**Paper presented at the HSci 2006 - 3rd International Conference on Hands-on Science, 4th - 9th September, 2006, Braga, Portugal, proceedings published by University of Minho (http://www.hsci.info/hsci2006/index.html).**

# The Hands on Science project: Perspectives of an adventure(*).

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(*)*This work has been partially funded by the European Commission (project "Hands-on Science" contract number 110157-CP-1-2003-1-PT-COMENIUS-C3). Neither the Commission nor the authors of this work may be held responsible for any use of the information provided here.*

**Abstract**. *Contemporary knowledge conscious societies are dependent for their prosperity and development on Science and Technology literate citizens. The rapid advances in Science and Technology and their quick implementation into applications of every day's use imply that social interaction may contribute very little, if any, towards this Science and Technology Literacy which may be effected only through an effective education. In this context the Science and Technology subjects of the school curricula especially of the schools in compulsory education become a significant parameter having as a primary objective the education of the future citizen and not that of a specialist to the field. The Hands on Science project, based on an initiative of Manuel Filipe Pereira da Cunha Martins Costa of the University of Minho was created within this context as a Comenius 3 project partially financed by the European Commission. In its 3 years of operation has been transformed into a large network with many and significant field activities. It acquired a momentum which has already formed other related activities permitting the continuation of its operation. It has also inspired new initiatives for an effective Science and Technology teaching appropriate for the citizen of a Technology conscious society. The perspectives of some of these initiatives are being explored in this work.*

**Keywords.** Science teaching, school curriculum, compulsory education.

## 1. The Hands on Science project.

In all knowledge conscious societies, special attention is paid to the Science and Technology Literacy (STL) of their citizens. Although this is mostly based on welfare arguments, STL is also vital for the survival of democratic societies [1]. The European Union supports STL in various actions, especially within the Education and training directorate (see for example in http://ec.europa.eu/dgs/education_culture/). The **Hands on Science** (HSci), a formal project within the framework of SOCRATES – COMENIUS 3 [2] is such a supported action. This project proposal to European Commission was drawn and submitted by Manuel Filipe Pereira da Cunha Martins Costa of the University of Minho. The original consortium extended to ten countries and included ten partners plus an international association with 28 partners and a number of other collaborators as associated partners under the overall coordination of Manuel Filipe Costa. The HSci project addressed students, teachers and other educators, administrators of education and its objectives focus on the promotion of the Hands on attitude for the teaching of Science (see list in [2]).

After its approval, the HSci project began on October 1, 2003 its operation with its 1st meeting of the coordinators held on November 15, 2003 in Malta. In this 1st meeting most of the partners met for the first time although a number of them had also previous experience of working together. Overcoming normal mismatch and divergences, the partners reached a mutual understanding and in the short time elapsed have produced very remarkable outcomes, as may be seen from the (opening) presentation of the coordinator at this Conference [3] or by browsing the project's web site [2], including:

- The project has expanded into a human network covering the whole of Europe. A real virtual community of persons interested in a more effective Science teaching has been formed.
- Material useful to Hands on Science teaching has been produced and made available to interested teachers.
- A significant number of events (Science fairs and Science weeks, training seminars,

workshops …) have been organized including three international conferences and three international workshops. In these events the participants had the opportunity to exchange experiences on good practices, syllabus and policy matters, social considerations and other issues related to Hands-on Science. More important they could be involved in face to face discussions establishing links with colleagues from different countries and (school) cultures and enhancing their visions.

