shared and conflicting, and, a process for achieving sustainable development aims.

Second, the concept of Education for Sustainable Development (ESD) will be presented, education that takes into account these three uses of "sustainable development", because it includes an analysis of the concept of sustainable development and of its goals and tries to enhance people views how to achieve the goals at different scales from the local to the global.

Sustainable development involves environmental, social and economic aspects common to all communities, but the different conditions of development of these communities and cultural differences between them, makes sustainable urban development specific of each community.

Citizens need to know the local realities and issues and to develop a certain number of abilities, attitudes and values enabling them to participate constructively in policy-making and implementation, namely at local level.

Education for Sustainable Development (ESD) addresses everybody, all citizens. The role of citizens is fundamental to reach a sustainable community.

Evidence will be given that Geographical Education can effectively contribute to ESD using a variety of pedagogical techniques that promote participatory learning and higher-order thinking skills and consequently to concur to the empowerment of citizens.

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Keywords. Education, Sustainable Development.

Street Physics in Taiwan. Informal Science Teaching from School to Society

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Abstract. Street Physics is an innovative and brand-new idea which originated from the hands-on activities and is famous in Taiwan for the recent years. Physics hands-on activities were designed by using the local daily goods and were held in public parks by professors and students from National Kaohsiung Normal University. Street Physics activities brought about great benefits for science teachers in formal Physics teaching through more than 50 advanced studying programs and several continuous general science activities per year. The significant characters of Street Physics activity include,

- Foster seed Science-Mothers to spread the popular science into society.

 ISBN 978-989-95336-1-5

- Give Physics lectures to audience of all age to improve lecturer's instructional skills.
- Use common material that everyone can obtain from daily life.
- Low cost (under $5 NT), high inter-person and intra-family activities.
- Under the special design for long term field trial, 80% of the first time participants can work through science topics within 10 minutes.

Street Physics is so popular that the Women-Children-Youth-Center of Kaohsiung County continuously used it as a medium to develop the communities in all twenty-seven villages. In this report, a qualitative research has been carried out with interviewing attendants, questionnaire to the participants, and collection of the secondary data about the Physics on Street. The study results of current situation of popularization of Street Physics and how it affects the popularization of scientific activities from schools to societies was presented.

Keyword: Scientific Hands-on, Street Physics, Informal Scientific Activities

Home-Made Science in Parallel with the Curriculum

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Abstract. Expensive laboratory equipment is not necessarily needed for experiment and observation, on the contrary, there are unlimited resources in our everyday lives. For the last few years, we have been exploring the world of "home-made science" and we are seeking ways to integrate these applications to the primary and high school curriculum in Turkey.

Keywords. Hands-on Science, Simple and Cheap Materials, Self-Learning.

1. Introduction

As educators we often ask ourselves the question: What do we like to achieve in science education? Our aim is to teach our students "a way" to look at the world around them. We would like them to perceive their environments with observation, not with hear-say and we would like them to build a systematic knowledge of the material world as a whole.

Fortunately humans are born this way, preschool children continuously observe their environments and draw conclusions from their experiences. They are curious and they are neither afraid nor reluctant to explore their environments, they constantly fiddle around and they are eager to learn about anything that comes to their way. They also have a tendency to check their newly gained knowledge with their prior experiences, trying to tie different bits of pieces of information to each other.

Until the preschool students start any systematic school education their knowledge of nature is mostly observational and self-gathered. At school however, learning experience is quite different, usually the knowledge is not acquired by the students, but it is given to them in prepared packages. Assessment of this knowledge is quite mechanical as well, exams usually seek for the information given in a certain package, failing to encourage them to make links between packages let alone to make any link with nature as a whole.

In such a classroom environment children may lose their curiosity and creativity, and they may even lose the motivation to explore. To prevent this, we should keep the students active at school. We should look for ways to constantly create opportunities for them to observe and experiment on their surroundings. The obvious way to do this is to supply them with hands-on activities in parallel with the curriculum. Such hands-on activities not only create an interactive and fun classroom environment, but also derive self learning [1].

2. Turkish Education System

In the Turkish education system the first eight years is mandatory. These eight primary school years include the five years of elementary school and three years of middle school education. Starting at 3rd grade, students start to take required science and technology classes. Starting at 9th grade, science classes are divided into physics, biology and chemistry. In the four years of high-school education, the topics covered from the 3rd grade to 8th grade are taught in more detail.

In the last few years there has been an effort to change the curriculum aiming to make all primary school graduates to be science and technology literate. However, especially in public schools the laboratory facilities are quite limited. Even in schools where there are science laboratories, the equipment is not sufficient to

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allow all students to have an extensive hands-on experience. This is why it is very important to integrate applications of science with simple materials to the curriculum.

Fortunately, there are unlimited resources of such applications in our everyday lives. One can get a lot of ideas from the internet and there are already several books written on possible applications of science with everyday materials, see for example [2, 3, 4]. Although a lot of these applications can be extremely simple, a systematic and scientific way to observe these applications not only may allow students to realize the link between science classes and nature itself, it may even change the way they look at the world around them.

For the last few years, we have been exploring the world of "home-made science" in parallel with the primary-high school curriculum in Turkey. We are trying to collect and design a series of course modules that are cheap, easily built, simple and effective in learning. These modules are in the form of small scale experiments, demonstrations and games.

3. Home-made science

3.1 Demonstrations and experiments

Students can be involved in the designing / building process of most of these modules. Some of these modules allow to take data and to obtain some quantitative results and some of them are just useful in demonstrating scientific phenomena.

A few examples to this type could be as following:

Gravity:

There are two very easy demonstrations showing the effect of gravity on objects on the surface of the Earth. We only need a book and a piece of paper to perform the first demonstration. Let the students drop the book at a distance from the floor and let the students observe the fall. Separately let the paper fall from the same distance. At this point one can discuss the effect of gravitational force on objects. Finally putting the paper on the book and dropping both together observe that the book and the paper fall to the ground at the same time, regardless of their mass.

Second application requires a little bit more equipment. An appropriately sized table can be used instead of the platform seen in Figure 1. Height of the table is preferable higher than one meter. Materials needed are a strong magnet, a rod almost as the same length of the chosen platform, one steel or iron ball, one plastic ball, a small and preferably thin nonmagnetic plate. Glue the magnet on one side of the rod. Fix the small plate on one side of the platform. Magnet holds the steel ball as shown in Figure 1, while the plastic ball stands still on the other side of the platform. Pushing the plastic ball by applying a horizontal force on the platform will start the plastic ball move towards a horizontal projectile motion, while at the same time will let the steel ball fall vertically downwards. An optional plate can be placed on the floor to make a sound as the steel ball reaches the ground, so watching only the plastic ball's motion is sufficient. Both balls regardless of their mass fall to the ground at the same time since their motions vertical to the ground are identical [5].

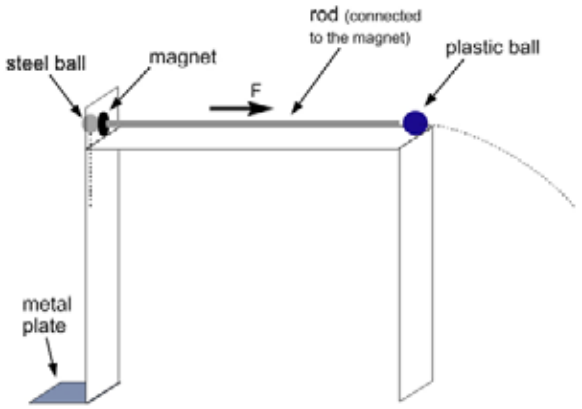

Figure 1. Set-up for the gravity experiment

pH indicator:

A lot of flowers and fruits are natural pH indicators. Red cabbage is one of them. The natural dye of the red cabbage can be extracted by soaking cut cabbage in boiling water. When strips of white filter paper are dipped into this water we have our home-made pH indicator. After the prepared pH indicators are dried they can be tested with household materials such as detergent, soap, lemon, vinegar etc. The indicator turns red with acidic materials and turns blue with base [6].

Simple motor:

Simple motor is a quite an elegant device which demonstrates transformation of electrical energy to mechanical energy. Another great thing about motors is that students can make their own motor design. One only needs conducting wire (preferably coated copper), magnets, connecting wires, battery (1.5 V batteries are usually enough).

 ISBN 978-989-95336-1-5

While discussing the topics of magnetic flux and magnetic force, it can be a good exercise for the students to build their own simple motor.

One possible design is shown in Figure 2. This motor design is adopted from [7]. The loop consists of about five turns and two sides of the copper wire that are extended as seen in Figure 2. A sand paper is used to left side completely conducting. Right side of the wire is rubbed partially by sand paper. At the position seen in Figure 2 a current flows through the circuit and the magnetic force turns the loop. When the loop is upside down, the right side of the wire is no longer conducting and the current stops. This way the loop can keep on turning and we have a simple motor.

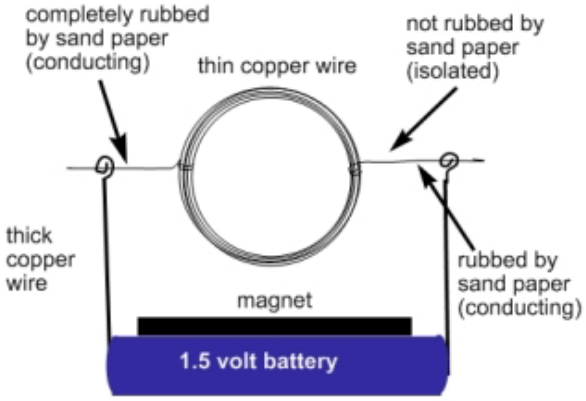

Figure 2. An example motor design

Another quite interesting motor design is the homopolar motor, the details can be found at [8]

CD Spectroscope:

Light is quite an interesting topic of science and one can built a very simple device to observe the spectrum of light. A used CD and cardboard is what is needed to build this device. A cylinder with radius about 3 cm and length 50 cm is formed by the cardboard. Close to one end of the cylinder the cardboard is cut with an angle about 30 degrees as seen in Figure 3, a CD is placed in the cut and secured with isolation tape such that no light can escape. On the other side of the cylinder a slit is opened for the light to enter. Light should not enter from anywhere except the slit so isolation tape can be used to cover all openings.

A hole is opened on the cardboard at the top of the CD for observation. When the light enters the cardboard and reflects from the surface of the CD, different wavelengths reflect with slightly different angles and one can observe the spectrum of the particular light source. Different light sources such as incandescent light, fluorescent light, neon lights and sun light can be observed and the properties of their spectrum can be discussed [9].

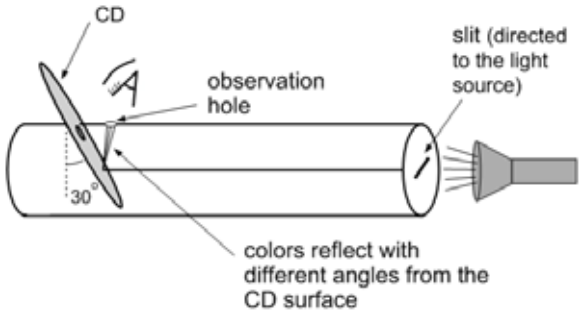

Figure 3. CD spectroscope

Ice and Buoyancy:

By using only ice and water one can demonstrate the concept of buoyancy and the structure of water in liquid and solid phase. Firstly we fill a balloon with water and freeze it. After water freezes, we put the ice in a preferably transparent bucket of water and label the level of water with ice in it. Then raise the question “Will the water level, increase, decrease or stay the same once the ice melts? Students may discuss this and explain their answers. After observing that the water level does not change, one can raise the second question: Why are we afraid of the rise of the sea level if the water level does not change upon melting of the ice? [10]

3.2 Games

This category is especially effective for preschool and elementary school students. Some examples to this type are as following:

Rollercoaster:

A model of a rollercoaster can easily be built by isolation pipes from a warehouse and marbles. The rollercoaster game [11] is organized as a competition between student teams. Same number of isolation pipes is given to teams and they are asked to build roller coasters which start at a start line at the same height on the wall.

Students try to build tracks on which the marbles can be rolled as far as possible, with as many loops and turns as possible. This game demonstrates the conversion of mechanical energy. The energy loss mechanisms can be discussed, at a higher level the motion of the marble can be analyzed in more detail.

 ISBN 978-989-95336-1-5

Speed game:

At the constant speed game [12] 5-6 students form a line standing at equal intervals (5-10 meters) all holding chronometers. A student starts to run at a distance and all the chronometers are started simultaneously. The runner tries to maintain a constant speed on a straight line. When the runner passes by a student with a chronometer, the timer is stopped. The readings of all the timers are recorded and a position-time graph can be plotted to clarify the concept of speed.

Cell Game:

Cell game is a board game which is designed to teach students the cell structure and its processes [13]. At this game a cell is associated with a city and different organelles of the cell are associated with city buildings, for instance the nucleus is the city hall, the smooth endoplasmic reticulum is the river passing through the city, the rough endoplasmic reticulum is the part of river where there are factories, ribosomes are the factories, mitochondria is the power plant etc. A large scale cell is drawn on a cardboard and buildings made of cardboard boxes are placed on the organelles. There is a path on the board that goes around the cell and has stops near every organelle. This path has numbered divisions on it. The students throw dice to move on the path. At every division there is either a question to answer or an act. When a player comes to a particular organelle he/she talks about its processes. Players start the game with equal number of beans, they gain a bean for every correct answer, and lose a bean for every wrong answer.

4. How to integrate home made science in the curriculum?

4.1. Freshman Project Course

Project 102 is a one semester project course aimed for the first year university students at Sabanci University. Faculty members offer various topics in science and engineering and supervise teams of students throughout the semester. For the last few years we have been offering the project “Designing, building and testing of science course modules aimed for primary-high school curriculum” through Project 102.

Students who sign up for our project firstly analyze the curriculum and try to come up with ideas which could be used in parallel with certain parts of the curriculum. Ideas are discussed and shaped under our supervision. During the rest of the semester, students work on these ideas, gather materials and complete a prototype of the modules. Students are also asked to prepare manuals for each module. Each manual includes some background information on the relevant scientific concept, directions for gathering materials and construction.

Of course, in order to safely recommend these applications to teachers we would like to systematically test them at schools and check student response.

4.2 Civic Involvement Projects

Civic Involvement Projects (CIP) is a one year course which is mandatory for every Sabancı University student. Through CIP students take active roles in civil society in cooperation with national and international nongovernmental organizations and state institutions [14].

CIP has a wide range of projects, about child development, human rights, environment, consumer responsibility and handicapped people. Child development projects are a big part of CIP and they are organized in cooperation with the Ministry of National Education and local primary schools. In these projects Sabanci University students visit certain underprivileged schools for a year and perform activities with the children. These activities are sought to be fun and educational.

Freshman students who are taking Project 102 course usually are also taking CIP at the same time. This is quite an advantage for Project 102 students to test their modules. They systematically take these modules to CIP schools and get feedback from the children. We then have a chance to modify our modules according to the feedback obtained at CIP schools.

We try to share our past and present experience with CIP coordinators and supervisors regularly, this way we get them to use these ideas in their own CIP activities.

5. Conclusions

Even if at schools with no laboratory facilities, students can have a lot of hands-on experience with experiments designed with easily obtained materials. Such experiments are aimed to be integrated into the primary-high school curriculum. These applications may help students connect science classes to nature more effectively, encourage them to look further and investigate, and they may even boost students’ self-confidence since they are directly involved in the learning process.

 ISBN 978-989-95336-1-5

6. Acknowledgements

Authors would like to thank all the Sabancı University students who chose to design course modules during their Project 102, Ünal Ertan, Emrah Kalemci and the CIP coordinators for their valuable contributions. Authors would also like to thank to Institute of Complex and Adaptive Matter (ICAM) for supporting this work.

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Carbon Market Forest Potential, Agriculture and Renewable Energies

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Abstract. The era of carbon market began. The year 2005 is marked by the entrance of the Kyoto Protocol and the beginning of the European trade of emissions licenses (CELE). The Kyoto Protocol was proposed in 1997, due to an international convention about climate changes. The participants were set to accomplish goals of reduction of the emissions of greenhouse gases (GEE's) up to 2010. Besides measures at national level to reach the limits of emissions of imposed GEE's, the protocol pointed out the creation of a world market of transaction of these gases. In this sequence, it's necessary to develop national regional and global level strategies to tackle climatic alterations including in what concerns the Carbon Market.

In the concrete situation of Minho region in northwest Portugal it is essential to carefully analyze the current situation in order to identify forgotten opportunities in the greens rural and mountain areas of the region. In this context s focus should be given to the forest potential, the agriculture-livestock and the renewable energies (wind, solar, biomass,…) use.

Keywords: Carbon Market, Renewable Energies, Greenhouse Gases Emission.

The Renewable Energy House

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Abstract. The renewable energies awareness should be improved significantly at all levels in our societies. Practical approaches relating as extensively as possible to everyday life situations should be provided explained and explored. The

 ISBN 978-989-95336-1-5

"household", will be the main part of the demonstration herein, illustrating and exploring the effective use of renewable energies for daily energy consumption in a variety of situations: heating house and water, cooking and producing electricity used in other household activities…

Various strategies of renewable energy production and conversion will be explored using a commercially available model and other simples easy to find pieces or instruments.

We will demonstrate that it is possible to rationalize energy consumption by adopting new habits. Showing how it is possible to cool down a house using a system where air circulation and water evaporation works as a cooling method, demonstrating that is possible to produce electrical energy from chemical reactions, to produce electrical currents using magnets, the use of wind to produce electrical energy.

Keywords: Hands-on, Renewable Energies.

Robotics@Gulbenkian
Experiments in Educational Robotics

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Abstract. The study described in this work was conducted by a class of 20 students, from the 6th grade in a music school, the Conservatório de Música Calouste Gulbenkian, in Braga (north of Portugal). The study involved three teachers from this school and was made possible by making available 2 hours per week, during three months, from the Citizenship Formation curricular component.

