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Science and Technology Education in the Arab world in the 21st Century*

The 21st century offers both a promise and a challenge. Remarkable advances in electronic technologies in general, and information technologies in particular, hold out the promise of new scientific discoveries, improved living standards, better communication, increased production, greater access to information and significant improvements in health and quality of life. However, many children, possibility the majority, face obstacles that stem from a lack of educational opportunity and quality health care as a result of poverty, overpopulation and violence. They will also bear the brunt of decreasing environmental quality, wider and increasingly brutal armed conflict and unequal opportunities between the sexes. These children, especially girls, will not be able to reach their potential. Consequently, preparing students for the 21st century should be one of the priorities of educational and political leaders around the world.

UNESCO underscores the value of scientific and technological literacy as a universal requirement if people are not to become alienated from the society in which they live, or be overwhelmed and demoralized by change. Meanwhile, research has shown that many students in both developing and developed countries lack the necessary knowledge and skills in science and technology (S&T) to function effectively in the modern world (*AAAS, 1989; Eisenhart, Finkel, and Marion, 1996; ETS, 1988; Halloun, 1993; et al.*). Students graduating from schools in the 21st century need the scientific and technological knowledge and skills that will permit them to be creative members of society, take responsible decisions in their everyday and professional life and function effectively in a world of work that is fluid and in which the traditional bases of economic competition continue to change. This requires students to develop a thorough knowledge and understanding of basic scientific and technological concepts, allied with problem-solving and critical-thinking skills that they can apply in a variety of situations. A strong conceptual base and essential thinking skills must thus be the new basics and the focal points of teaching and learning S&T in the classrooms of the 21st century (*Resnick, 1999*[1]).

But what science and what technology should students study and how should they study them? What characteristics should students have in order to be considered scientifically and technologically literate individuals? What qualities do graduate students need to succeed in an increasingly scientifically and technologically rich world?

S&T do not only bring benefits. They may also have negative consequences. It is important, therefore, that students see S&T as disciplines with important benefits and burdens and as endeavours that have positive and negative implications for the world beyond the school.

Science Education in the Arab World

What are the important issues that face science and technology education (STE) in the Arab world? The two

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1. See http://www.instituteforlearning.org/Interview.html, http://npeat.org/profdev/research.htm, http://instituteforlearning.org/content.html, and http://austinschool.org/tools/learning_guide/Guide_pol.pdf

Message from the Director-General of UNESCO on the occasion of the World Science Day for Peace and Development

(10 November 2003)

The greatest challenge of our time is to create a world where all citizens live in dignity and peace in a hospitable environment that they have learnt to care for. Achieving this will require political will, public support and science. In celebrating World Science Day for Peace and Development 2003, we place particular focus on the role of science, calling attention to the positive attributes and beneficial consequences of scientific research and knowledge.

However, while we continue to marvel at new scientific discoveries and enjoy the benefits of innovative technological developments grounded upon scientific advances, there is a growing unease about science and mounting concern about its adverse consequences. In some quarters, these misgivings have turned into distrust and opposition, reactions which are worrying because they may erode the foundations of public support for science. That support, which is inseparable from public confidence in science and scientists, can no longer be taken for granted.

Today, therefore, the case for science needs to be re-made, in terms that are convincing to a general public less and less deferential towards the pure intentions of scientists or their greater wisdom. Nor can the case for science rest on past achievements or on promises of future benefits taken on trust. Science will increasingly need to justify itself anew in the knowledge that its evidence and arguments may be subjected to critical scrutiny by a more sceptical public.

Scientists should welcome these developments, especially when they are associated with the proper functioning of democratic processes. At the same time, scientists should work hard at educating policy-makers, opinion-shapers and the general public about science – its purposes, its principles, its methods, its critical and questioning spirit, and its many accomplishments. In this perspective, science education should address not only education in science but also education for and about science, taking the more troubling and contentious issues confronting us into active consideration.

Scientists must become better communicators but this is not just about sending out clear, accurate and relevant messages about science. It is also about listening to the interaction between science and society as well as recognizing the failures and dangers of scientific activities – the days of an automatic equation of "scientific development" with "human progress" are long past. Consequently, the education and training of scientists, which should be considered lifelong in character, must include the ethical, social and political dimensions of scientific activity.