## 2. A brief commentary

In its 3 years of operation, the HSci project has been transformed into a large network with many and significant field activities. These activities and the interaction between the partners, the associated partners and the teachers and other educators, who participated to the workshops and the Conferences, created an expertise valuable to anyone interested in a more effective Science teaching, appropriate for the citizen of a knowledge based society. Some examples, not included directly within the information provided on the projects web site, are:

- **Syllabus.** An update of the school Science syllabus is necessary. A century since relativity of space time and quantum mechanics were introduced, it is about time for them to reach schools [4]. These topics together with statistical physics, elementary particles and cosmology, materials science and solid state physics, radioactivity, - even more traditional topics like (micro) electronics- and other recent developments should form a new syllabus in a coherent and consistent way. The up to now practice (in tertiary education also) to add separate additional chapters after traditional Science has been taught only confusion provokes. New subjects should be included into the syllabus not as an add-on new module but integrated and interrelated with other subjects [5].
- **Experiments.** They are inherent to Science and they should be integrated to Science teaching. In smaller ages experimentation with simple materials has inherent advantages. Self-made equipment helps towards a better understanding of the basic notions of Science [6], [7]. Experimentation should be incorporated smoothly to the teaching activities with the skill of planning an appropriate experiment to test a hypothesis to be an explicit aim. The distinction between observational (e.g. experimental data) and their interpretation (e.g. the corresponding theory) is very important [8].
- **Inquiry and Modelling.** Open type questions and problems are necessary to complex cognitive skill development. They should, however, be accompanied with scientific discipline. Physics (and Science in general) by inquiry is a valuable resource [9].
- **Teaching.** Should incorporate 'Experiments' and 'Inquiry and Modelling', as commented earlier, towards the attainment to create models of the natural phenomenon under study. The creation of models is a very advantageous process, may be used more generally and should constitute an explicit objective of Science teaching [10]. The relation of observations from everyday life to Science teaching [11] coupled to 'what children think' [12] is very advantageous, leads to a better understanding and appreciation of Science and helps towards the development of reasoning (logic) [13].
- **Teacher education.** This is a matter of urgency. Towards this end, valuable resources are polymorphic practice [14], new and flexible methods of training [15] and project based teaching. My experience from Science Teachers' Education and Training shows that Project based teaching results in a better understanding of the basic principles involved especially if the guidance provided is not in the form of (very) detailed instructions but, rather, in the form of appropriate questions for the trainee to research and solve. Used this way to train the Science teacher it may also serve as an example of the teaching method to use with their students.

## 3. Perspectives

Three years now after the beginning of the HSci project, the financial support from the European Commission ends. The expertise and the momentum gained, however, permit the continuation of the HSci activities. This can be effected in many ways, including:

- Continuance of the HSci initiative as a Human Network of persons interested in Hands on Science Teaching through the creation of a virtual community. There is a world wide interest for this type of activity and a lot of relevant web pages may be found.

Application for financial support in order to have (yearly) meetings with face to face discussion is also possible. The European Commission under the SOCRATES program supports thematic networks for 1 to 3 years (see more in http://ec.europa.eu/education/programmes/socrates/tnp/index_en.html).

- The yearly organization of the HSci International Conference. This Conference has already got a reputation [16]. It may well continue to operate as long as there are institutions to host it.
- The operation of the Hands on Science project has brought together persons from all over Europe. During the events organized by the project, they had the opportunity to discuss their interests and form new consortia. Many consortia have been established, some of them formulated as application projects and quite a few have been successful to get financial support. This process may be continued.
- Associations have been established with primary and secondary schools in almost all the European countries. These associations are a valuable resource linking Higher education and schools with a mutual benefit towards a more efficient Science Education.
- On initiatives created within the Hands on Science activities, for example the Comenius seminars within the International Conferences, many schools have formed Comenius 1 and Comenius 2 consortia supported by the European Union. This is a potential which permits the ongoing collaboration by own means (and, of course, by other financial support, e.g. through bilateral intergovernmental agreements).
- The inventory of Hands on Science activities produced permits the organization of official informal in service training of the interested Science teachers. One such training scheme has been described in [15] and is being implemented as the Comenius 2.1 project AESTIT – Affordable and Efficient Science Teacher In-Service Training [17].
- Etc.

In conclusion, the activities of the Hands on Science may continue with many ways open.