In a first stage, the students were involved in a period of about 1 month where they learnt the basics of Robotics: namely in the construction and programming of robots. A set of Lego Mindstorms robotics kits with the new NXT control unit were used .The Robolab programming software that allows visual or iconic programming was used to program the robots. The students solved a number of exercises, of increasing complexity, requiring both the construction of several types of robots and a number of programming tasks.

Once these basic skills were acquired, a project was proposed to the students that would involve building and programming robots, in order to create a "show" that could be presented to the community in the end.

The students gathered to discuss what would be the content of the show. It was decided to split the class into two main groups, according to the preferences. A first group decided to create a dramatization of the story of the "Three little pigs" and the second group was involved in creating a fashion parade.

In these projects, the work started with the definition of the characters where each will correspond to a robot. The robots were built to fit these tasks. Next, the paths that each robot needs to follow were defined and the students programmed this behavior in Robolab. The final stage dealt with putting all these things together, by painting the scenery, designing the wardrobe of the robots, making final adjustments in the robots and their programs and doing a final rehearsal.

 ISBN 978-989-95336-1-5

The show was presented to the community at the end of the school year (in June). Several parents were involved in helping with scenery and the wardrobes. Most of the parents and numerous students and teachers from the school attended the show. For most this was the first contact with Robotics. The work in Robotics will follow in the next year in this school.

The teachers involved are unanimous in acknowledging the fact that important skills in Mathematics, Science, Technology, Arts and Portuguese language were used in this work. Other transversal skills were also addressed, such as real world problem solving, logical reasoning, critical thinking, creativity, autonomy, cooperation, communication and group work.

All those involved in the project also emphasize the enthusiasm and motivation of the students, but mainly their persistence in following a project until its completion. The students were visibly proud of the result of their work.

Keywords. Robotics, Mathematics, Science, Technology, Art.

Ethanol from Lignocellulosic Biomass: Technology, Economics and Process for the Production of Ethanol

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Abstract. The European Union is promoting the development of ethanol from lignocellulose feed as an alternative to conventional petroleum transportation fuel. Production of ethanol from agricultural and forestry residues, and other forms of lignocellulose biomass could improve energy security, reduce trade deficits, decrease urban air pollution, and contribute, to the reduction of carbon dioxide accumulation in the atmosphere.

Different techniques are available for the conversion of the cellulose and hemicellulose fibers into lignocellulosic material, such as wood, waste paper and fast-growing energy crops, into fermentable sugars. Some techniques are based on acid hydrolysis utilizing either dilute or concentrated acids or enzymatic hydrolysis.

Keywords. Energy, Environment.

1. Introduction

Ethanol production via biotechnological renewable matter is one of the best and most recent examples of the importance of Biotechnology. Bioethanol production will have highly positive consequences at an environmental level, besides reducing the world's dependence on fossil energies. The introduction of 10% of ethanol in gasoline used by cars – that does not require motor adjustment – will result in a significant reduction of CO_2 production and a reduction of 25% in carbon monoxide emissions. Plus, it would cause a reduction of the ozone emissions, produced by the combustion of gasoline. Bioethanol production is an excellent example of the importance that the Biotechnology can have, not only at environmental level, but also in the production of products of low increased value. Being so, bioethanol production can today be an option due to progress made in enzyme production, in the development of microorganisms with capacity to ferment the substrates available (lignocelluloses, starch, cheese serum, etc.) and in the technology of the bioreactors. The directive 2003/30/CE recently published, establishes quantitative and temporary goals that the States-Members should respect for the usage of certain proportions of those products in fuels normally used in transportation. Those proportions vary between 2% of all the gasoline and diesel fuels, placed in the market with that end purpose until December 31, 2005, up to 5,75% in 2010. The goal of 2% of the fuels consumed in Portugal in the transport sector, implicates the production of approximately 100 million liters of Bioethanol, from which will result an annual volume of sales superior to 50 million euros, with a significant growth potential in with respect to the community purpose for 2010.

2. Portugal's situation

With respect to biofuel obtained from energy cultures, it seems that some industrial sectors are interested in its production but the projects are still under development. However, there are some projects for biodiesel usage, as is the case of Lisbon's public transportation, which is incorporating about 10% of this biodiesel liquid. The use of fuels of natural origin in the transport sector came about due to a variety of factors such as excessive dependence and energy costs of fuel importation (Brazil), reasons of an environmental nature (USA) and, in Europe, since 1992, the possibility to have cultures, whose end is of a non feed nature, in lands excluded from production due conditions

 ISBN 978-989-95336-1-5

imposed by the by the Common Agricultural Politics (PAC).

As reflection of the growing need for mobility of people and goods, the weight of the transport sector has suffered a great increase, representing in 1999, approximately 25% of the world wide energy consumption. In Portugal, the transport sector energy dependence on petroleum is much accentuated, being responsible for the consumption of 42% of the total imported petroleum.

3. Biomass

Biomass can be described as the amount of organic matter, resulting from the metabolism of plants and animals formed in a given habitat.

In a wider sense, organic matters like plants (trunks, branches, and bark) and transformed matters such as residues of industrial wood, the food industry and agriculture-livestock can be included in the definition of biomass. Energy can be obtained through the direct combustion of materials or through chemical or biological transformation, in order to increase the overall energetic power of the biofuel. There exist several ways to take make use of this type of fuel, such as direct combustion, biogas and biofuels. Direct combustion implicates the burning of forest and agricultural residues, which produces water vapor. This, on the other hand, is channeled to a turbine for a turbine with the purpose of producing electricity.

4. Lignocellulosic biomass composition and availability

Lignocellulosic biomass represents the major fraction of most plant matter. As shown in Figure 1, the major fraction of such materials, typically about 35-50%, is a polymer of glucose known as cellulose. The next largest fraction, of about 25-30%, is hemicellulose. Hemicelluloses are also polymers of sugars. The types and distributions of these sugars vary depending upon the particular biomass, the five carbon sugar xylose represents the predominant fraction of the hemicellulose component. The third largest fraction, of about 15 to 25%, is typically lignin, a phenyl-propane polymer of complex composition that cannot be broken down to form sugar molecules.

5. Cellulose

Cellulose is a polysaccharide whose chains contain among 4000 to 10000 units of $(C_6H_{10}O_5)_n$. This linear polymer of D-glucose in $\beta(1\rightarrow4)$ linkage is the major component of wood and thus of paper.

Cellulose is linked to hemicellulose and lignin, therefore not an easily accessible substrate. Physically, cellulose is a solid, white material that exists in an amorphous crystalline state. The crystalline form is resistant to chemical attack and to microbial degradation, while the amorphous form is promptly attacked and degraded [1] (Biermann, 1996).

6. Hemicelluloses

Hemicelluloses are not related structurally to cellulose. They can be pentosans or hexosans. More commonly, polymers of pentoses (particularly D-xylans, polymers of D-xylose in $\beta(1\rightarrow4)$ linkage with side chains of arabinose and other sugars). Due to its low degree of polymerization and to its amorphous nature, hemicelluloses are more easily degraded when compared to cellulose. Yet there is still the need for a complex enzyme system or acid for its degradation, because of its ramified structure (Sjöström, 1981). Just as cellulose, one of the main functions of the hemicelluloses is to give resistance to the cellular wall, acting as a support matrix for the cellulose microfibrils (Kirk & Farrell, 1987). Physically, they are a solid, white material, rarely crystalline or fibrous.

7. Lignin

Lignin is the second largest cellular component of wood. It establishes connections among the fibers of the wood, giving firmness and rigidity. It's found between the cells and the cellular wall and is resistant to biological attack because it does not contain bonds to be hydrolyzed. Lignins and hemicelluloses are linked covalently.

Lignin is a polymeric amorphous structure, aromatic, highly ramified and insoluble in water. It comes under a three-dimensional net with crossed connections (Sjöström, 1981).

Figure 1. Plant compounds

It is a complex heteropolymer consisting of units of fenilpropane (C9) that presents a high

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molecular weight (600 - 10000 Da). During chemical treatment, its removal allows the cellulose fibers and hemicellulose to be separated easily (Kirk & Cullen, 1998). It is of a hydrophobic nature, which in the presence of pastes inhibits the absorption of water and the dilation of the fibers. Lignin is covalently associated to the hemicellulose, on the cellular wall, through numerous types of bonds). Lignin is a highly irregular molecule, without a precise structure, yet containing a varied series of substructures.

As lignin consists of mixture estereoirregular units, the ligninolitic agents certainly will be much less specific than the typical biological catalysts (Hammel, 1997). Only, the basidiomycetes, a class of microorganism, are capable to degrade lignin.

8. Production process with Concentrated Acid

8.1. Pre-treatment

In the bioethanol production process, an efficient pre-treatment step is necessary so as to increase the surface area and accessibility between the hydrolyzing agent and the lignocellulosic fibers. A concentrated acid (HCl) is the agent used in process A and diluted acid (H_2SO_4) in the process B.

8.2. Titration and Drying

The pine wood containing 44,6% of cellulose, 25,9 % of hemicelluloses and 25,4% of lignin is crushed and reduced to small chips. This reduction will turn the hydrolysis step more efficient.

In both processes (A and B), the chips pass through a drying process and in the end, 5% are diverted to a combustion chamber to produce vapor that can be used in the drying stage.

8.3. Acid Hydrolysis

The pre-treatment phase is technically the most complex phase, because of the heterogeneous nature of the material and the energy expenditure implicated. During the pre-treatment phase, the lignocellulose is degraded reducing the crystalline fraction and increasing the of amorphous cellulose fraction, which is more sensitive to the acid attack. In other words, in the hydrolysis step, the cellulose chains are broken in way to produce reducing sugars, hexoses and pentoses. These will be used as the substrates in the fermentation to ethanol step.

However, in process B the fractions of hemicellulose and cellulose of the biomass are recuperated along two subsequent steps. The first stage is processed under moderate conditions, in order to hydrolyze only the hemicellulose (5% H_2SO4, 160 ºC) to pentose, while the second step is optimized to hydrolyze the more resistant cellulose fraction to hexoses the (10% H_2SO4, 200 ºC)

8.4. Alcoholic Fermentation

In both processes of ethanol production, it is necessary to ensure the sterilization of the flux of sugars (at a temperature of 130ºC) and the filtration of the air current supplied. This stage is indispensable in order to maintain the inoculate sterile.

For the fermentation stage, the yeast Saccharomyces cerevisiae is the microorganism used for the conversion of the hexoses into ethanol. However, this microorganism does not metabolize the pentoses produced in the pre-treatment of the fibers. In both processes, the fermentation of the hexoses into ethanol is done by several fermentations in series, with a capacity of 10000L, operating continuously, at a temperature of 30 ºC. The pentoses that result from the diluted acid hydrolysis are fermented using genetically modified bacteria, E.coli KO11.

The pentoses that are not used in the first process (A), for the bioethanol production, are used as co-products for the production of methane and then energy.

8.5. Distillation of ethanol

The fermentation broth is submitted to a rotational filtration under vacuum, as to remove the present biomass. The resulting flux, consisting mainly of ethanol and pentoses, continues on a distillation column for the purification of the main product, ethanol 96%. Both columns operate at 90ºC, however, they possess a number of different levels.

9. Perspectives for the Region between Douro and Minho

The Region between Douro Minho reveals some potential for the production of energy from biomass. This potential occurs, on one hand because of the fact that it generates products and sub-products of animal and vegetable origin capable of being valued because of there energy production, and on the other hand presenting conditions for the production of certain energy cultures (for example, the intense production of forest species of rapid growth) although the latter

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debatable. In the cattle sector, biogas production can allow the valorization of effluents and at the same time solve some of the Region's environmental problems. Given the existence of a high degree of use for these effluents as fertilizers, it becomes, necessary to evaluate the generated surpluses, other than what is used for fertilization. A plan can be elaborated, to finance the next programming period in order to value these effluents for the production of biogas.

In the Region, there also exists a group of slaughterhouses and food and agricultural industries generating residues susceptible to biogas production. In the same way, it will be necessary to proceed to the counting of these residues so that, later, it's possible to frame the necessary investments necessary.

With respect to the vegetable sub-products, the Region's contribution is bounded to the forest sector. The forest area (about 320 000 ha) and of uncultured area (193 000 ha) is significant and, being so, the resultant biomass is then used for the production of electrical energy. In this context, it is important to think about the use of forest dedicated species of fast growth (certain varieties of poplars, eucalyptuses, birches, etc.), for the biomass production and energy.

In many cases, these species can be used to occupy agricultural soils or even abandoned soils.

Finally, the Region is not likely to become more competitive in the production of the more conventional energetic species, like, corn, soy, etc, used in the production of biofuel.

10. Restrictions

Several restrictions were identified for the introduction of a biofuels in Portugal, being some of easier resolution than others:

Shortage of available land: the substitution of 5% of the diesel oil consumed in Portugal, with the actual productivity of the sunflower cultures, requires the plantation of about 500 000 ha. The addition of 5% of ethanol, produced from cereals, to gasoline would require, at least, of 50 000 ha, depending on the type of cereal.

Low agricultural productivity, essentially pertaining to the cultivation processes and the type of soils: in Portugal, the mean productivity of sunflower, registered in 1997/2001, was inferior to 0,7 ton / ha (1,3 ton / ha in Spain, values greater than 2 ton / ha in France and in Italy).

High cost of the raw material and industrial processing: the low productions don't allow the use of scale savings associated with the construction of great processing units, leading to the increase in oil costs that becomes hard to compete with the cost of diesel oil by the consumer.

High cost for collecting and transport the raw material, with respect to ethanol production from forest residues.

The lack availability of raw material: the percentage of lands in fallow ground oscillated with the impositions of PAC between 17,5% and 5% in the period 1993-98 and in 10% starting from 2000. Besides this area, there still exists the possibility to make fallow lands voluntarily in superior rates.

However, to this date, Portugal did not use any fallow land surface for the production of non-feeding cultures, contrary to what happens in France and in Germany.

The raw material price instability in the international market.

Lack of quantification of the costs associated with the use fuels of fossil origin: a recent study revealed that the taxation of the diesel oil just covers about 22% of the external costs associates with its use.

The lack of project demonstrations, in Portugal, illustrating the problems and solutions associated with the production and usage of biofuel. International agreements of trade, which limits the use of by-products of the of biofuel production chain.

11. General agreement about agriculture in the extent of GATT

The high cost of biofuel is basically due to the low agricultural productivity, relative to the actual prices of the conventional fuels. The lack of physical disarmament of biofuel, unlike what happens in the other European countries with the biodiesel and in the USA, Spain and Sweden with the bioetanol.

12. Proposed measures

The main support mechanisms for the development and integration of a row biofuel (biodiesel or bioethanol) are synthesized in the following points:

Long term promotion of physical incentives: total exemption of ISP in the biofuel produced in units of demonstration in the first 5 years.

A European norm for biofuels that does not impose restrictions of technical nature for the use of endogenous resources of a given area.

Definition of a regulatory frame for the usage of biofuel in a coherent and stable form.

Assure progressively a same price, for alimentary ends and for energy ends, for the seeds of oleaginous and for the cereals, avoiding

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the dependence of the production of these cereals in fallow soils areas.

Promotion to the collection of selective used alimentary oils (restoration, taverns, etc.), obtaining low cost raw material for the biodiesel production and eliminating a pollutant source.

Motivate the usage of ethanol as component for the gasoline's (incorporation tax that can go up to 5%) or indirectly by the addition of ETBE.

Utilization on the environmental legislation, with base in non emitted CO_2 by means of the usage biofuel.

Define simplified contractual frames that regulate the relationships among producers, transformers and biofuel distributors.

Promoting, the cooperation among the central and regional authorities with a view to the development of rows of biofuel (marketing actions, usage of biofuel in municipal vehicles, etc.)

Motivate the use of lands that was putted like fallow soils to the development of energy.

Promotion of specific plantation culture, with fast growth and with few cultural demands (in case of the thistle) for bioethanol production.

Quantification and popularization of the social benefits, economics and environmental associates to the creation of a row of biofuel production.

Identification of the existence of market niches where the usage of biofuels is covered from advantages face to the traditional fuels.

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Work Done in Kindergartens by Our Students Orientated by Distance Learning

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Abstract. During two years, 29 teachers of kindergarten were orientated, by distance learning, in annual university discipline called Seminar in a way of implement didactic projects in biology field in their schools. The aims of these didactic projects were teaching biological concepts to the children and change community attitude to several problems. These objectives were reaching, as prove the inquiries done after the implement of projects. In fact the themes chosen by students were different. Some chosen themes of how protect endemic species of an area, others try to improve the respect to animals and plants and the useful of them to human being. Distance learning reveals a good option because students were of different parts of Portugal including Madeira and Azores Islands.

Keywords. Kindergarten, Biology.

1. Introduction

In Pedagogic and Scientific complement course for Kindergarten teachers, the last discipline is called Seminar. This discipline develop along one year and consists in practical work done in each college by our students and the evaluation of our students were made by the written report, according by the manual [1], and by oral presentation of work and oral discussion . Our students are kindergartens teachers without university graduation, this is why they must do this course in order to maintain their works.

The aim of this discipline is to learn the kindergartens teachers how to plain an activity and how to evaluate their impact in children and involve community. In last two years 29 students were orientated by methodology using in distance learning.

2. Tools used to orientation of seminars

Because our students came of all parts of the country, the seminars were orientated by distance using the tools at disposition to this type of learning: telephone, videoconference, e-mail and learning platforms. In this case the students, in general, did not like use learning platforms,

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which is Moodle platform. In fact were verifying that a lot of them did not trust, so the way that almost the students like is by e-mail or telephone.

In the first step of the work that the students must done, is to choose a theme and justify their importance and establish the objective. Second step is to prepare the temporization of activities, identifying for each one of the objectives.

After applying the project evaluated if objectives were reach and if not why. They also determine what were the impacts of this work done with children in community. In same cases the community is small and the activities of children have reflection in the changed of the behaviour of the families.