While science is recognized as contributing to some of the problems and looming crises facing our world, this does not mean that viable solutions can leave science out of account. The design of realistic solutions must be undertaken with science, not against it. We need the contribution of science, for example, to analyse the extent to which human activities are responsible for climate change, environmental degradation and other worrying phenomena. And it is scientists and engineers who will help us to prepare for tomorrow's complex problems.

Science must be mobilized globally to address the enormous problems related to public health, agricultural productivity, environmental degradation and poverty. This will require addressing the very real disparities between the developed and developing countries when it comes to producing scientific knowledge and using this knowledge for social and economic benefit. Closing this knowledge gap will require, inter alia, finding solutions to the unceasing exodus of scientific brainpower to the rich countries of the North. Closing the scientific knowledge gap also requires North-South and South-South partnerships between scientists, institutions and governments. Science is a shared enterprise. The pace of scientific progress and the interrelations between global problems require teamwork and networking. Consequently, national and international partnership and collaboration between scientific institutions, academia, NGOs and other sectors and disciplines are essential.

World Science Day for Peace and Development is an occasion for UNESCO to reaffirm the vision of scientific research as promoting the economic, social and cultural development of nations and peoples and fostering the prospects for peace and a sustainable future. Let us all commit ourselves to working together for greater solidarity in the sharing of scientific knowledge. Without global science, there can be no sustainable development; without sustainable development, there can be no global peace.

Koïchiro Matsuura

major problems that face Arab science education are the level of access to, and the quality of, education. The problems of access are manifest in the enduring high levels of illiteracy, especially among females, in some Arab states. Many Arab states are attempting to increase access to education through a variety of programmes and strategies. This is evident from the increase in student enrolment at all educational levels in recent decades and the decrease in illiteracy among the population in general and among women more specifically. However, the illiteracy rates are still generally very high. Basic literacy is no longer sufficient. The need now is for scientifically and technologically literate individuals who can function in a global village characterized by intense competition and the rapid production of knowledge. In such a world, 'catching up' is extremely difficulty even for those who are highly educated and trained.

Even when the problems of access are addressed, a very serious problem in the Arab world is the low quality of education experienced by students at all levels. The problem of quality is manifest in outdated curricula and teaching methods, an emphasis on theoretical science education to the detriment of hands-on and practical activities, a lack of access to computers (or the use of obsolete equipment) and to the Internet, the low quality of STE programmes, a lack of teacher support to implement new teaching methodologies and the use of new technologies, and inadequate budgets to improve the quality of education. There have been many attempts to reform science curricula in the Arab world. The Arab League Educational, Cultural and Scientific Organization (ALECSO) has been instrumental in promoting S&T. As early as 1989, ALECSO published an Arab strategy for S&T. This was followed by an Arab strategy for information in the Internet age in 1999. In 1994, the Organization published a strategy for biotechnology in Arab countries and subsequently made available a reference book on the integration of subjects at the basic level of education in 1996. More recently, ALECSO published model audio-visual educational tools packages for teaching and learning in the field of renewable energies. This will be distributed to training centres in the Arab world[2] along with a number of dictionaries that are aimed at standardizing usage of S&T terminology in the Arab world.

According to Sleem (*1996*), a number of Arab states have adopted science frameworks developed by ALESCO. These curricula have the advantage of being developed by Arab experts who were in tune with the needs of Arab society. Other countries have adopted or adapted science education reform projects developed in the West to their different needs. A third group of countries has contracted Arab curriculum design specialists to develop their curricula.

Nashwan (*1993*) analysed the science curricula of eleven randomly selected Arab countries. He found that they focused on the theoretical aspects of science, neglected the applications of science in novel and everyday situations and did not develop students' abilities to use investigative, problem-solving and thinking skills. They also ignored students' interests, backgrounds and environments, paid no attention to creativity and imagination, did not attempt to address students' unacceptable beliefs in myths and superstitions and did not help them to understand their bodies and take care of their health and hygiene. Nashwan concluded that science curricula in the Arab world should not be focused solely on helping students to know scientific facts but should also assist them to apply scientific knowledge to solve everyday problems.