## 4. Acknowledgements

I would like to thank all the colleagues in the Hands on Science Network for their fruitful cooperation. I am also grateful to Athanasia Margetousaki, Miltiadis Tsigris and Simos Anagnostakis from the Laboratory of Science Teaching of The University of Crete for their support. I would like also to express my special thanks Manuel Filipe Costa for his wise coordination of the Hands on Science network and, also for his invitation to make this presentation.

## 5. Notes and References

[1] In Democracy the citizens, acting on their own capacities and not as followers of a "gifted leader" (as sheep under the herdsman), are supposed to participate actively to the decisions taken. As these decisions are increasingly dependent upon Science and Technology developments, the active citizen's participation implies that he (she) not only should be Science and Technology literate but also that he (she) must have cognitive skills permitting decisions on incomplete knowledge, i.e. also in areas he (she) is not an expert. Formation of models develops such skills and is (or should be) an integral part of Science teaching. Otherwise, science will be mixed with religion as in the Dark middle ages or in some places (for example contemporary USA – see http://www.ncseweb.org/ (visited on June 22, 2006) where Science education, especially the theory of evolution became a legal matter competing with religious doctrine). Note: the effective Science and Technology education has been declared by UNESCO "democratic right", a right to democracy.

[2] http://www.hsci.info/

[3] http://www.hsci.info/hsci2006/index.html

[4] George Kalkanis 'Which (and How) Science and Technology Education for Future Citizens?', pp. 199-214 of Vol. II of the proceedings of the University of Cyprus, '1st IOSTE Symposium in Southern Europe – Science and Technology Education: Preparing Future Citizens', Paralimni-Cyprus 29/4-2/5 2001.

[5] see Miltiadis Tsigris and P. G. Michaelides, '*On the feasibility to include contemporary Science concepts in the Primary school curricula – a retrospection into two case studies*', paper to be presented at the HSci

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[6] P. G. Michaelides, Tsigris Miltiadis, Science Teaching with Self-made Apparatus, paper presented in the 1st International Conference on Hands on Science: Teaching and Learning Science in the XXI Century, 5-9 July 2004, Ljubljana, Slovenia, proceedings pp. (http://www.hsci.info/hsci2004/PROCEEDINGS/FinalPapers/040530.pdf).

[7] Miltiadis Tsigris, '*The Didactics of Science through Polymorphic Self-Made Experimental Apparatus of Quantitative Determinations. An alternative proposal for the teaching of Natural Sciences*, in HSci 2005 - 2nd International Conference on Hands on Science: Science in a Changing Education, 13 – 16 July 2005 at The University of Crete campus at Rethimno-Crete, Greece, Proceedings pp 384-386 (http://www.clab.edc.uoc.gr/2nd/).

[8] P. G. Michaelides, "Understanding difficulties in Science observations", oral presentation, 2nd Pan-Hellenic Conference on the Didactics of Science and the introduction of New Technologies in Education, University of Cyprus, Nicosia May 3-5, 2000 , book of abstracts page 26 (in Greek).

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[13] Reasoning in Physics: The Part of Common Sense by Laurence Viennot, KLUWER Academic Publishers.

[14] P. G. Michaelides, "Polymorphic Practice in Science", pp 399-405 of the proceedings of the 1st Pan-Hellenic Conference on the Didactics of Science and the introduction of New Technologies in Education, University of Thessaloniki, Thessaloniki May 29-31, 1998 (in Greek).

[15] P. G. Michaelides, An affordable and efficient in-service training scheme for the Science Teacher, "Sixth International Conference on Computer Based Learning in Science 2003 (CBLIS03), University of Cyprus, Nicosia, Cyprus, 5 - 10 July 2003" proceedings pp. 792-799.

[16] A search for the whole phrase 'Hands on Science International Conference' gave more than 1 million hits most are referring to the 3 International Conferences organized by the participants of this Hands on Science project.

[17] Athanasia Margetousaki, P. G. Michaelides, '*Affordable and Efficient Science Teacher In-Service Training*' paper to be presented at the HSci 2006 - 3rd International Conference on Hands-on Science, 4th - 9th September, 2006, Braga, Portugal, proceedings published by University of Minho.