3. Theme chosen by students and work development

The themes chosen by students were different and each student has different requirements, this may be the reason why e-learning platforms were not the tool chosen by students.

The themes chosen by students were about subject:

- vegetable gardens, its importance and the role in human alimentation,
- protect endemic flora,
- care with pine forest,
- protect species of animals in particular endangered species,
- knowing the needs and importance of cattle,
- care of domestic animals.

The theme around vegetable gardens, the children helped to prepare the field, put seeds in it, different techniques of planting, different roots, stems, flowers and fruits. The children take care of the garden and development the concepts of what's the needs of plants, meanwhile some of the students put in classroom plants in water and add some colour to the water in a way to explain that in fact plants need water, also put some plants in dark to show the children that light is essential. When they made the crop, with the vegetables the children participate in the elaboration of a salad and a soup to eat at lunch. The repercussion of these works with children is that they start in their homes to eat soup and salads without reclaim. Some parents notice that they also want to participate in garden careering.

The theme of protect flora were developed by our students that lived near a protect area. The work with children starts to show the differences between types of plants (Figure 1). Visits the protect area and teaching why and how they can preserve and respect the nature. A lot of works were done in field and in classroom. In public locals of exposition the works like drawings, gluing and clay pieces were exhibited. The result in community is that all members of the family learn what the importance of the flora nearby and behaviour changes.

Figure 1. Children visiting a botanic park

In Portugal the fires of pine forests is a concern. So some students that live nearby pine forest development the work with the children in this area. First try to learn to children what is a pine, the importance of pine to their habitat. They went with children and observed the other communities of animals and plants living in pine forests. Also explain the importance of wood to men and also the importance of resin. Development in children the correct behaviour when visiting the forest and what to do if saw a fire. These works haven't immediate results in community but in future these children remember some of the concepts.

All the students that chose protect endangerment animals had good results. Normally the students, in these two years, chose endemic species came from the isles, such as marine turtle (Caretta caretta) of Azores, Cory's shearwater (Calonectris diomedea) of Azores, Mediterranean monk seal (Monachus monachus) that is one of the most endangered mammals in the world and lived in Madeira archipelago and Zino's petrel (Pterodroma madeira). All these students investigate first the specie and than programmed the activities.

One of the most interesting is that marine turtle die if swallow a plastic bag, children assimilate so good the concept that try to change attitudes of their parent to use more the same plastic bag and speak with all people around to never quit a plastic bag to sea because the turtles can dye. In general the work done with

 ISBN 978-989-95336-1-5

children that includes visiting to nature, to local museums, dramatization, drawings (Figure 2), etc, lead that children and their families learn about specie and cares necessary for preservation of it.

Figure 2. Children made classroom drawing about turtles

The work developed with children about respect, needs and how cattle are important to Human Being is very important to the children understand the aliments that eat. In case of cow the children participated in doing cheese (Figure 3) and butter. Normally this theme had no repercussion in community except that all of children asked persons of family that have cattle if they call the vet to medicate, given vaccines and take care of them.

Figure 3. Children made cheese

The theme of respect the domestic animals is centre in cats and dogs. The aim is to take care of animals and avoid abandoned animals in the street. Our students done with children a lot activities and one done a "sculpture" of a dog with empty bottles of water and other material (Figure 4). As happen with last theme children asked to all persons knew if animals have a vet and how often are the visits. Some asked to parents to adopt an animal.

Figure 4. Dog made by children with recycled material

4. Problems felt by students

4.1. During first stage

The first type problem of students is what theme to chose. After is given questioner to fill where the students must wrote the theme, objective, justification of the chose and methodology chosen. During the period giving to fill it the students prefer telephone to put their questions. In this period they contact a lot with us. During this period the average of contacts by students was 5 times.

Was establish a data for conclusion of these period and they send us by email or by post. Was evaluated and if considerer ok they continue is work.

4.2. Application of work

During the application of work the email is preferred by students. Normally the first questions were theory about subject and they want bibliography references to understand the theme. The need of bibliography was more evidence in students that chose an animal endanger, local animal and endemic flora. In this theme is necessary teaching the student how to distinguish the different species.

They send us schemes to given an opinion, asked how to programmed the things to do in visits with children, what kinds of entities can they contact, what persons can they invited to the classroom, send us the questionnaires that they given to parents of the children to fill, asked how to deal with legal questions such as photograph the children and use these to put in written work and use in future, etc.

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During these stage the contacts were constant and in same cases three or four days a week.

After every activity or in end of activities was necessary evaluating the repercussion of them and identifying problems and things to be changed in future actions. These also reveal complicated for the majority of the students (about 70%).

4.3. Write the work

The roles to write the work was establish in manual of seminar (general for all themes, in this paper only referred theme of biology).

The students contact to ask the items referred in contents, and they always had problems in writing everything in the 20 pages. Annex can be apart but it only allow put there photos and a copy of questionnaires done.

During the writing, normally, contact to ask the role and with doubt about how to introduce bibliography references in the middle of the text and how to do final references. To the last group orientated was send to all a text with all these explain and with examples. But when the final work was evaluated verified that a few number did not understand everything and done mistakes in it.

In this stage the contacts of students was by email and two times per week (average). A very few try to use Moodle platform at this stage.

4.4. Presentation of work

To present the written work orally, they have 10 minutes, the doubt is what tool to use. The students of continent went to university in Lisbon to done this presentation and students of islands done it by videoconference. The tool chose after our explanation was computer program PowerPoint.

5. Conclusions

This distance teaching is ideal for this kind of work because allow a permanent contact between teacher and students. The doubt that the student had can be explain in a few time. For the teacher was only necessary to have a computer with access to internet. Is equal a very good tool when our students came for all parts of country. In relation to the evaluation done by our students of the impacts the work had in communities the results were very good. In a lot of communities the mentalities of persons who contact with children (family, friends, neighbours, etc.) in fact stay more alert to several problems.

6. Acknowledgements

To my students and their student's parents that allow the used of the photos.

7. References

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Aquarium as a Tool for Teaching Sciences at All Grades Levels

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Abstract. The aquarium are an excellent hands on teaching tool in the classroom, it offers students the opportunity to learn directly through experience. The first step is to choose the environmental and animals specifically for the objectives of teaching. Its possible creates environments of different places: seashore, corals reef, lakes, different rivers, etc. The most common tool for classrooms is an aquarium of freshwater. The material necessary depends on the environment chosen. The second step is set up the aquarium with all material necessary. Then is necessary select the gravel and decoration roots or stones. If is recommend for the environment chosen the species of plants to introduce. Finally the fishes and invertebrates must be introduced. The phase of set up allows the classroom understands the requirements of animals and plants, come from different environments. A several examples of different environments aquariums will be referred. After the aquarium is established the water parameters must be control, such as water temperature, pH, ammonia, nitrite and nitrate levels. Graph the information and looks to trends is an excellent way in such levels to explain a lot of concepts. The animals must be fed with appropriate food, this introduce the concept of food chain. The reproduction and behaviour of animals are also very important to understand zoology concepts. The reproduction and grow up of plants are also very important to understand botany. Is given some examples of done this in classroom.

Keywords. Aquarium, Teaching Tools.

 ISBN 978-989-95336-1-5

1. Introduction

Teaching sciences is not easy in classroom and students need to contact with real situations to understand the theoretical concepts. Is also not easy arranging an activity that involves and allows practical activities for disciplines such as biology, physics, chemistry and mathematics. One toll that can be used is aquarium in classroom. Normally the aquarium stimulates a lot of interested in the students, and is a moment of learning and relaxing.

2. What kind of environment and fishes in it

The first step is to choose what kind of environment. If the objective of set-up an aquarium is to study a determine environment, is easy. Otherwise if objective is using the aquarium as a tool to teach sciences in general, our advice is to choose a warm freshwater environment, because is easy to maintain and have a lot of potentialities as you can understand below.

Our advice is chosen environments with warm water. Is easy to put a thermostat and maintain the temperature than put a chiller to maintain low temperature and the last equipment is very expensive. The other reason to choose warm water is because fishes that lives in that conditions are colorful and have more attractive, in general.

The marine aquarium can be done in classroom, but the price of the equipment is higher, time necessary to the stabilization of the aquarium is longer and his maintenance is more complicated.

Choose a freshwater environment aquarium allow the classroom study in advance what kind of river or lake they like to set-up.

In first levels the teacher can explain that the current, temperature and water chemistry is different. This can be done showing photos of rivers and lakes and chemistry is easy if different kinds of bottled mineral and natural water are given to taste to the students.

In high levels can be explain the different conditions of environments and put students to study what the differences in water chemistry, current, etc, between the different environments. Can also study what species are in endangerment in each habitat. Our advice is to study a river environment with current, one of lakes of rift (Malawi or Tanganyika), Amazonian environment and Asian environment. The students can also study the needs of the fishes of each environment and compatibility between them. Composition of decoration must be study and the possibility of introduce it in each environment. Is also necessary study the behavior of fishes if is better to maintain a couple or maintain a shoal. If were considering: a rift lake of Africa, which has high pH, calcareous stone and gravel, must be chosen, Amazonian river that have low pH, natural roots are the appropriate. The necessary current also be study and students calculated the power of the pump need for an aquarium and to a determine environment.

Temperature is very important and in warm water are a lot of fishes with different requires. For example Amazonian environment the temperature is 28ºC and in Rift Lake is 25ºC.

Fishes live in different water layers. There are fish species mostly swim near the surface, in the middle or near the bottom of the aquarium. In order to have fish in all water layers is necessary considerer this when selecting the fish.

3. Plants

The aquarium must have plants. A beautiful planted aquarium is a relaxing and decorative. Apart of decorating plants also help the maintenance of a healthy aquarium and offer the fish hideaways and reduce the stress. Plants are also, good places to young fish hide from the adults.

Plants are an excellent oxygen provider and remove nitrate that is an algae grow promoter.

The plants to introduce in aquarium must be of different types and with optimum of living appropriate to environment chosen. Is interesting choose a plant that gives flowers. In classroom can be discuss the different types of plants and their requirements. The quantity of light, radiation necessary and temperature are essential to a good grown and to maintain healthy plants.

Another aspect to take in account is avoiding plants that the fish chosen to eat.

When was considerer the height of plants there are three types. Foreground Plants that must be smaller to not obstruct the view into the aquarium. Middle ground plants that can be solitary or planted in groups and backgrounds plants that decorating the back of aquarium and help to hide the material necessary for the correct functioned of it.

Depend of the environment chosen can also be introduce floating plants.

Plants must be “fed”, they must be had a good substrate (like home plants) and in some cases must be added to water a fertilizer.

4. Set-up the aquarium

To set-up the aquarium is need the glass aquarium. The aquarium of 80 cm length is

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enough, if there is space limitation it can also be an aquarium of 60 cm length.

The localization of aquarium in classroom must be appropriate. Choose a quiet place away from direct sunlight, because sunlight can promote algae growth. The power supply should be above the aquarium, if possible, to prevent water spills going into the outlets during maintenance. After put the tank in final localization, must prepare the other equipment necessary: filtration system, heater and lighting.

To have a good water quality is necessary have mechanical filtration and biological water cleaning. In the last one microorganism, such as bacteria, make that pollutants such as fish excrements and dead plants are broken down biologically. Both of these process can be done by modern extern filters, is only necessary put inside the filter sponge to made mechanical filtration and a substrate that provides ideal condition for bacteria (these must have large and rough surface).

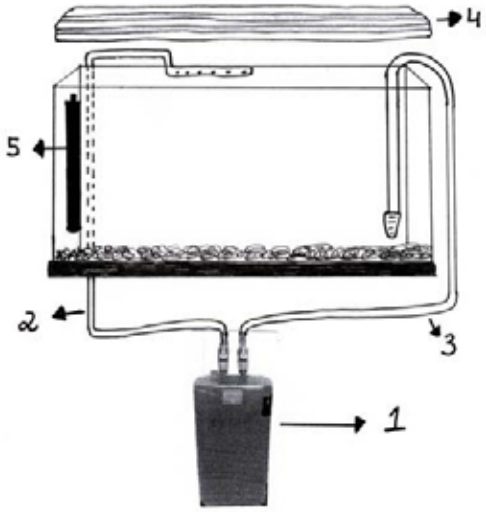

Figure 1. Scheme of an aquarium with equipment. 1 – External filter, 2 – Water from filter to aquarium, 3 – Water from aquarium to filter, 4 – Lighting, 5 – Heater

The bottom must have a substrate that contains essential nutrients, valuable humic acids, as well as trace elements, that provide the plants with everything they need. After that a layer of gravel were added (Figure 1).

The gravel and decorative pieces must be natural, such as roots, bog wood, stones (granite, limestone, lava, etc.), these as referred above must respect the environment chosen.

Before start put decoration and plants inside the aquarium must be planning the decoration design, technical equipment in the aquarium (filter, heater, etc.) can be hidden in such a way that they become invisible when you look to the aquarium.

After decorating the aquarium and put the plants you can fill it with water and turn on the equipment. Tap water needs to be conditioned according to the requirements of the fishes. The tap water quite often has disinfecting chemicals such as chlorine to kill dangerous bacteria and pathogens. But the chemicals also provoke damages in fish and kill bacteria of the biological filter. The products to conditioner the tap water are easily found in commerce. When fill the aquarium put a plate in bottom to avoid the flux of water remove the gravel.

Fish are only added a few days later, with this allows the bacteria to grow in our filtration system and all small particles that stay in suspension after filled the aquarium will be in the bottom of the aquarium or in the filtration system.

5. Maintaining the aquarium

After the aquarium is functional, with all animals and plants in it (Figure 2), another step is begun - the maintenance period.

Figure 2. Aquarium with 60 cm length after set-up with Amazonian environment

Students collect data, with a periodicity estimate before, from an aquarium by measuring and recording water temperature, pH, GH, KH, nitrate, nitrite and ammonia levels. The data can be plot in a graph, and the information studied. Observe the trends can be correlating the differences with events in aquarium. For example if water is changed and the new water is from home canalization can be seen pH variances. After setup and before the aquarium is stable the levels of nitrate, nitrite and ammonia are an excellent period to explain in high levels the nitrogen cycle. If pH must be correct, adding products, the quantity of product necessary can

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be done as an exercise of chemistry in classroom.

In biology classes the student can observe the growth rates of the different animals and plants and register these.

Figure 3. Cichlid Fishes with fry

The type of food added to fish can be also a good example to study different types of alimentation. Introduce a leaf of spinach in aquarium lead to some herbivorous fishes going to eat it and some carnivorous will try it and then throw out the spinach. Is interesting observe some herbivorous graze on algae that grow in glasses and decorative things.

Figure 4. Cichlid Fish protecting the nest

The observation of coloration of fishes (when they have sexual dimorphism) is a good away of understanding the differences and also observed that before spawning period the colors are intensifying. The courtship period, if the students were lucky to be observed the aquarium in this period, is also very interested to observe a particular behavior.

The different types of reproduction can also be observed, if you choose a fish that easily reproduces and in aquarium you have fishes that the parents take care of the fry, like the fishes belongs to cichlid family (Figure 3) the students can observed a very interested behavior (Figure 4).

If the aquarium have livebearers can be easily observe the behavior of viviparous and students can compare the differences.

There are some cares that is necessary for a healthy aquarium. One is water changed, 20 % per week is good. Cleaning the external filter is also necessary. The sponge can be wash normally but biological part no, because is necessary prevent the dead of the bacteria. Algae can be removed from the tank glass with an algae magnet or scraper. Regularly remove any dead leaves from live plants as was done to home plants. If plants need some substrate it must added to water.

The alimentation required by fishes lived in an aquarium can be different and is necessary given different kinds of food in a way of given to everyone their appropriate food. Take care to do not overfeed the fishes as this will cause excess waste in the water which will settle at the bottom of the tank and need to be removed (Figure 5).

Figure 5. Giving alimentation to the fishes

6. Final consideration

With an aquarium in classroom students understand the relationship between producers, consumers, scavengers, and decomposers.

The aquarium allows students to understand the biological concepts as competition for a territory, between animals and between plants. Furthermore, by studying its chemistry, students realize how quite dependent the biotic community is on the abiotic components of the system.

In relation to chemical of water students can learn the nitrogen cycle, pH, hardness of water and how these parameters changed.

Students become sensitive to the effects of destroying part of an ecosystem or removing a particular organism. They also consider more complex issues, such as endangered species

 ISBN 978-989-95336-1-5

and the impacts of human intervention in a habitat.

7. Acknowledgements

To Delfim Machado to allowed the use the photo of Figure 3.

Virtual Instrumentation for Lessons of Mathematics and Sciences of Nature

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Abstract. The interest of members Fun Science Club for Virtual Instrumentation leads to organisation of a contest which first part has ended with an examination witch contained a practical test and a presentation of a project. We will show in this work some aspects of the first part of the class, difficulties and successes, exemplified with project sequences of those who passed the examination.

Keywords. LabVIEW, Fun Science Club, Virtual Instrumentation, Physics.

1. Introduction

The Fun Science Club was founded after the proposal of teachers and students of the „Tudor Vladimirescu" Theoretical High School (Bucharest, April 2005). The presence of the students on some important meetings, with well-known users of the Virtual Instrumentation was very important. These facts lead to an increase of the interest for using LabVIEW.

This is the cause for our proposal in organisation a contest „Virtual Instrumentation for lessons of mathematics and sciences of nature". This activity as organised inside the Hands on Science Network Romania, by aegis the project „Education and Instruction in Science for a Society of Knowledge".

These lessons are part of a strategy which lasts several years. Its first objective is the promotion of LabVIEW through the students and teachers. Then we'll pass to another sequence in which the Virtual Instrumentation will be used frequently in the mathematics and sciences of nature. This sequence also contains the developing of real experiments with signal acquisition. There are also premises for such a beginning: for the next year there were proposed optional classes which will be hold by our high-school.

The first level of the class, named „LabVIEW through examples", it had as objective the initiation in the use of LabVIEW.