Similarly, Badran (*1993*) conducted a study to assess the quality of science curricula and textbooks in seven Gulf States. The results of this study indicate that the curricula did not benefit from the new technologies in teaching science and did not address social and environmental problems associated with the applications of S&T. Moreover, Badran found that the contents of school science textbooks appeared to be copied from foreign books with no emphasis on local science-related social and environmental problems or on the applications of science in technology and in everyday life. To make matters worse, the textbooks were outdated and lacked emphasis on inquiry type activities.

Science teaching in most Arab states suffers from an overemphasis on teacher-centred approaches and on pedagogies that encourage memorization. Such approaches neglect the development of critical thinking, problem-solving capability, and inquiry and investigative skills. While it is hard to find studies that have attempted to investigate the nature of science teaching across the Arab world, studies in individual countries and recommendations for change in reports on Arab education almost always reveal the need to adopt new and more student-centred teaching methods[3]. Moreover, many studies have shown that teachers do not emphasize the nature of science and that they have an inadequate understanding of it.

There has been a variety of projects to improve the quality of science teaching in Arab states. Many of these have focused attention on improving teaching methods, on developing computer literacy and on updating teachers' science content knowledge (*Abd-El-Wahed, 1996; UNESCO Regional Office for S&T, 2000*). In many cases, however, the projects have been of limited scope and duration and have suffered from the familiar problems of pre-college level teaching i.e. they were trainer- rather than learner-centred focusing on theoretical issues rather than on practical and useful classroom teaching skills. The enormous number of pre- and in-service teachers who need to be trained or re-trained and the lack of human and material support to implement their training resulted in what can be characterized as 'one-off' training experiences in which large numbers of teachers were trained together and then left to solve their own problems in the classroom.

2. For more information about this project. See http://slis.uwm.edu/alecso/Abstracts/MdlTeachpack.htm
3. Final reports of the fourth and fifth Regional Conferences of Ministers of Education and Ministers Responsible for Economic Planning in the Arab States (Abu Dhabi,1977 and Cairo, 1994).

Most of the pre- and in-service training programmes lacked the necessary follow-up mechanisms to help teachers or to investigate the impact of training and university education on teachers' classroom practice. Moreover, teachers were rarely provided with supplementary instructional materials or trained to produce such materials that are essential for teachers to implement student-centred teaching and inquiry approaches to science teaching. In short, many of the teacher-training programmes in the Arab world attempted to do worthwhile things but failed to implement them satisfactorily. Finally, there have been many attempts to implement distance learning in teacher education in a number of Arab states, e.g. Egypt. These attempts suffer from the problems that have plagued traditional teacher preparation and training approaches, namely, they were trainer- rather than teacher-centred, focused on the dissemination of information and lacked teacher follow-up and support strategies.

ICT education in the Arab World

The second half of the 20th century brought extraordinary advances in electronic technologies in general and in information technologies in particular. "*These advances have profoundly impacted the nature and practices of the scientific enterprise. Computation is becoming an increasingly crucial aspect of scientific investigation. Breakthroughs in micro- and supercomputer hardware and software design, and developments in networking capabilities are rendering the analysis, modelling, and visualization of complex systems an increasingly important component of various scientific disciplines*" (*Abd-El-Khalick, 2001*). These modern-day technologies have become an integral part of science and this has important implications for teaching science at the pre-college level.

Technology education in the Arab world, i.e., technology as an end and the use of technology in science teaching, i.e. technology as a means, are in their infancy.[4] There have been several attempts to increase access to, and the use of, technology in many Arab states. Also, Arab countries have realized that technology is not a luxury, but a necessity for catching up with, and competing in, the global economy and workplace. However, as is the case with efforts to improve teachers' skills, attempts at reform have been limited in scope, duration and impact. Many factors have contributed to this situation, the most important of which is the lack of material and human resources.

