Perspectives on the Development of Science Education in the near Future

Manuel F. M. COSTA
Universidade do Minho, Departamento de Fisica, Braga, Portugal

Abstract. In the Society of our days there is a major increasing need of an in depth quality education in Science and Technology. Science school teaching should be generalised aiming not only the sound establishment of a "Science" culture in our societies but also to guarantee a steady basis for the improvement of Science and its technological applications. Urgent actions should be taken in this direction.

Keywords. Science Education, Scientific Literacy, Experiments, Hands-on Science

Introduction

After decades of human development on last years a feeling of civilizational regression is growing in our western societies.

Terrorist acts perpetrated by individuals organizations or even states lead to a generalised sense of insecurity and of loss of acquired basic individual and human rights, in general. Furthermore the repeated social and economical crisis can and are said to be related to insufficient and unsustained rates of economical development in our societies. In the European Union the Lisbon' strategy aiming the establishment of a "leading" knowledge based economy is still facing unsolved implementation problems. Great concerns about world' environment are arising *finally* also among governments. Recently the United Nations declared the decade 2005-2014 the decade of "Education for a sustainable development" stressing the importance and impact education may and should have on the future development of our world. The quality and effectiveness of youth's education will ultimately determine their future behaviour as citizens. Therefore, it is of utmost importance that students get a sound education in science and technology thus establishing a good scientific literacy while learning to value and how to preserve their environment so that, in the future, as citizens in an advanced democratic society, eventually even in decision-making roles, they can assure that society's development is made in a sustainable manner.

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 recognising 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

[1] Correponding Author: Manuel Filipe P. C. M. Costa, Universidade do Minho, Departamento de Fisica, Campus de Gualtar, 4730-734 Braga, Portugal; E-mail: mfcosta@fisica.uminho.pt.

Science a clearly higher importance.

However the improvement in the levels of quality and effectiveness in school science education can hardly be achieved without and 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 scientists do…*

This was the driven idea that leads to the establishment of the "Hands-on Science" Network back in 2003.

1. The Hands-on Science Network. 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 enrols today, as regular or associated members, about 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 countries candidates to the integration.

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 performed. 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. Nine 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 - http://www.hsci.info; http://hsci.no.sapo.pt; http://www.hsci-pt.com; http://colos.fcu.um.es/comenius/; http://webs.uvigo.es/eventos/h-sci/; http://ptcl.chem.ox.ac.uk/%7Ehmc/hsci/; http://www.emg-huerth.de/comenius/index1.htm; http://www.hsci.info/hsci_si/; http://www.cherbourg.home.ro/comenius/menu.html; http://http://www.ee3.org; http://micro-kosmos.uoa.gr/Hands-on-Science/ http://www.hsci.info/hsci_mt/; http://www.clab.edc.uoc.gr/hsci/; http://lsg.ucy.ac.cy/other/hsci/- most of them establishing links to many other websites offering an enormous amount of resources (including remote

laboratories - http://colos.fcu.um.es/rlab/) that can be used freely by teachers, students, and all interested persons in general.

Several 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, governments, parliaments and decision makers, 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.

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. 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 search for the whole phrase 'Hands on Science International Conference' gave more than 1 million hits most of them referring to HSCI2006 [3] and over 1/3 of all hits on hands-on science conference refers to activities of our network). 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.

A number of new international cooperation projects and activities at national, EU and world level are being prepared. The next Hands-on Science annual conference is tentatively scheduled for the Azores Islands late July 2007. Next spring a follow-up of our workshops on Scientific Literacy and Life Long Learning will be organised in Romania, by mid April the 3rd Training course in School Robotics will be organised in Malta, ...

The Hands-on Science network 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.

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