2. "LabVIEW through examples"

The first level of the „Virtual Instrumentation for mathematics and nature science" lessons had as a specific the explication of the programming elements starting from problems proposed to the members of the club for lessons of mathematics and physics, after learning the basic elements.

For most of these lessons, the items were formulated this way:

1. definition of problem;
2. writing the application algorithm;
3. the presentation of programming elements needed for the algorithm implementation;
4. creating the work file/ lab file which contains instructions about how the application works.

For exampling we will present some sequences from the „Rectilinear motions" application, which was proposed in one of the class lessons. For this subject we required from the students the identification of the main difficulties they had. This way we established which of the information would be offered by the application and how they will be presented. In fig. 1 a first sequence from this software is shown, sequence which was proposed because it reduces the difficulty of graphic interpretation of motion and velocity laws.

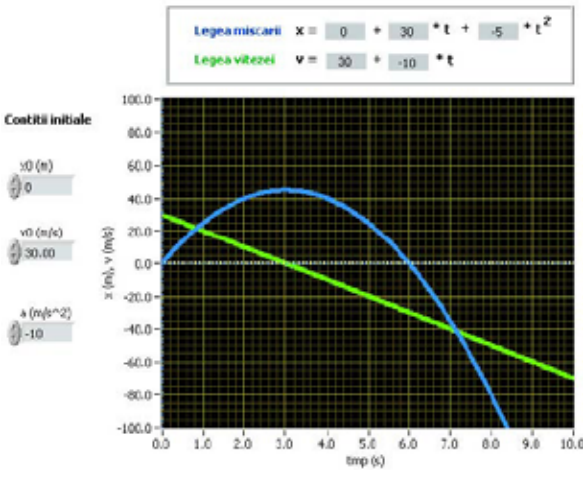

Figure 1. The Application "Rectilinear motions" - sequence 1

As the sequence presented previously was developed for allowing the association of the kinematical equations of motion with the graphic

 ISBN 978-989-95336-1-5

representations of a rectilinear motion laws, in another sequence this graphics are reproduced simultaneous with the simulation of the motion (fig. 2).

We did not neglected in our lessons the aspects of the design and we did try for any solutions to optimise the user's interface:

- the position and the proportions of the elements for a better visibility;
- customize user interface components (fig.3);
- the realisation of the high-quality interfaces, for which key words are: intuitive, easy to use, and easy to learn.

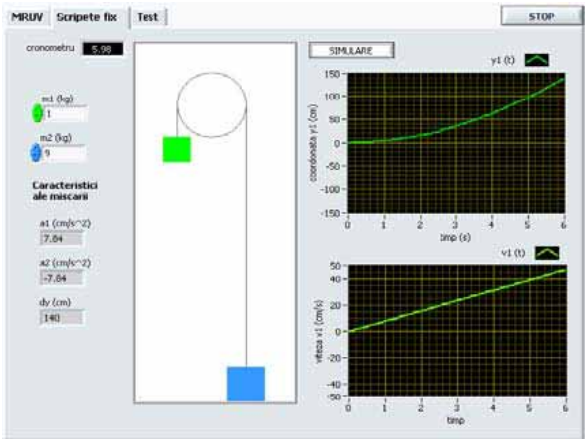

Figure 2. The Application "Rectilinear motions" - sequence 2

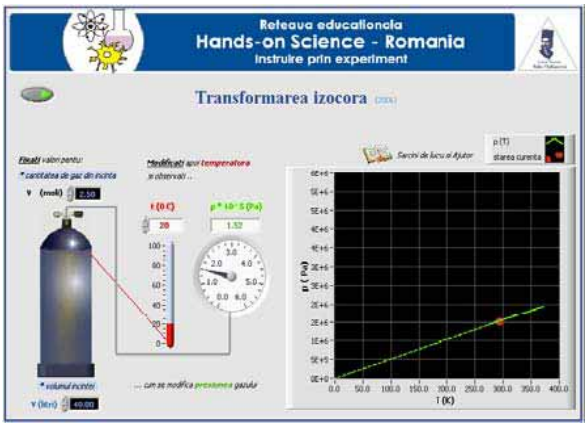

Figure 3. Sequence of the application "The isochoric process"

Because some students learned very easy these lessons of the first module, we did present them an introduction of data acquisition, we did support them to realise some real experiments and to use NI USB 6008.

For these experiments we used the components of classical systems and the students' buildings (fig. 4). It was used the sensors for computerised experiments for motion, light, force (in fig. 5 it is presented the signals which was obtained in a partial elastic collision, it was used motion and force sensors - the signals present the dependences x (t), v (t) and F(t).

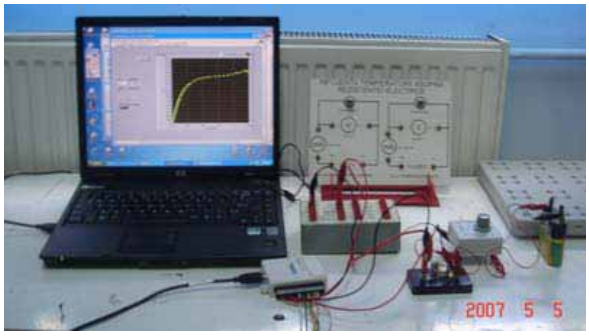

Figure 4. The characteristic of a light-bulb – a computerised acquisition

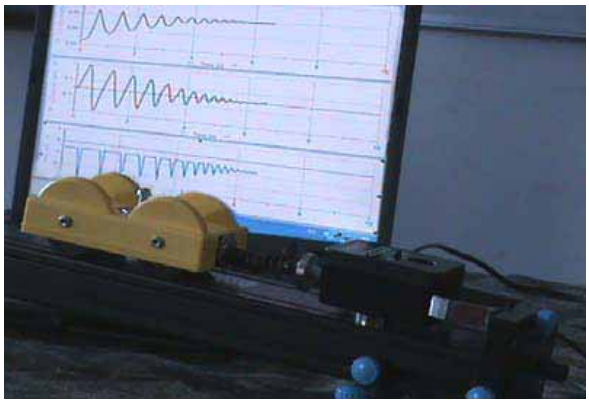

Figure 5. The signals obtained in a partial elastic collision

3. Evaluation

The first part of course "Virtual instrumentation for lessons of mathematics and sciences of nature" was ended with a test. This test had two parts: a practical test (every student had two problems to resolve) and a project. The results showed the interesting of the students for using LabVIEW. Their seriousness did manage to success

Dynamical Systems in the Classroom

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4th International Conference on Hands-on Science
Development, Diversity and Inclusion in Science Education
© 2007 HSci. ISBN 978-989-95336-1-5

Abstract. It has long been believed that typical students learn better through contemporary approaches to questions originated by physics problems that allow experiments. This belief motivated us to develop interactive-computational didactic materials about contemporaneous mathematics that can be used both in the classroom and in mathematics clubs in the school.

Most students think that all the mathematics they learn can be found in the "Elements" of Euclides or, in the best chance, they know some principles of Calculus from Newton's time. Most topics in mathematics curriculum are presented in an abstract setting, with no physical meaning, which makes students feel no motivation and enthusiasm for what they see as a dead discipline. Dynamics (or Dynamical Systems), the study of how physical systems evolve with time, is a contemporary research field that has the profit of being comprehensible by young students. Furthermore, it allows the introduction and exploration of many of the topics present in the student's mathematics curriculum. Dynamical Systems are present in many different branches of science, which allows interdisciplinarity, such as biology, economy, ecology, medicine, meteorology, astronomy and computer science. Moreover, most problems have a physical insight. These features of the field of Dynamics lead us to elaborate a series of activities based on Dynamical Systems topics such as iteration, graphical analysis, generation of fractals, Julia and Mandelbrot sets and other interesting features of "chaos theory". Another important goal to achieve with these activities was to give mathematics an experimental/laboratorial component, which rarely is present. In fact, all the interactive/computational didactic materials developed include simulations.

Last, but not the least, students can enjoy the beauty of mathematics, since they can, for instance, generate wonderful pictures by iteration of a simple function with the help of a computer.

During the "hands-on experiments demonstrations" we will exhibit and demonstrate some of the interactive/computational didactic materials that we developed.

Keywords. Mathematics, Dynamical Systems, Hands-on Experiments.

Learning by Doing Robots for Competition

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Abstract. The NID (Investigation and Development Department) of the Vocational School Gustave Eiffel was created in the beginning of the year of 2004, with the objective to support a new approach to the teaching of technological subjects, not only by the students but also by the teachers. One of the areas of great success was the participation on different robotics competitions. In 2003 we obtained the second position on Dance competition in Padua, Italy on the international competition Robocup Júnior 2003, when we were the first Portuguese team to participate on Robocup Junior.

But more important than the prizes, is that this results have allowed to create a structure to support a larger number of students to participate. Actually there are more than that 40 directly involved in the activities of the group, with so much success that this year we had win all the competitions on the national robotics festival.

In 2004, we began to involve in this project some mathematics and physics / chemistry teacher. These are subjects were the students traditionally have lots of difficulties. Through the calculation of components and structures for the robots, in the case of the mathematics and physical, of special effects in the case of the chemistry, we get a significant increase from students for the subjects of these disciplines. Thanks to all the participants', teachers and students, we have obtained some significant prizes at the national and international competitions.

With the objective to enlarge and to consolidate this project we had established partnerships with English and German schools for 2006, through a Comenius I project for the development of soccer robots. - The success and acknowledge of this project in relation to the soccer robots in the schools of partnership has caused that other students and schools wants also to participate with projects in other type of competitions, like dance and rescue. Now we had purposed to the national agencies of 9 countries: UK, Germany, Spain, Holland, Austria, Norway, Hungary, Finland and Portugal a new project called EuroRobocup. In this science fair we wish to present some of our videos and make

 ISBN 978-989-95336-1-5

some presentations with some of our best robots for dance and rescue.

We hope with these presentations done by some of our students and teachers to get the interest of some of the presents to collaborate with us in a Comenius project in this area.

Keywords. Hands-on Experiments, Robotics.

Science of Music

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Abstract. This educational software offers a journey into the world of Music, guided by the laws of Physics. It tries to show by mathematical means the regularities that appear in the world of musical sounds. The application is designed for those keen about physics or music (or both) and it's also useful as an auxiliary material for student class preparation.

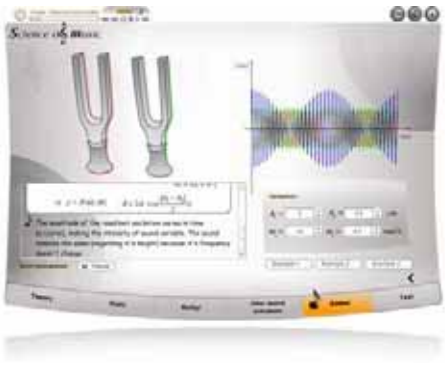
The software was developed using Macromedia Flash 8 Professional and Adobe Photoshop CS. It consists of 6 sections:

1. Theory: displays the Physical laws underlying the music; it contains mathematical explanations and definitions for all the concepts involved in the field of music.
2. Piano instantiates the theory by enabling the user to play with a virtual piano while time observing all the information about a certain musical note.

3. Guitar this page enables the user to play a virtual guitar in the same manner as the Piano page.

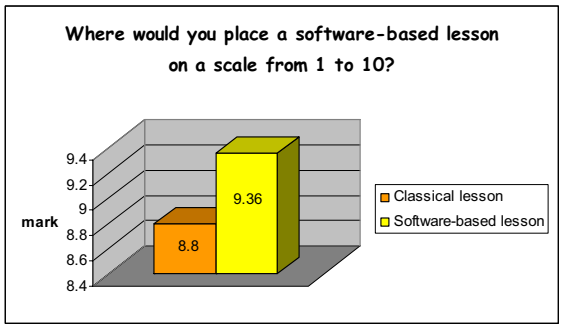
4. Other musical instruments: this page contains examples of some other types of possible sounds of instruments instantiated in the Theory page.

 ISBN 978-989-95336-1-5



5. Game: the user can understand better the concepts by playing.
6. Test: containing single-choice questions based on the concepts presented throughout the software.

The visual support enables the understanding and fast connection between the physical and musical phenomena. Many hours of explanations are condensed into a few minutes of activity. The application is entirely interactive. It looks attractive even to those who are not really interested by any of the two subjects. This is not mere wishful thinking, but the conclusion we came at after testing our software on our college peers.



Keywords. Music, Physics, ICT.

Data Acquisition Experiments for Earth Science Lessons

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Abstract. Our study is developed in the framework of the Comenius "Hands on Science" Project. We intended to find the right way to show how the Nature works to our students. We have used a data acquisition system: a computer, a data acquisition board NIDAQ 6013 and sensors for light, temperature, microphones to record sounds, humidity, pressure and more. The software for the signals registration and analyzing was developed in LabVIEW. The goal of the studies is to realize some experiments using the data acquisition system for obtaining real signals in the purpose of studying some phenomenon involved in the global warming process. We are presenting a model for producing alternative current in hydroelectric dams and the wind turbines, a study of the gas emission in the atmosphere, a study of burning, a monitoring of a fish tank, a one-way and a full-wave rectifier of alternative current, a study of some spectral sources, a study of signal transmission through optical fiber, etc. It is a way of informing the people on the obligations towards our planet! It is at everyone's hand to try and fight for reducing these emissions and the global effects that they generate. For this, the quantities of fossil fuels have to be reduced by using more environment friendly and more efficient cars, by reducing the electricity consumption.

Keywords. LabView, Data Acquisition Experiments.

1. Models for producing alternative current

Electromagnetic induction is the production of voltage across a conductor situated in a changing magnetic field or a conductor moving through a stationary magnetic field. Inductance is an effect which results from the magnetic field that forms around a current carrying conductor. Electrical current through the conductor creates a magnetic flux proportional to the current. A change in this current creates a change in magnetic flux that, in turn, generates an electromotive force (emf) that acts to oppose this change in current. Inductance is a measure of the generated emf for a unit change in current.

 ISBN 978-989-95336-1-5

For example, an inductor with an inductance of 1 H produces an emf of 1 V when the current through the inductor changes at the rate of 1 ampere per second. The number of turns, the area of each loop/turn, and what it is wrapped around affect the inductance. For example, the magnetic flux linking these turns can be increased by coiling the conductor around a material with a high permeability.
A model for producing alternative current in hydroelectric power plants and wind turbines are presented.

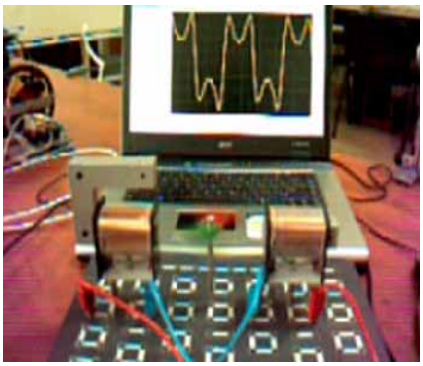


Figure 1. Experimental set up for demonstrating electromagnetic induction

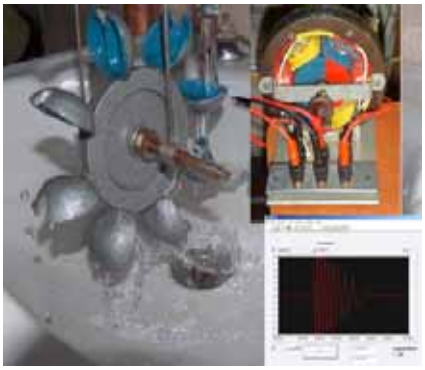


Figure 2. Experimental model of hydroelectric power plant

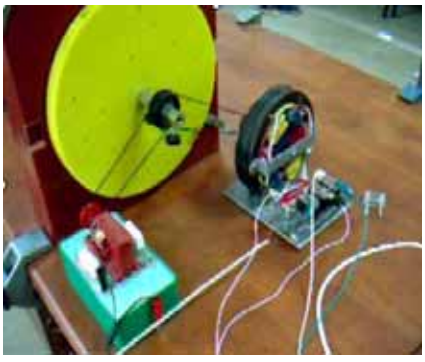


Figure 3. Experimental model of hydroelectric power plant

In Figure 6 you can see a handmade model of the wind mill, while in Figure 7 we are presenting the signals registered from our model of the wind mill during a down wind.

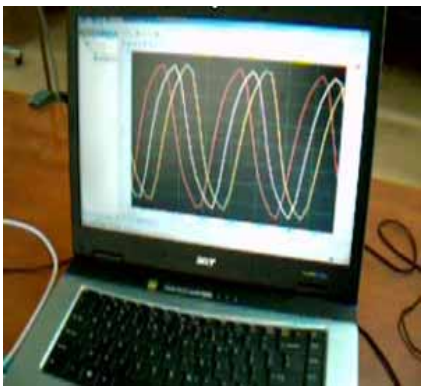


Figure 4. The registered signals from three channels of the data acquisition board

Figure 5. Wind mills

Figure 6. Experimental model of the wind mill

Figure 7. The registered signal from the data acquisition board, during a down wind

 ISBN 978-989-95336-1-5

2. Rectifiers

A rectifier is an electrical device that converts alternating current to direct current, a process known as rectification (the opposite of inverting which converts DC to AC). Rectifiers are used as components of power supplies and as detectors of radio signals. Rectifiers may be made of solid state diodes, vacuum tube diodes, mercury arc valves, and other technologies.