But one cannot group together all Arab states when discussing technology and its use in education. On the one hand, there are countries that have the resources to place a computer or a number of computers or any technological device in each classroom, provide access to the Internet for each student or teacher, or equip the latter with individual computers. On the other hand, there are countries where it is very hard to find one computer in the school and where the basic infrastructure required to support the introduction of technology is not available. However, even in countries where computers and other technologies and access to the Internet are available, education systems are plagued with very serious problems. These include the absence of human resources to train the huge number of teachers and students who need training and the lack of coordinated and clear strategies to implement technology education in the classroom (*Abu Shakra, 1993*). One other very serious problem is the lack of educationally and culturally appropriate software programmes, matched to the needs of Arab students and aligned with science curricula in Arab states. When considering using the Internet in the science classroom, one serious problem is that many Arab students and teachers lack the necessary language skills to 'surf' and benefit from the Internet in a meaningful way.

The way forward

What are the problems to be solved and the issues to be addressed for improving STE to fulfil the promise and confront the challenges of the twenty-first century? Teachers and students of the first few decades of the 21st century should work in school environments that are positive, supportive and demanding. These schools should implement integrated curricula that are up to date, flexible and intellectually rigorous. Teachers and students should have access to well-equipped S&T laboratories and classrooms. They should value education, S&T, be reflective and thoughtful about the advantages and disadvantages of S&T and be productive and reflective problem solvers. These characteristics are detailed hereafter:

1. The first priority remains that of building sufficient schools to enrol all school-aged students in Arab countries where this is still a problem. Government budgets and loans/grants should not be the only sources for building schools. Community and business involvement is also important for community-supported schools provide short- and long-term advantages for all the students, especially girls, and the community.
2. Increasing access to well-equipped schools should move hand-in hand with improving education by reforming teacher education programmes, providing teachers with the appropriate means to help their students, and designing and implementing up to date curricula, teaching and evaluation methods. Teachers who are not themselves scientifically and technologically literate cannot prepare students to be so. Moreover, continuous follow-up in classrooms to support teachers' work is essen-

4. There are many instances of successful use of technology in the Arab world. However, these are very limited. The aim here is to provide a general picture of the state of technology education in the Arab world. The discussion that follows is based on the author's impressions gleaned from participating in several conferences that aimed to assess the state of technology education in the Arab world, the most recent of which was a conference held in Amman, Jordan between October 20 and 21, 2001. Other conferences included the first and second scientific conference on the future of science and mathematics teaching and the needs of Arab society held in 1993 and 1996 in Lebanon and Tunisia respectively.

tial. Teachers in general, and S&T teachers in particular, should be coached and provided with enough flexibility to innovate and introduce new technologies and topics within a general national framework. What changes should take place in teacher preparation programmes in order to prepare professional teachers who can prepare their students for the future rather than for the past? A number of trends and directions need to be emphasized to approach the goal of preparing professional teachers. According to Smylie and Conyers (*1991*) teacher preparation programmes should move from:

a. a deficit-based to a competency-based approach, in which teachers' knowledge, skills and experiences are considered assets. This approach will help to shift teachers away from dependency on external sources for the solution to their problems and toward professional growth and self-reliance in instructional decision-making.
b. replication to reflection, in which practising teachers focus less on the transfer of knowledge and more on analytical and reflective learning. This reflective approach will sharpen teachers' skills in problem solving, determining students' needs and conducting action research that is designed to develop new knowledge and skills related specifically to their schools and classrooms.
c. learning individually to learning together, in which teachers learn to work cooperatively to address instructional and other school-related problems. If cooperation is vital for students, it is no less essential for teachers.
d. the conception that students' minds are empty vessels to one that encourages students to construct their own knowledge. Teachers must abandon the idea that the external learning situation including the teacher, classroom, books and experiments are the only determinants of learning and espouse the notion that students' prior ideas and learning are essential for successful teaching.
e. a teacher as a 'finished product' to a teacher as a lifelong learner. Science teachers should always be ready to learn and incorporate new knowledge and technologies into their teaching. They should be able to change in order to help their students meet the needs of a changing world.

One should not forget the important role that technology is currently playing and will continue to play in the lives of science teachers. Lifelong learning therefore should necessarily include an important role for technology.