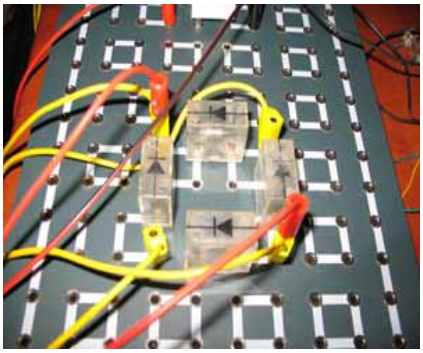


Figure 9. Experimental set-up

Full-wave rectification converts both polarities of the input waveform to DC, and is more efficient. However, in a circuit with a non-centre tapped transformer, four diodes are required instead of the one needed for half-wave rectification. This is due to each output polarity requiring two rectifiers each, for example, one for when AC terminal 'X' is positive and one for when AC terminal 'Y' is positive. The other DC output requires exactly the same, resulting in four individual junctions (See semiconductors/diode). Four rectifiers arranged this way are called a bridge rectifier:

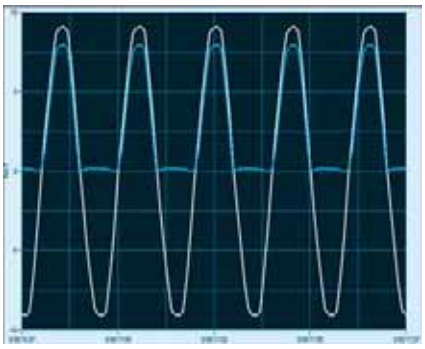


Figure 10. The registered signals from the channels of the data acquisition

A full wave rectifier converts the whole of the input waveform to one of constant polarity (positive or negative) at its output by reversing the negative (or positive) portions of the alternating current waveform. The positive (negative) portions thus combine with the reversed negative (positive) portions to produce an entirely positive (negative) voltage/current waveform.

For single phase AC, if the transformer is centre-tapped, then two diodes back-to-back (i.e. anodes-to-anode or cathode-to-cathode) form a full wave rectifier

Figure 11. The registered signals from the channels of the data acquisition board in full-wave rectifier

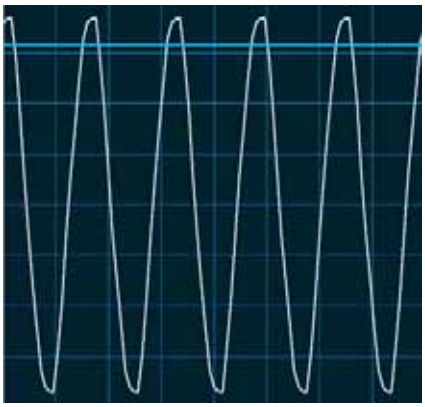


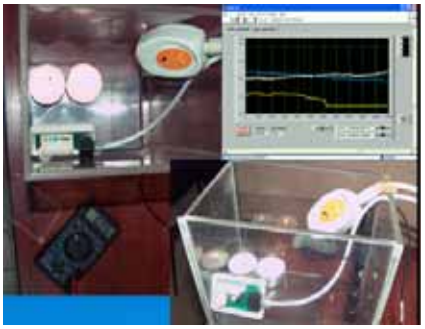
Figure 12. The registered signals from the channels of the data acquisition board in full-wave

3. Environmental Science

How Much Oxygen Is Required To Sustain A Flame?

Three elements must be present at the same time for a flame to burn: fuel, oxygen, heat. If any of these elements are reduced or removed, then a flame will be extinguished. This experiment uses the Oxygen in Air sensor to monitor the oxygen level required to keep a flame burning.

 ISBN 978-989-95336-1-5



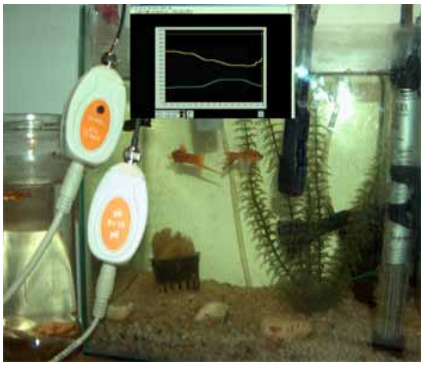


Figure 13. Monitoring burning candles

Combustion of a typical paraffin candle will give you carbon dioxide and water vapour. But the water vapour will condense to liquid water. The original air was 78% give or take a bit of Nitrogen and 1% argon plus the balance mostly oxygen. Exactly how much of the oxygen is used by the candles depends on a number of variables, such as temperature of the experiment, exact composition of the candle, type of wick etc. In other words we can't give an exact figure. But pretty close to all of it. There may be a couple % left, but it varies. The results of monitoring the fish tank looks like the Figure 13.

4. Acknowledgements

Our study is developed in the framework of the Comenius "Hands on Science" Project. We intended to find the right way to show how the Nature works to our students. Thanks to "Hands on Science" Network.

Thanks to "Hands on Science" Network România, and to the Centre for Scientific Education and Training, CSET, for the support they give us in the frame of the Project "*Educatie si instruire în domeniul stiintelor pentru o societate a cunoasterii*" (Contract nr. 58/2006). Our activities were developed in the Physics Lab from the Theoretical High School "Grigore Moisil" from Bucharest and in the Mobile Natural Lab from Valea Lunga, Dâmbovita.

We are dedicating all our works to the fight for healing the world!

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Global Science Club. Activities in an European Environment

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Abstract. "Global Science" Club is the club of the "Costin C. Kiritescu" Economical High School's students and it was founded and led by the teacher of physics Maria Enache since 2005. There are around 30 students activating within the club. Until October 2006 they have participated at activities within the European Project "Hands on Science" (110157-CP-1-2003-PT-COMENIUS-C3). "Global Science" Club has initiated the foundation of a work place which had the task to "build experimental devices made by students from materials they have available at hand" and also to "find a practical use for them". These applications were meant to develop the students' imagination and interest for its study and knowledge. Since October 2006 the club takes its activity within the "Hands on Science" network of Romania, guided by the project "Education and instruction in the area of

 ISBN 978-989-95336-1-5

sciences for a society of knowledge" from the program "Excellency research – CEEX, part III, contract no. 58/2006, whose national leader is Dr. Dan Sporea. The work emphasizes the activities organized within the "Global Science" Club and the quality education in a European context. The tasks of interest are the following: - promoting the scientific education in schools by using experiments – a modern tool to revitalize the students' interest to study these scientist - promoting teaching procedures among teachers and education institutes, procedures that have been validated or created new regarding the students' instruction for participating at scientific experiments of fixed subjects - Encouraging students to sign up for scientific competitions with the description of experiments or presentations that they have created. - Organizing activities within some educational clubs, symposiums, scientific challenges that may bring together students, teachers and research institutes that are interested in exchanging experience and consolidating partnerships. It also has to be noticed that since June 2006 prof. Maria Enache has officially opened the "European Club of Students" from the "Costin C. Kiritescu" Economical High School 2007 – is the European year for everybody to have equal chances Within this club different activities have been organized, among which: - 16.04.2007 – Conference on the theme "Principles, achievements and future of the European Union" - 09.05.2007 – Activity in the capital of Bucharest on the theme: "Together in the European Union since 1957: schools celebrate Europe".

Keywords. Physics, Science Fairs, Hands-on Experiments.

Robotics, Sound and Light

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Abstract. This communication refers to the use of robots in a classroom context with the purpose of teaching basic theoretical concepts in physics, particularly in the areas of sound and light. The experiment developed at the Escola Secundária de Fafe with classes from the primary education (Ensino Básico) courses of Education and Training. We developed and tested contents from the syllabus module "FM5 – Sound and Light" using the Mindstorms NXT robotic kits from Lego. The presentation of this module contents were approached by the application of several experimental activities where the robot plays a major role. In order to evaluate the effective benefits of the use of robotics, the same experimental activities were applied with a second group of students but this time without employing robots.
The conceptual progress of the students was controlled through tests before and after the activities. Continuous evaluation was also performed taking into account several parameters in the development of the class work such as students' behaviour interest commitment and the level of participation.

Keywords. Optics, Acoustics, Robotics, Hands-on, Secondary Schools.

Hands-on Tools

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Abstract. The computer models are computer programs which allow recreating natural phenomena. This tool is widely used in technology by engineers or scientists for research and industrial purposes. The applications of computer model in the classroom are huge. It allows teachers and students to conduct experiments identical to those scientists run on laboratories to simulate particular systems in a limited time. Some of these experiments can be difficult, expensive or even impossible to reproduce in the laboratory. With computer models the students can run their own experiences without any equipment limitation and risk to students' health safety. Here is presented a complete study about software for educational purposes. This lecture aims to explore simulation potential and to explore some available simulations in the field of Newtonian Mechanics, Optics and Inorganic Chemistry.

Keywords. Computer Model, Simulation.

 ISBN 978-989-95336-1-5

Exploring Physical Laws with Standard Informatics Tools: A Case Study Using Excel

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Abstract. Step by step the computer is playing a central role in the teaching strategy of science. The potential for data acquisition and evaluation, as well as in the presentation of the results and the search for information is steadily increasing. Further, and an effort is still being done in creating new and more complete resources as well as informatics conditions at the schools. One of the greatest potential of the electronic resources is in the fields of virtual laboratories, which can contemplate the visualization /demonstration of the main natural laws and/or the interaction and experimentation by changing parameters and/or experimental conditions. It is commonly thought that these virtual labs can only be prepared by information specialist with together the necessary pedagogical and scientific support. In this presentation, it will be demonstrated different functionalities of Excel that allow the teacher to create simulations and worksheets able to be implemented within the classes and during the self-study of the students. This tool provides the teacher with a powerful, easily available teaching resource in which can create material appropriate for the own subject and level. The main point is the use of the ActiveX control tools, in particular the Scroll Bar in order to create animations with Excel. The created graphs can be used to represent functions and data as well as to design real objects. These tools, together with other standard functionalities such as data bases, will provide the ability to implement and explore different situations and phenomena. Examples from the areas of Classical Mechanics, Electricity and Magnetism and Optics will be presented and discussed.

Keywords. Physics, Computer Science.

Creating Museums for Everyone

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Abstract. During this session, we will share examples of how we are working to reach out to new audiences and remove barriers that exclude different publics from full participation in science learning. Museums are places where everyone is invited to learn. And sometimes, it can be the last chance for the contact with science. How do we create learning experiences that serve a broad range of visitors with learning disabilities?

Keywords. Science Centres, Special Education Institutions, Science Learning.

Littoral Azores: Hands-on Natural Sciences

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Abstract. The project "Littoral Azores" was borne in order to involve students in the construction of their own knowledge. Observing, researching and doing themselves are the easiest way for students to learn and structure their knowledge in a permanent way. With this project twenty six students of the 8th grade of Escola Secundária de Lagoa, São Miguel was able to study the contents of Natural Sciences discipline in a different manner. The Azorean littoral was used as a display for students to develop skills such as observation, research and communication of data. On the other hand, under the global climate changes that our world is going through is very important for students to be aware of the fragility of ecosystems, mainly those that occur in their littoral and can be affected by the rise of sea level. This project was developed in various stages that included an introduction to the Azorean littoral, several field trips to shore where biodiversity, living strategies and adaptations of several shore animals in their own habitats were observed, photographed, and some specimens were collected to recreate a rocky pool in the school. All this material was used by the students at school, creating an aquarium with the organisms collected in shore,

 ISBN 978-989-95336-1-5

making more accurate observations of smaller organisms using a binocular microscope, and performing some experiments to study the trophic relations. The photographs taken will be used to create a web page showing the diversity of the Azorean littoral. Involvement of students in these activities was very enthusiastic and promissory for the development of further activities both in shore and in school.

Keywords. Littoral, Ecology, Aquarium

Equity and Science Learning

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Abstract. In this presentation I will describe how the interaction with the Pavilion of knowledge during these years was so important for us. To come here with students with learning disabilities, so many times, was for us like a discovery. In the beginning, Science it was something so difficult, now we know that is difficult but we can understand many things. The exhibitions and various scientific and educational initiatives change our life for ever.

Keywords. Science Centres, Special Education Institutions, Science Learning.

Implementation Strategies of Virtual Laboratory Activities at Secondary Schools

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Abstract. The teaching of science in secondary school must contemplate the execution of laboratorial activities in order to be fully effective. In order to take fully advantage of the experimental activities, three different moments are contemplated: preparation of the experiments – often in the previous class, execution and evaluation. The use of virtual labs can be a useful approach to enrich exploration of experimental activities, in particular, in the preparation and execution stages. Virtual Laboratory Activities can be an important tool in order to: a) relate information and concepts, b) simulate experiments before the actual experimental class, c) simulate different experimental conditions, often difficult to achieve in the real lab due to time concerns, d) include interactive questionnaires. Further, virtual labs are an alternative way to realize experimental work in the case of schools with no conditions to implement some of the laboratory activities.

This work will discuss, based in several examples, the creation of a Virtual Laboratory Activities and the study of its pedagogical impact in two different situations: a) as a complement to the real laboratory, b) as a substitution of the real laboratory The results will be presented and discussed together with the results obtained with students that performed the real laboratory experiments with no help of the Virtual Laboratory Activities.

Keywords. E-Learning, Physics, Simulation, Education, Chemistry, Computer.

Alternative musical instrument

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Abstract. This project was born in subject of Project Area of 12th grade. It consists of manufacturing an alternative instrument to expand my personal knowledge in musical acoustics and at the same time preserve the environment by reusing disposable material and creating an instrument which would prom old the ecological and musical awareness of our community. The musical instrument chosen was an idiophone, whose sound comes from the vibration of itself, it was built with PVC tubes, its length is 1,24 meters and 1,24 meters in height. The social interest of this project is draw people's attention to ecological and musical issues. Schools offering music teaching can easily use these instruments due to their low cost.

Keywords. Science Fairs, Acoustics.

 ISBN 978-989-95336-1-5

Center for Science Education and Training's Support to Optics Education in Romania

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Abstract. Starting from 2006, a Center for Science Education and Training was created at the National Institute for Laser, Plasma and Radiation Physics targeting the assistance of science teaching in Romanian schools. The Center (CSET – http://education.inflpr.ro) was established in the frame of a grant offered by the Romanian Authority for the Scientific Research and coordinates the national network "Hands-on on Science – Romania", as part of the European network "Hands-on Science".

The Centre's activities focus on the support of science education in schools (at all levels, up to the University level) and have as main components:

- the use of computer-based systems, data acquisition and sensors to develop laboratory experiments with the support of graphical programming training;
- 3D graphics animation in science teaching;
- education in the field of environmental protection and alternative energy sources;
- training on modern electronics and robotics;
- education on modern optics and photonics.

This paper will refer to our strategy and results dealing with the last mentioned subject. In this field the main achievements are:

- the distribution to several schools of training aids (optics kits, spectrometers, optical fiber communication sets) in order to develop their own extracurricular experiments;
- the organization of a national symposium dedicated to "Light";
- the support for a Romanian school teacher to be trained on photonics in the frame of a programme run in USA;
- the consultancy offer to a group of school teachers to prepare a teaching book having as subject optics and spectroscopy;
- technical support and advice to be offered to some schools on light pollution.

The authors want to acknowledge the financial support of the European Union through the Comenius grant "Hands-on Science" (Project nº. 110157-CP-1-2003-1-PT-COMENIUS-C3) and the Romanian Authority for Scientific Research through the project "Science Education and Training for a Knowledge-Based Society" (contact No. 58/ 2006). Special thanks go to Fenna Hanes from the New England Board of Higher Education (NEBHE) in Boston, Mass. for her unconditional, competent and open assistance.

Keywords. LLL, ICT, Hands-on Science.

Science for Everyone

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Abstract. We'll present a project for students with learning disabilities, with an alternative curriculum. In Aveiro district those students at 2nd and 3rd cycle of basic education don't have in their curriculum Physics and Chemistry matters and only 38% have Sciences of Nature. We pretend that those pupils contact with sciences, recognize its importance in society and increase their scientific literacy, trying to contribute to their educative success and integration with hands-on methods. This project will be a partnership between Fábrica Centro Ciência Viva, Aveiro University and the schools involved.

Keywords. Science Centres, Special Education Institutions, Science Learning.

With Science and Art in Hands… We See Colours Like They Are

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Abstract. We present a Project that made a link between Science and Art. A house-museum, Casa-Museu Dr. Anastácio Gonçalves submitted to a conquest the Project "With Science and Art in hands…we see Colours like they are". The main concern was to motivate teenagers to the importance of technology evolution and scientific discoveries in the field of pigments, dyes and binding media. The focus was the importance of

 ISBN 978-989-95336-1-5

techniques in the history of painting. We wanted them to understand that all is linked, and, why not try it in a museum? Our visitors were 400 students, 100 of them were deaf. One of the reasons for the success of the activity was a deaf key worker.

Keywords. Museum, Informal Learning.

Crossing the Borders. E-Twinning Project with 9th Grade Students

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Abstract. The E-Twinning Project we present in this paper "Crossing the Borders", engaged a Portuguese school in Braga, Portugal and a similar school in the Czech Republic, during the school year of 2006/2007. The development of an innovative and motivating strategy was at the basis of the project. It should promote not only a broad range of ICT skills, but also the students' moral and social development. In this paper we present the results of an electronic twining experience which is a pedagogical experience with 9th grade Portuguese students attending an e-Learning Programme of the European Union named E-Twinning Project.

The main goal of this EU project is to create a network of collaborative work between European schools, involving all school levels in the development of common projects through the use of Information and Communication Technologies.

Keywords. E-Learning, E-Twinning, ICT, Blog, Citizenship Competencies.

1. Introduction

The European Union pursues the goal of becoming the world's most competitive economy, based upon the conception of a new Europe, whose economy is based on knowledge and therefore strongly investing in Education and Training. In order to attain such goals, the European Commission has been engaged in concentrating on matters such as social cohesion, employability, access to information and info-exclusion since the very beginning of the new millennium.

2. Case report

This study aims to describe the implementation of the electronic experience – E-Twinning, with 9th grade students from a private school in Braga and a congener in the Czech Republic.

The Crossing the Borders´s activities were developed in ICT classes with the objective of inquiring whether the electronic twinning would be an advantage in terms of learning, and at the same time, promote team work in a perspective of an education for citizenship.

This empiric study is descriptive and exploratory. It involved 72 students and 3 teachers. We used several instruments to collect data: a questionnaire about ICT literacy, a questionnaire to evaluate students' perceptions, English teachers interviews involved in the Project, e-mail contents' analysis, collaborative blog's interactions and products analysis.

3. Description

The Crossing the Borders Project began on 29th September 2006 and finished in the end of May 2007.

Teachers started the process of planning and creating supporting environments: the virtual space in the E-Twinning platform, a moodle subject and a collaborative blog.

The collaborative blog is available on:
www.crossing-the-borders.blogspot.com

Figure 1. Post from collaborative blog

It was created as a collaborative tool for student interaction as a place where students could publish information (text and image) which everyone would access and contribute to. This would enable communication between all project members.

 ISBN 978-989-95336-1-5

In the first stage of the Project, the following task was performed – creating a self-portrait of each of the students involved in the project. The students used Microsoft Word (*.doc) to perform this tasks.

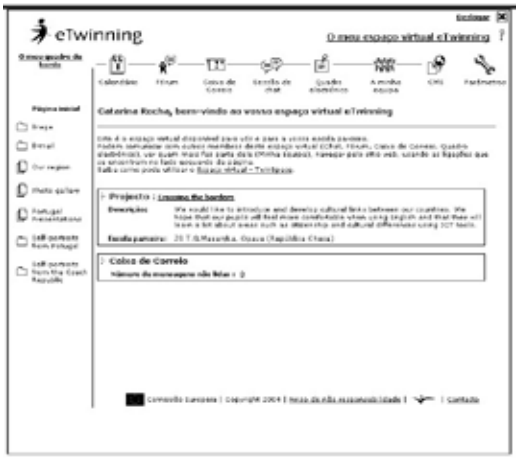

Figure 2. Virtual space at E-Twinning platform

After their profiles had been posted, students were able to comment their colleagues' profiles by editing posts in the collaborative blog.
By allowing multiple authorships and creating the possibility of several co-collaborators to publish posts and comment on existing messages, blogs can become not only spaces where people can publish information, but also spaces of true communication."[9].

This virtual space was then used by the students to comment on their profiles and also to Exchange emails and personal photographs. According to [1], [4], [5] and [9] the creation and dinamization of blogs with educational purposes should be implemented as a way to develop several social skills and to promote learning.

Products	Portugal	Czech R.
Self-Portrait (*.doc)	55	17
Country & traditions (*.ppt)	25	17
Town (*.ppt)	25	17

Table 1. Products

The second stage of the project was based on exchanging information about both towns: Braga and Opava. The presentation of both towns (Braga (2) and Opava) happened in December, in articulation between three subject areas: English, ICT and Project Area.

The elaboration of student's town's electronic presentation was done in groups using Microsoft PowerPoint (*.ppt) At first, students explored this application and acquired fundamental skills in terms of its use as done in previous author´ s experiences [6]. Using it as a supporting tool in their work, they then created the electronic presentations of their towns in Portugal and in the Czech Republic, in which aspects related to culture, tradition, landscape and history would be some of the aspects to be presented.

4. Some results - Students perceptions

We will present some results about the conclusions of the students' perceptions questionnaire and the product's evaluation and analyses:

- The improvement of the ability to use computer applications;
- Autonomy, creativity and responsibility promotion;
- Increase of the students' interest in research, problem solving and innovation;
- Acquire basic communication skills in English;
- Reflecting upon their own social and cultural reality through exposure to different cultures;
- The increase of the knowledge about Portugal;
- Development of sociability, tolerance and cooperation skills.

5. Conclusion

With this research project, we concluded that the implementation of the electronic twinning promoted meaningful learning in ICT and in English language, by training transversal competences of the curriculum. In this way, students became more aware of the social and cultural differences between both groups. Moreover, they grasped and respected them. The construction of knowledge was shared by everyone and this was the core of the project. This underlying philosophy allowed students to develop pro-active attitudes with the intention of a true European citizenship.

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Hands-on Physics Activities with an Overhead Projector

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Abstract. As Science is essentially experimental, Science learning can be improved by means of Hands-on activities [1]. These innovative ways of teaching are beginning to establish themselves as powerful tools in the didactical process because they can be used in different and complementary learning contexts as: a) individual open works, where students perform experiments by themselves; b) collaborative learning resources like in Science Fairs or Science Museums in School [2]; or c) a demonstrative support during conventional science teaching processes in classroom. In this last case, common overhead projectors become in powerful learning strategies in which the interest of students may be maintained in classroom work, since this device allows the audience to see at the screen in a big scale the corresponding activity carried out by the teacher in a spectacular way [3]. This presentation shows how much can be done quickly, safely and easily with an overhead projector [4] in order to present any Physics concept, as for example: resonance [5], electrodynamics [6], polarization [7], wave interference [8], stationary waves [9], diamagnetism [10], phase-change [11], coupled pendulums [12], magnetic field [13], standing microwaves [14], coriolis effect [15], acceleration [16], etc.

Keywords. Hands-on, Physics, University.

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101 Hands-on Electromagnetic Induction Activities

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Abstract. Updated concepts and methods of teaching can be used for improving instruction in Physics, in such a way that better connexion between real-life and specific curricula is obtained [1-2]. Hands-on activities can be the proper tool in order to achieve these objectives [3-4]. In this context, a detailed bibliographic research shows us [5-6] that the electromagnetic induction has been analysed in detail and that there exist a lot of Hands-on activities that can be employed in order to illustrate the different involved concepts, situations and important applications. The reasons can be found in the fact that electromagnetic induction is an important topic for science education as it is a physics phenomenon related to innumerable application present at everyday life including [7-8]: induction sealing, induction motors, electrical generators, transformers, contactless charging of rechargeable batteries, induction cookers, induction welding, inductors, electromagnetic forming, magnetic flow meters, transcranial magnetic stimulation, faraday flashlight, graphics tablet or wireless energy transfer.

In this presentation, low cost and simple experimental activities for university students are presented. The aim of these hands-on activities is that students try to understand the relations among the physical quantities involved in this very important but non-intuitive effect, as well as the mechanisms in its multiple applications. The traditional didactic approach in classroom of the phenomenon is essentially limited to the repetition of the Faraday-Henry experiments [9]. However we can found a lot of Hands-on Science Electromagnetic activities that can be employed in classroom, related, for example, with: Earth's magnetic field [10], eddy currents [11-13] or electric motor/generator [15-16].

Keywords. Hands-on, Physics, Experimental work, University.

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Science Fairs as a Bridge between Informal and Formal Learning

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Abstract. Modern learning processes theories demonstrate that Science learning quality is enhanced if students have different opportunities to make clear, interrogate and use new concepts, principles, theories and laws [1-2]. In this context, Science Fairs can be a valuable tool as provide an informal playful environment for learning formal curricula [3-5]. This work presents the objectives and main outcomes of our experience during the Third Hands-on Science Fair developed during the second week of April 2007 at Escolas Proval Secondary School (Nigrán-Spain) [6-8]. In this case, though a tailored small interactive science museum in school with new 50 simple and easy hands-on experiments that requires the interaction of the students that visit the activity and that show different scientific concepts related with their formal curricula, where students are introduced to scientific inquiry, in such a way that a friendly space is created and formal/informal relations with Science are established [9-11].

As these activities are presented in the proper context, they become attractive as it can be easily observed in the animated response from the students. Each of the hand-made interactive modules has its own mind-on explanatory panel, where instructions on how to interact with the activity are provided and scientific concepts related with school curriculum are given. This kind of projects are innovative due to the collaborative interaction between teachers and students, and show scientific work in an interdisciplinary way where different fields of Technology and Science work in a integral and global cooperation [12]. These activities have as a main purpose to promote the integrated progress of competencies and attitudes of the students in such a way that they can be able to employ their knowledge in any circumstance. At the same time these activities are new means to incentive our students and raise their motivation.

Keywords. Hands-on Science, Informal Learning, Interactive Centre, University.

Acknowledgements

The authors are grateful to the cooperation of the student monitors who helped and the colleagues from Escolas Proval Secondary School. We would also like to thank the local authorities Nigrán, Gondomar and Baiona for their financing, as well as the network "Hands-on Science" (110157-CP-1-2003-1-PT-COMENIUS) from the Socrates/Comenius programme of the UE.

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Mechanical Oscillation Superposition and Lissajous' Figures

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Abstract. Lissajous' figures are usually presented to the students with the help of oscilloscopes and signal generators. We present here an old but simple way to observe Lissajous' figures which allows the students to have a better insight of the physics involved. The experiment uses a double pendulum with mass oscillating in two perpendicular planes and so generating the Lissajous' figures. This quite simple experiment can educate the students to distinguish the figures described by the mass and easily transfer theoretical knowledge to a practical situation. The superposition of different frequencies for the double pendulum is easily simulated for different double pendulum parameters using Maple software and diminishing the trial time spent. Computer graphics generated with Maple are presented as well as some photographs for the most interesting cases. Therefore, with a simple experiment a student can train his/her abilities in mounting, observing and understanding the mathematics behind the physical phenomena. It also teaches how to find computer solutions to a physical problem.

Keywords. Lissajous' Figures, Physics, Double Pendulum, Computer Simulation.

4th International Conference on Hands-on Science
Development, Diversity and Inclusion in Science Education
© 2007 HSci. ISBN 978-989-95336-1-5

Hunting Open Clusters around "O" Stars - An European Hands-on Universe Project

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Keywords. Hands-on Universe, Star, Astronomy.

Abstract. Hands-on Universe is a project born at UC@Berkeley. A project devoted to enrich the teaching of Astronomy within the classroom environment with a different approach, more connected to the new technologies. Its main goals are not only to promote the use of such technologies but also to reawaken on students the taste for STEM (Science, technologies, engineering and math) related issues and also to increase their scientific culture. Eight countries in Europe decided to adopt the method and, funded by MINERVA, formed the European Hands-on Universe. Several resources were produced and a data reduction software developed http://www.euhou.net/.Other European countries are interested and should join this coordinated effort in the near future. At an international level there are 20 countries using this approach. There are plans to develop scientific cooperation among these countries. Pilot scientific research projects in schools are being tested in EU-HOU schools (like the Hunting Open Clusters around "O" Stars), Russia and USA. There is also a game being developed to be used as a new tool for teaching scientific content in the classroom environment. An effort to develop an international network of scientific / educational collaboration is the next step.

Drudgery Reduction and Women

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Abstract. Women in their daily life carry out tasks which are rather hard. Tasks are related with keeping up homes, helping children to grow and also help family's economic activities. In various regions of India life related cores and economic activities have methods and materials which have drudgery in operation. By using technical know-how these operations can be simplified. Many a time men and women make drudgery related operations easy by using natural insights.

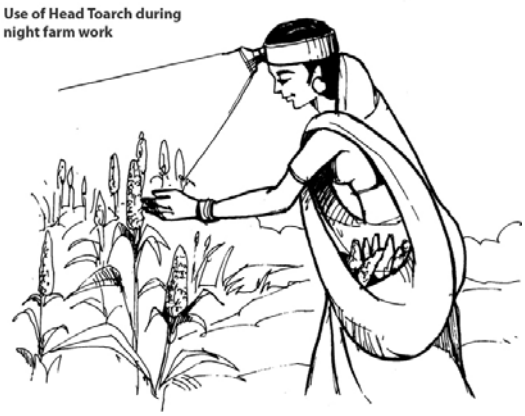
Drudgery related operations can also be less strenuous by using wisdom emerging from traditional procedures. Technologies complied in this simple booklet introduces trainers and group leaders to possible approaches to reduction of drudgery for Indian women belonging to poor segments of our communities. Ideas are taken from various experiments carried out in India and other developing countries.

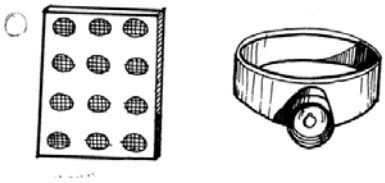
For developing simple drudgery reduction procedures we have not to depend on big laboratories or equipment. Several very useful techniques can be developed by simple means, if we keep field conditions in view.

 ISBN 978-989-95336-1-5

Approach

Our organization has compilation of introductory drudgery reduction technologies has been chosen keeping the following general approach in mind. Of course this approach is flexible in nature. The chosen topics cover fields like Health, Sanitation, Infrastructure, Tools, Energy, Water and other similar topics. They cover some essentials topics of village life.





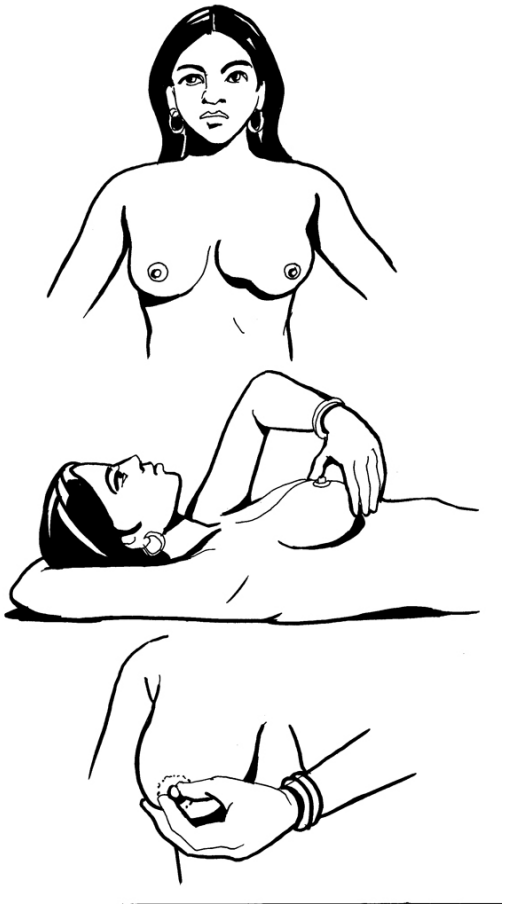
Simple Ideas

A. Self
   Family
   Home
   Sanitation
B. Health
   Water
   Health (Community)
   Sanitation (Community)
C. Transport
   Fuel
   Energy

Objectives

- To introduce concept of Science & Technology to reduce drudgery of rural women. To encourage them to use possible methods of drudgery reduction in daily life.
- To improve quality of life within a community structure.
- To improve individual woman's quality of life.
- To initiate innovative innovativeness in women's thinking approach with some times can lead to development of ideas for drudgery reduction.
- To make group leaders aware of drudgery reduction resources.

Understanding Health by Simple checking methods



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Some Related Activities

- The trainers or group leaders can arrange possible demonstrations of single technologies related of drudgery reduction methods in day to day life.
- Arrange group visits to centres where these types of activities are undertaken.
- Provide them some realistic Science & Technology experiences.
- Locate possible drudgery reduction process existing within the community or neighbourhood.

Orient total communities towards simple ideas about drudgery reduction by arranging happenings like exhibitions and demonstrations.

Robot's Construction

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Abstract. Our project is based on the construction of a robot. We chose this project essentially for the development of diversified abilities that could be useful in our professional life, and mainly, for the improvement of our acknowledgments in programming. We decided to opt to construct a mobile and autonomous robot according to the regulation of "festival nacional de robótica 2007" (national festival of robotics), 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 and logistical 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 technical problems were solved by helping each other, developing team work.

The accomplishment of this project includes several learning in the different stages of the construction (mechanics, electronics and computer science). We had the chance 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.

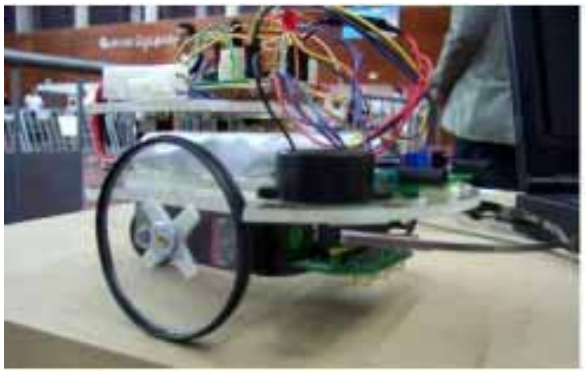

Figure 1. Our robot

Keywords. Robotics, Hands-on.

Hydrogen Production from Seawater, with Environmental Benefits

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Abstract The project is presented as a prototype on a laboratory scale set-up using a tank of seawater. A floating board containing electrodes is fed with electricity coming from a photovoltaic panel and an aeolian generator. Two cells, conductimeter and pH, are used to monitor the electrolytic process. The resulting hydrogen is stored and used later in a fuel cell.
This way we have access to a primordial energy, hydrogen, carbon free and ready to replace the fossil fuels which have been causing so many worries. The use of renewable energies and the benefits that the process has on the environment justify its eco-sustainable character.

Keywords. Energy, Sustainability Development, Electrochemical, Environmental Protection.

1. Introduction

Nowadays oil is used for about 72% of direct or indirect energy for means of transport [1]. Slowly but effectively, hydrogen has been emerging as a privileged alternative fuel for the future [2]. Vehicles running on hydrogen batteries are already a reality.

Hydrogen is not free in nature and it is important to come up with means to produce it in an eco-sustainable way [3], and establish as perfect a biogeochemical cycle as technology will

 ISBN 978-989-95336-1-5

allows. Eco-sustainability requires matching both the "**eco**nomic" and "**eco**logical" aspects in a complementary perspective, which means making economy and ecology two sides of the same coin.

2. Energy as hydrogen

In this aspect, due to its characteristics and abundance [4], seawater stands out as the prime raw material most suited to the electrolytic production of hydrogen. The process requires energy which is produced by means of the mechanical and photovoltaic transformation of natural resources such as wind (aeolian), the sun (heliostactic) and the sea (thalassic).
Despite their abundance, these forms of renewable energies are not very productive and they are practically impossible to store. But nowadays, once available, it is possible to transform all these forms of natural energy into hydrogen, which is storable energy.

3. The group involved

The work group involved in the project is composed of secondary school students (11th and 12th forms) attending the Chemistry, Environment and Quality course at Colégio Internato dos Carvalhos. We must point out the interdisciplinary character of the project, which involves different subjects such as chemistry, physics, biology, geology and mathematics.

4. Electrode reactions

In the electrolysis of seawater, the cathodic reaction of an inactive electrode leads to hydrogen release by reducing the water molecule, as shown by the following chemical equation:

$$2H_2O\ (l) + 2e \rightarrow H_2\ (g) + 2HO^-\ (aq)$$
$$E^o = -0.828\ V$$

The anodic reaction of an iron electrode leads to the formation of Fe^{3+} (aq) ions resulting from both the seawater alkalinity and the cathodic reaction precipitate, keeping an ionic concentration limited by the KPs of the $Fe(HO)_3$ (1.1×10^{-36}).

$$Fe\ (s) \rightarrow Fe^{3+}\ (aq) + 3e$$
$$E^0 = -0.330\ V$$

At first, iron ions make a hexahidrated complex with water,

$$Fe^{3+}\ (aq) + 6H_2O\ (l) \rightarrow [Fe\ (H_2O)_6]^{3+}\ (aq)$$

And, with the increase of the HO^- concentration that results from the cathodic reaction, it starts the gel precipitation in three steps:

First:

$$[Fe\ (H_2O)_6]^{3+}\ (aq) + HO^-\ (aq) \rightarrow [Fe\ (H_2O)_5\ HO]^{2+}\ (aq) + H_2O\ (l)$$

Second:

$$[Fe\ (H_2O)_5\ HO]^{2+}\ (aq) + HO^-\ (aq) \rightarrow [Fe\ (H_2O)_4\ (HO)_2]^{+}\ (aq) + H_2O\ (l)$$

Third:

$$[Fe\ (H_2O)_4\ HO_2]^{+}\ (aq) + HO^-\ (aq) \rightarrow \mathbf{Fe\ (H_2O)_3\ (HO)_3}\downarrow + H_2O\ (l)$$

brown pp (gel)

Figure 1. Marine ecosystem (Lab.)

Figure 2. Electrolyser view (Lab.)

The iron concentration in the seawater is on a scale of 10^{-6} [5]. The iron concentration is due to the solubility of the precipitate $[Fe^{3+}] = 4.5 \times 10^{-10}$ mol·dm^{-3}. Despite being slow, the production of hydrogen through seawater electrolysis contributes to the increase of iron ions (in the water).

In the global balance:

$$3\ mol\ H2 \Leftrightarrow 2\ mol\ Fe$$

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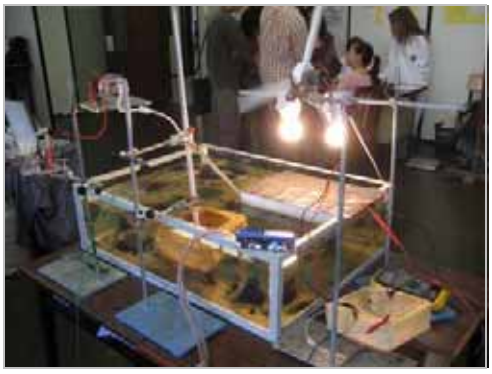

Figure 3. All project in action (EXPOCIC/07)

Figure 4. Monitoring (Science on Stage)

Among the graphs showing the experimental results obtained, the following two stand out.

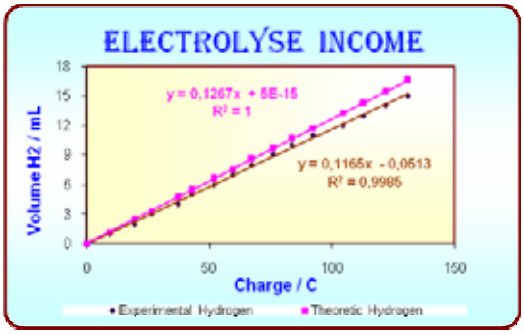

Figure 5. Electrolyse maximum income

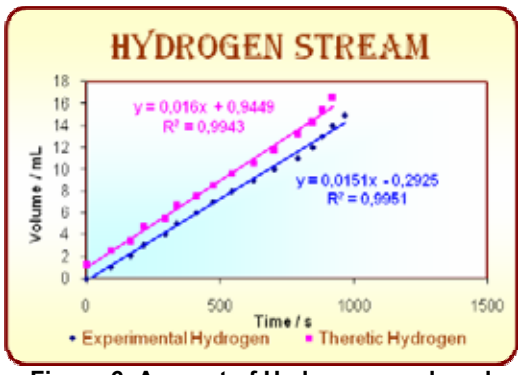

Figure 6. Amount of Hydrogen produced

5. Environmental impact

The electrolytic process goes along with benefits for the environment coming from the reactive iron anode, which increases the amount of iron in the sea when it is sacrificed in exchange for the released hydrogen, thus contributing to the development of chlorophyll [6] and phytoplankton — the beginning of a food chain that has been destroyed by human activity [7]. This way the process contributes to the fixation of carbon biologically.

And if we consider the acid rain that directly or indirectly reaches the oceans, the hydrogen release will result in a compensatory process for the recovery of pH ($\pm$ 8.3) with subsequent implications on the balance of the hydrogenocarbonate ion and natural fixation of carbon dioxide in the ocean, in an inorganic way [8]:

$$CO_2\,(g) + H2O\,(l) \leftrightarrow H_2CO_3\,(aq)$$
$$H_2CO_3\,(aq) + H_2O\,(l) \leftrightarrow HCO_3^-\,(aq) + H_3O^+\,(aq)$$
$$HCO_3^-\,(aq) + H_2O\,(l) \leftrightarrow CO_3^{2-}\,(aq) + H_3O^+\,(aq)$$

6. Acknowledgements

I thank all students involved in the project and colleagues of the Chemistry Group, especially the group coordinator. I also thank Edite Pereira da Silva, the English teacher.

7. References

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Teaching through Drama

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Abstract. In this communication we intend to describe and explore a range of drama techniques that can be exploited in the teaching of science, particularly for ages 14-16, but also to appeal to all ages. These will include:

1) roleplay – by taking a historical or significant contemporary figure in the scientific sphere (e.g. Darwin), 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 roleplay. 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) structured debate/argument – by identifying a key ethical or social controversy at the heart of a scientific issue, this technique encourages students to be inducted into various opinions in order to engage in the debate. For example, we could take an issue such as 'Climate in Crisis' with participants representing the various viewpoints – a) the possibility of ecological disaster or b) 'science will provide an answer' or c) sustainable growth.
4) simulation – this involves the structuring of a more concerted project, possibly 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 (Art for graphics and displays, History for social and political background, also Geography and Literacy skills). For example, students could prepare information and know-how to feed-back or challenge the historical/scientific figure on his 'return'.

Portuguese Women with PhD in Sciences

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Abstract. The number of women finished PhD in Portugal was increasing and in 2005 the number of women is higher than man in biological sciences, agrarian and veterinary sciences, chemistry and mathematics. In physic, health sciences and earth and space science were lower but the percentage of the last two sciences is very close 50%. The tendency of women dominate science fields in Portugal can be possible explain because the access to university is done by grades and are the better students in secondary school that have access to university, and in fact at the age of seventeen years old girls had better grades in general, when comparing to the boys.

Keywords. Women, Gender, Science

1. Introduction

The accesses of women in science to university were increasing in more civilized countries. This work is based essentially in publish statistics by FCG (1981) [1] and OCES (1986) [2].

2. Women obtained PhD in science fields

2.1. Biological Sciences

The women in past prefer studied botany than zoology. The flowers and herbs were more attractive than zoology that manipulates animals. Teachers in secondary school of biology were usually women.

The first woman that finished PhD in this area in Portugal was Seomara da Costa Primo (1895-1986), that finished her PhD in Botany in 1942, in Lisbon University. The second woman that obtained a PhD in a Portuguese University was Maria Manuela da Gama in 1965.

The Figure 1 represents the number of women and men that finished PhD after 1970. As can be seen the numbers of person obtained PhD. in Portugal increased a lot in last years. This can be because in past only persons that chose academic career in university did the PhD. In research institutes and enterprises were not usual to obtain PhD.

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Can be observed that the women dominate with the exception of six years (1974, 1977, 1979, 1983, 1989 and 1992).

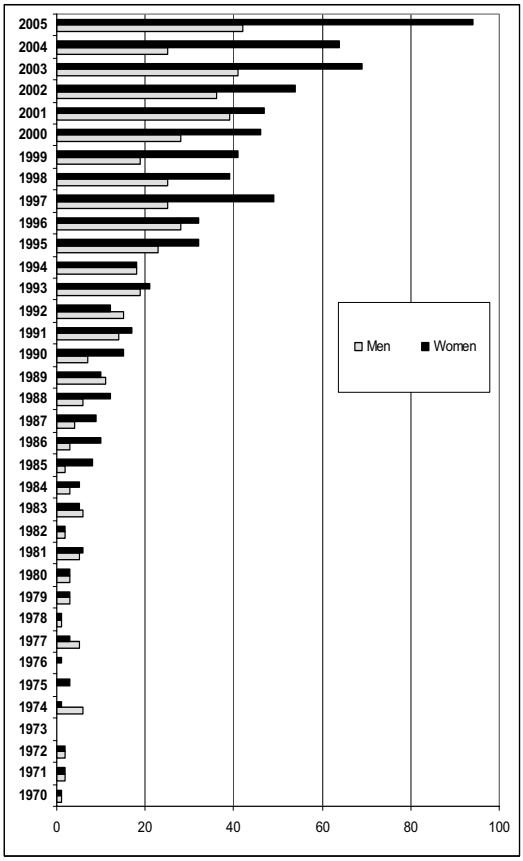

Figure 1. Number of women and men that obtain the PhD, in Portugal after 1970. Data from FCG (1981) and OCES (2006)

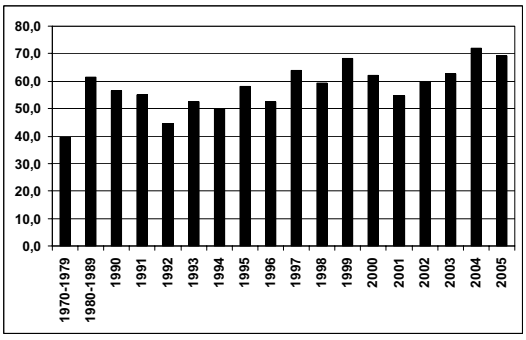

Figure 2. Percentage of women that finished PhD in biological sciences, in Portugal after 1970. Data from OCES (2006)

When the percentages of women were observed (Figure 2) can notice that the percentage of women increased a little in last years but was not significantly different for the other years after 1980.

2.2. Health Sciences

Health Science that includes medicine were usually considerer before 1970 a men profession. In medicine university women started to enter in 1960 decade but in a very few number. Now is the opposite the number of women enter in medicine is higher than the number of men.

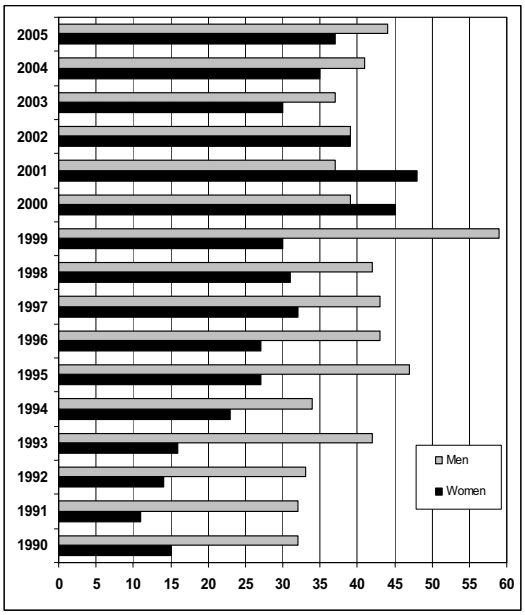

Figure 3. Number of women and men that obtain the PhD, in Portugal, in health science after 1990. Data from OCES (2006)

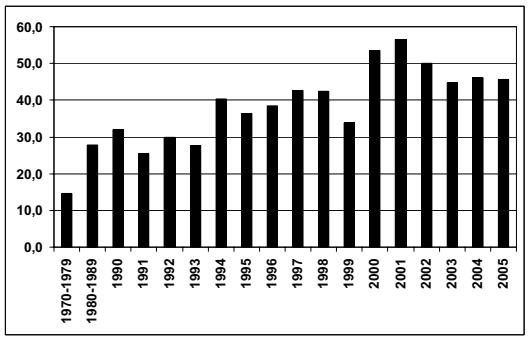

Figure 4. Percentage of women that finished PhD in health sciences, in Portugal after 1970. Data from OCES (2006)

One of the first woman to that obtained PhD was Amélia dos Santos Costa Cardia (1855-1938), that made her PhD about yellow disease. Another was Cesina Borges Adães Bermudes (1908-2001), doctor that obtained her PhD in 1947, with a final classification of 19 values (in a scale between 0 and 20).

In last sixteen years the number of persons that obtained PhD, has increased, especially the

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number of women that finished the PhD (Figure 3).

In Figure 4 represent the percentage of women after 1970. It can be observe that the percentage of women finished PhD was, in last years, very close the 50% and in two years the percentages of women were higher - 2000 and 2001.

2.3. Agrarian and Veterinary Sciences

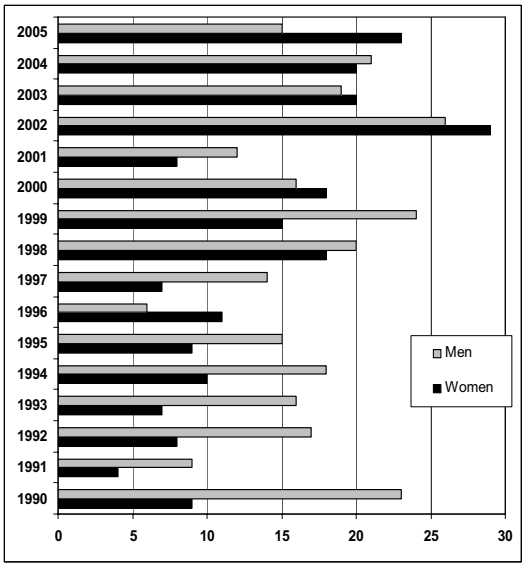

Figure 5. Number of women and men that obtain the PhD, in Portugal, in agrarian and veterinary sciences after 1990. Data from OCES (2006)

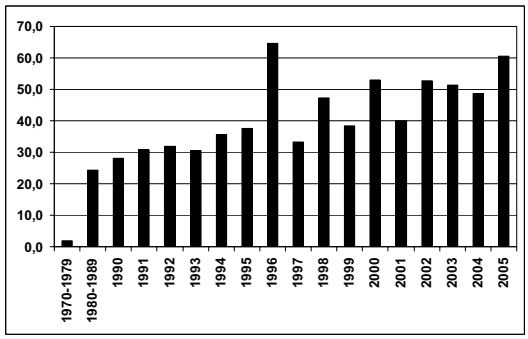

Figure 6. Percentage of women that finished PhD in agrarian and veterinary sciences, in Portugal after 1970. Data from OCES (2006)

The statistics put together the agrarian and veterinary sciences that in our opinion did not allow a correct understand of what happen.

The number of men did not increase in last sixteen years but the numbers of women increased a lot (Figure 5).

In Figure 6 were plot the percentage of women that finished the PhD after 1970. The numbers of women were high 50% in five years (1996, 2000, 2002, 2003 and 2005).

2.4. Chemistry

One of the first women finished PhD in chemistry in Portugal was Maria Alzira Bessa Almoster Moura that finished in 1956.

Chemistry because Marie Curie won a Nobel Prize of chemistry in 1911 encouraged a lot of women in Portugal to thought that could choose this area.

The number of women and men in last sixteen years suffered a great increase as can be observed in Figure 7.

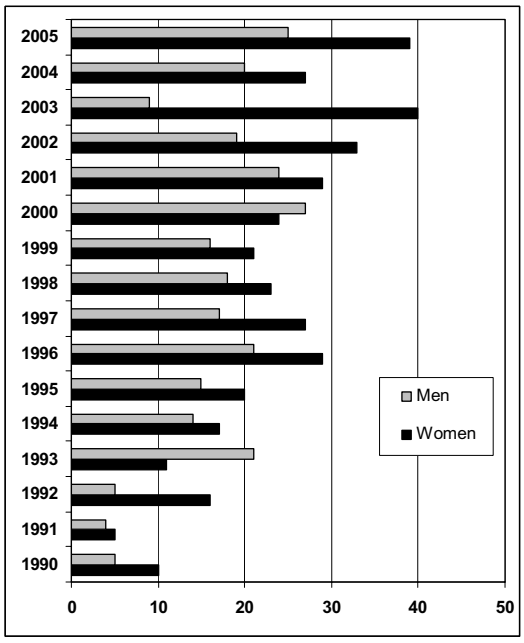

Figure 7. Number of women and men that obtain the PhD, in Portugal, in chemistry after 1990. Data from OCES (2006)

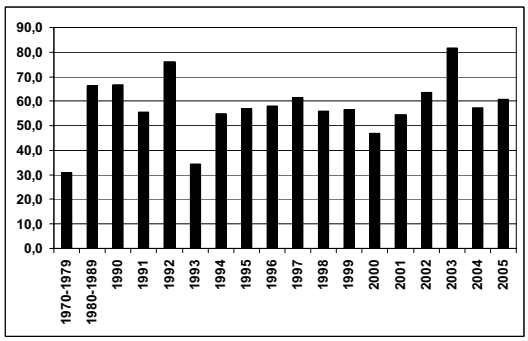

Figure 8. Percentage of women that finished PhD in chemistry, in Portugal after 1970. Data from OCES (2006)

The percentage of women that obtained the PhD in chemistry was represented in Figure 8.

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Can be observed that the women dominated with exception of 1970-1979, 1993 and 2000.

2.5.Physics

One of the first's women finished PhD in Portugal was Lidia Salgueiro in 1945 and Maria Teresa da Silva Bernardo Gonçalves in 1963.

In physics Marie Curie with the won of Nobel Prize in 1903 also encouraged the women that liked this field to study it.

The number of women and men in last sixteen years increase, as can be observed in Figure 8, in similar proportion.

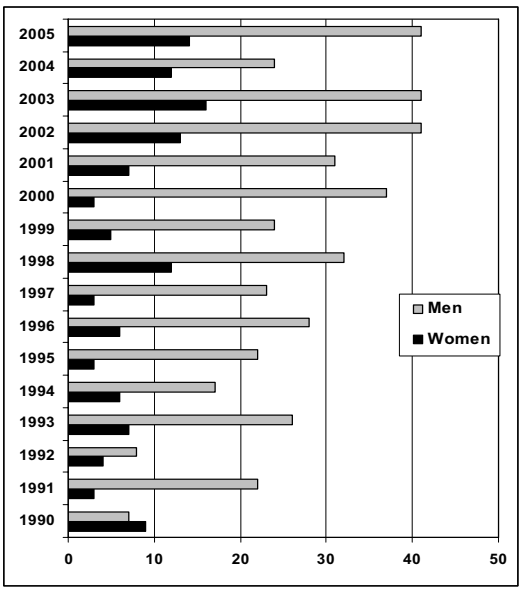

Figure 9. Number of women and men that obtained the PhD, in Portugal, in physics after 1990. Data from OCES (2006)

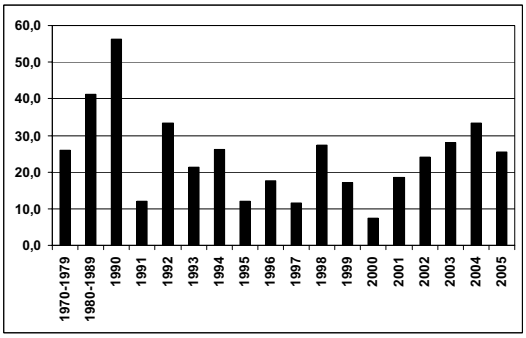

Figure 10. Percentage of women that finished PhD in physic, in Portugal after 1970. Data from OCES (2006)

In physics, the situation is different from the previous sciences refer (Figure 10). Women only dominated in 1990, and after 1990 the percentages of women were in general below 30%.

Physics was considerer in Portugal a science of men. In fact women, in general, did not like physics.

2.6. Mathematics

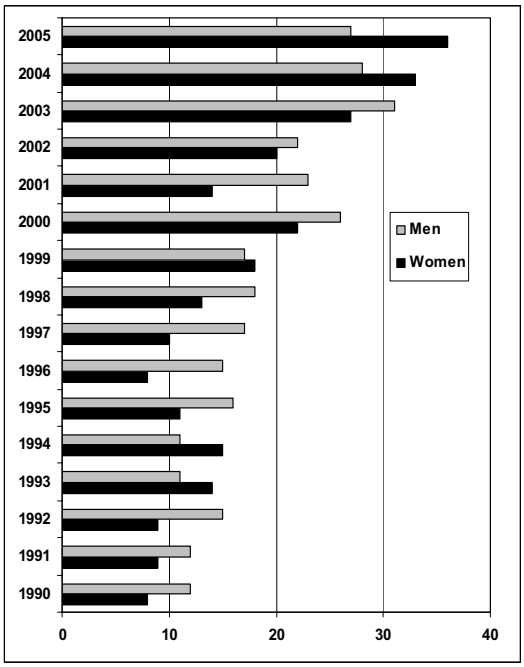

Figure 11. Number of women and men that obtained the PhD, in Portugal, in mathematics after 1990. Data from OCES (2006)

One of the first woman to obtain the PhD in Portugal was Maria Luisa Melo de Noronha Galvão, that obtained PhD in 1963 in Calculus and later Maria de Fátima Fontes de Sousa that made it in 1970 in Probability and Statistics.

The number of persons that finished PhD in mathematics increased in last sixteen years (Figure 11).

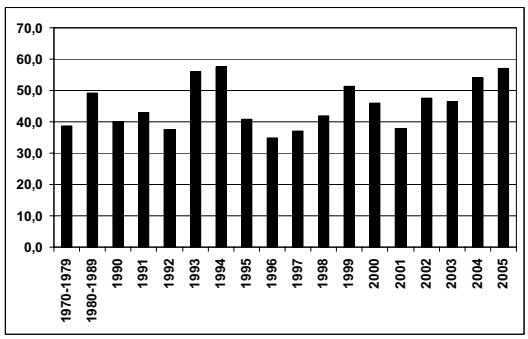

Figure 12. Percentage of women that finished PhD in mathematics, in Portugal after 1970. Data from OCES (2006)

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In Mathematics the percentages of women that obtained PhD were higher than men (Figure 12) in five years (1993, 1994, 1999, 2004 and 2005). But in general is near 40 %.

2.7. Earth and Space Science

The number of persons of persons that obtained PhD has increased in last decade (Figure 13).

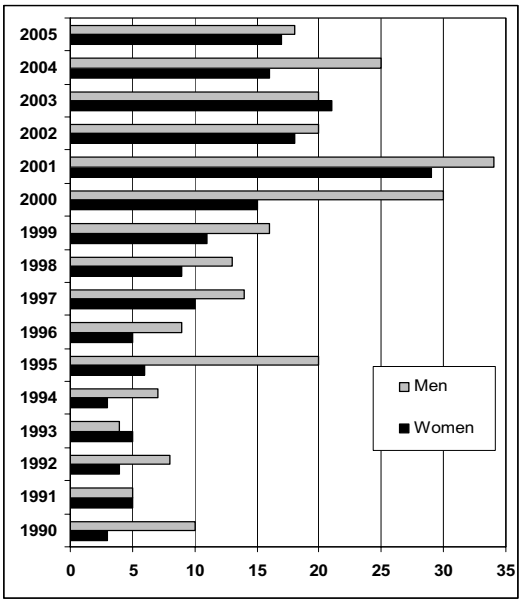

Figure 13. Number of women and men that obtained the PhD, in Portugal, in earth and space science after 1990. Data from OCES (2006)

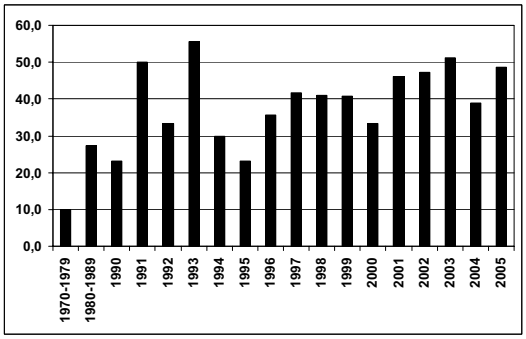

Figure 14. Percentage of women that finished PhD in earth and space sciences, in Portugal after 1970. Data from OCES (2006)

The percentage of women that finished PhD in field of earth and space sciences only were higher than 50% in two years (1993 and 2003) and in 1991 is 50% (Figure 14).

3. Final consideration

The women accesses to PhD in Portugal were increasing. Women dominate in biological sciences and chemistry. In physics men dominated. In other sciences, health, agrarian and veterinary, mathematics, earth and space the values are near 50%.

One of the reasons for this is because the percentages of women that enter in university are in these fields higher than men because the accesses to the graduation course were made by classification in previous years (secondary school). Men, in general, have low average in classifications eventually because physiologically enter in adolescence later than the women. Actually only the courses that women don't want have more men than women. Of course these reflect in posterior career.

The numbers of PhD increase in last years because more persons have access to university and because nowadays PhD in past was only obtained for persons that were in academic career. But the maternity still also a problem to done PhD for a lot of women in Portugal.

4. Acknowledgements

AMONET - Associação Portuguesa de Mulheres Cientistas

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Workshop 1

Drama and Science Teaching

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Thursday, July 26, 14:30 up to 17:30, room B (maximum of 20 participants)

Aims:

To explore and exercise a range of drama techniques that can be exploited in the teaching of science – for ages 10 to 75... These will include:

1) roleplay – by taking a historical or significant contemporary figure in the scientific sphere, RP would 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 roleplay. 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) structured debate/argument – by identifying a key ethical or social controversy at the heart of a scientific issue, this technique enables students to be inducted into opposing opinions in order to play out the debate. For example, we could take an issue such as 'Climate in Crisis' with participants representing the various viewpoints – a) ecology or b) 'science will provide an answer' or c) the 'economic growth' argument.
4) simulation – this involves the structuring of a more concerted project (e.g. for a whole year group over a longer 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 would engage the participants practically, enabling them to exercise and practice these skills within the session, whilst in the lecture-demo RP would also be inter-active with the audience, dramatically illustrating the techniques employed.

Delegates would be provided with a hard-copy of information and techniques used within the workshop.

Workshop 2

Microsoft EXCEL Simulations for Physics Teaching

V. Fonseca
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Universidade do Minho
Portugal
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Thursday, July 26, 14:30 up to 17:30, computer room 1 (maximum of 20 participants).

Aims:

The potential for data acquisition and evaluation, as well as in the presentation of the results and the search for information is steadily increasing.

An effort is still being done in creating new and more complete resources as well as informatics conditions at the schools. One of the greatest potential of the electronic resources is in the fields of virtual laboratories, which can contemplate the visualization /demonstration of the main natural laws and/or the interaction and experimentation by changing parameters and/or experimental conditions.

It is commonly thought that these virtual labs can only be prepared by information specialist with together the necessary pedagogical and scientific support. In this presentation, it will be demonstrated different functionalities of Excel that allow the teacher to create simulations and worksheets able to be implemented within the classes and during the self-study of the students.

This tool provides the teacher with a powerful, easily available teaching resource in which can create material appropriate for the own subject and level.

The main point is the use of the ActiveX control tools, in particular the Scroll Bar in order to create animations with Excel. The created graphs can be used to represent functions and data as well as to design real objects.

These tools, together with other standard functionalities such as data bases, will provide the ability to implement and explore different situations and phenomena.

Examples from the areas of Classical Mechanics, Electricity and Magnetism and Optics will be explored hands-on.

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Workshop 3

From the Earth to the Stars! Da Terra às Estrelas!

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Tuesday & Thursday, 14:30 to 16:00, room C; and, 16:30 to 18:00, room B.
Delivered in Portuguese.

Aims:
A Astronomia também permite aos intelectos viajar através do Cosmos. Pode-se pensar esta viagem em diferentes etapas: da Terra ao Sistema Solar, das estrelas às galáxias ou no grande cenário que é o Universo.

A imensidão do Cosmos exige escalas, que não se usam diariamente, para referir as distâncias inter-planetárias, ou inter-estelares, ou inter-galácticas. Mas como pode o homem, habitante de um planeta, talvez vulgar, situado num "vulgar" sistema planetário e numa vulgar galáxia, determinar estas dimensões imensas? Nesta workshop, começa-se por introduzir as convenções usadas no estudo do céu e discutir as escalas do Cosmos, referindo as unidades de medida astronómicas mais frequentemente utilizadas, a dimensão aparente dos corpos celestes e alguns métodos de medida de distâncias astronómicas.

Numa escala mais terrena, os movimentos da Terra provocam a existência das estações e fornece as medidas de tempo. O movimento da Lua em torno da Terra, traduzido pelo ciclo de fases lunares, deu origem ao conceito de mês. Estes movimentos e as posições relativas do Sol, da Terra e da Lua, sugerem um conjunto de questões que serão analisadas: Há um "dark side of the moon"? Porque há eclipses de tipo diferente? Porque é que não há um eclipse da Lua e um eclipse solar por mês lunar? O que é a "Lua de Sangue"? Como se justifica o avermelhado da Lua durante o eclipse lunar? Qual a mecânica das marés?

Hoje sabe-se que as estrelas são constituídas pelos mesmos elementos químicos que encontramos na Terra. Conhecemos o seu tamanho, a sua temperatura, a sua massa; também percebemos porque é que as estrelas possuem cores diferentes: as azuis têm temperaturas superficiais elevadas enquanto que as estrelas vermelhas e as amarelas têm temperaturas superficiais mais baixas. Como conhecemos todas estas características? Como podemos conhecer a natureza das estrelas, objectos tão distantes que a sua radiação demora anos até chegar à Terra?

Neste curso pretende-se discutir como a radiação estelar, pode ser utilizada para determinar as propriedades das estrelas e a sua evolução.

Workshop 4

Using Simulation Software to Teach Computer Networks

I. Berezovska
Department of Computer Sciences, Ternopil State Technical University, Ukraine
richard.pinner@btopenworld.com

Tuesday, 15:00 to 16:00, computer room 1 (maximum 20 participants).

Aims:
To learn how easy-to-use computer simulation software can achieve the advantages of simulation-based instruction and provide additional learning enhancements. We present a computer-based simulation that helps students to learn computer network concepts which are key matters in computer networking and see many factors influencing the network performance. The instructional potential of two simulation packages, NetCracker Professional 3.x and Packet Tracer 4.x, and a connection-oriented protocol analyzer, EtherDetect Packet Sniffer 3.1, is addressed.

Workshop 5

Safety in a Plastics Bottle

J. Trna and E. Trnova
Faculty of Education, Masaryk University
Czech Republic
trna@ped.muni.cz

 ISBN 978-989-95336-1-5

Tuesday, 15:30 to 16:00, room B (maximum 20 participants).

Aims:
To explore and train a set of new hands-on experiments with over-pressured plastics bottle. These will include:

1) Safety of the human body – simulation of behaviour of the human body during swimming, bathing and diving (the rupture of ear-drum, Caisson disease etc.) in over-pressured plastic bottle.

2) Overpressure and underpressure – use of the over-pressure in plastics bottle as alternative to known and unknown science experiments with the under-pressure.

The overpressure in the plastics bottle is made out by hand-pressing or by a small velocipede tire-pump. Instruments in plastics bottles are fixed on stands made out of copper wire, metal stick and wooden small plates. The combining of living phenomena on human body and hands-on science experiments results strong students' motivation and interest. Very important task is the good professional preparation of science teachers in the use of these hands-on experiments. Authors present also experiences from science teachers training. Participants would be provided with a hard-copy of information used within the training session.

Workshop 6

Virtual Laboratory of Biotechnology: demonstration of a software

N. Ribeiro, S. Pereira, J. Pissarra and J. Santos
Universidade do Porto, Portugal
nunom_ribeiro@sapo.pt

Tuesday, 14:30 to 17:30, computer room 2 (maximum 20 participants)

Aims:
The main goal of this activity is to demonstrate the software Virtual Laboratory of Biotechnology. The participants will use the software, in interactive work groups, and will try to answer a series of investigative questions that aim to highlight the characteristics of the different techniques. Afterwards, they will apply these techniques to specific case studies. Finally, the participants will reflect about the ethical implications of these technologies through discussion. As the participants go through this educational pathway, they form a clearer picture about what Biotechnology is, its applications and ethical implications and about how this area of knowledge can revolutionize the future of humanity

Workshop 7

The Information and Communications Technologies in Promotion of Experimental Science Education: Exploration of a Multimedia Didactic Application in Thematic Sexual Reproduction

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Thursday, 14:30 to 16:00, computer room 2 (maximum 20 participants).

Aims:
Aiming the promotion of sciences eaching, "Reprodução 9|11|12" ("Reproduction 9|11|12", a multimedia didactic application, was developed (http://www.ibmc.up.pt/moodle). It is an application where the different domains essential for the educational success of the tool are conjugated: content, didactics, design and functionality. In relation to the content, the thematic of the sexual reproduction is approached, holding in mind the curricular programme of the elementary and secondary education. It is approached since the procreation of a new being, with the junction of the two gametes to form a zygote, until its initial embryonic development. It is also pointed out the use that man does of the knowledge of these reproductive processes, manipulating the individuals' fertility. In this direction, the present workshop/hands-on experiment demonstration becomes pertinent for the spreading of "Reproduction 9|11|12" next to the professionals in science education. This is address, in particular, to teachers of Biology and Geology, of third cycle and secondary.

 ISBN 978-989-95336-1-5

Workshop 8

Implementation Strategies of Virtual Laboratory Activities at Secondary Schools

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Thursday, 16:30 to 17:30, computer room 2 (maximum 20 participants).

Aims:

The teaching of science in secondary school must contemplate the execution of laboratorial activities in order to be fully effective.

In order to take fully advantage of the experimental activities, three different moments are contemplated: preparation of the experiments – often in the previous class, execution and evaluation.

The use of virtual labs can be a useful approach to enrich exploration of experimental activities, in particular, in the preparation and execution stages.

Virtual Laboratory Activities can be an important tool in order to: a) relate information and concepts, b) simulate experiments before the actual experimental class, c) simulate different experimental conditions, often difficult to achieve in the real lab due to time concerns, d) include interactive questionnaires.

Further, virtual labs are an alternative way to realize experimental work in the case of schools with no conditions to implement some of the laboratory activities.

With this workshop we will discuss, based in several examples, the creation of a Virtual Laboratory Activities and the study of its pedagogical impact in two different situations: a) as a complement to the real laboratory, b) as a substitution of the real laboratory

The results will be presented and discussed together with the results obtained with students that performed the real laboratory experiments with no help of the Virtual Laboratory Activities.

Workshop 9

School' Robotics

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Informally through the science fair.

Aims:

The impact of robotics in our societies is already very significant and our youngsters are, in general, well aware of it. As motivational factor to the study of S&T, robotics proved already to be rather useful. In previous Hands-on Science conferences several reports on good practices were delivered as well as a large amount of support material. However this is a topic somewhat unfamiliar to our school science teacher. In an informal and open way we will assist and lead the interested teachers, with the support of the many students "robotics' specialist" that the conference' organization brought to this event, on the basics of robotics and its use in class.

Workshop 10

Elementary Optics

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Tuesday, 18:00 to 19:30, room B (maximum 20 participants).

Aims:

Upon the success of our previous hands-on informal training session on elementary optics held at HSCI2006 conference, we will setup a number of simple basics optics experiments to be explored in a friendly and open way by the participants.

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The Hands-on Science Network acknowledge these sponsorships and collaborations