3. Updated, flexible and rigorous curricula that emphasize thinking and problem-solving are essential if Arab students are to do well in the 21st century. S&T curricula that emphasize breadth rather than depth are inappropriate. If students are to be able to think, they need a deep and coherent knowledge base, the necessary skills along with encouragement and opportunities to use them and evaluation systems that reflect the desired outcomes. Moreover, they need the skills to reflect upon what they have learnt. From this stems the importance placed on the nature of S&T and its inclusion in the characteristics of scientifically and technologically literate individuals. Understanding the nature of S&T helps students reflect upon both, to relate them to their own lives and to realize the importance of lifelong learning.
4. Understanding the nature of science and including it in science curricula may have another advantage. Students who are religious sometimes find it hard to reconcile their religious and scientific beliefs if science is considered as the only truth. However, when science is taught as one way of knowing and understanding the natural world, students may feel less threatened by it and consequently may pursue careers in science.
5. Having access to the Internet at present requires students to master at least one language other than Arabic. Consequently, very serious efforts are needed to improve the quality of foreign language instruction at all education in schools. The emphasis needs to be on teaching scientific and technological terminology to provide students with the necessary tools to access information. This does not preclude emphasizing the learning of Arabic and trying to write science in this language. Rather, it provides students with the competitive advantage of knowing another language.
6. The popular adage that technology will improve our world and enhance competitiveness is misleading. S&T by themselves do not help people to advance. It is the serious effort that is exerted by each individual to understand and use S&T that brings about advancement, thus the importance of effort-based schools mentioned above. Additionally, the driving forces behind any important advancement are the values placed on education, S&T, and their methods. Memorizing terms, even whole science books, is useless if the methods and values of S&T as well as their limitations are not appreciated.
7. Living in a technologically and scientifically rich environment requires students to think carefully about, and reflect deeply on, the interactions of science, technology and society, the benefits and burdens of science and the ethical and moral issues associated with science and technology related problems and solutions. Integration, even partial, of school science with other curriculum subjects could be one way for students to appreciate the relationships between science, technology and society as well as the moral and ethical issues associated with them. Moreover, this integration can be instrumental in giving meaning to health and environmental concepts and the role that S&T can play in sustainable development.
8. Technology should be considered as an end by itself as well as a means or a tool for accomplishing educational and everyday tasks. Schools should therefore have technology curricula and programmes that exploit and integrate learning technologies in the teaching of all subject areas.

Finally, S&T have been traditionally considered male subjects. This bias

cannot and should not be sustained in the 21st century. Depriving women of the opportunity to fulfil their potential and aspirations is indefensible on moral as well as economic grounds. The rights of individuals to pursue their ambitions are supported by all international conventions. Moreover, squandering the productive potential of half the population may deprive nations of their competitive edge in the global economy.

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UNESCO activities in STEE

Framework for an International Implementation Scheme of the United Nations Decade of Education for Sustainable Development

(January 2005 – December 2014)

In keeping with its role as the lead agency for the implementation of the United Nations Decade of Education for Sustainable Development (DESD), January 2005 – December 2014, UNESCO is developing a Framework for the implementation of the DESD on an international scale (*v.* ***Connect****, Vol. xxviii, No.1-2, 2003*). A draft framework is now ready which UNESCO intends to share with all its potential partners: Member States,

IGOs, NGOs, specialized agencies and institutions, associations, etc., for further refinement so as to have the widest possible impact on all sections of the population worldwide.

The draft Framework comprises 3 sections: *Education for Sustainable Development; Partnership Approach to the DESD* and *Initiating the DESD* together with a preamble which briefly explains the why and wherefore of the United Nations Resolution on the DESD.

Section I, *Education for Sustainable Development,* elaborates the **nature of education for sustainable development** and clarifies its links with other major international educational processes and priorities. This serves to highlight the synergistic nature of sustainable development and education and the priority areas of poverty alleviation, gender equality, health promotion, conservation and protection of the natural resource base upon which social and economic development depends, rural transformation, human rights, peace, international understanding, cultural and linguistic diversity and the potential of ICTs.

The section is divided into 4 chapters:

1. **Meeting Millennium Development Goals:** explaining what these goals consist of and some of the means to achieve them; what has been accomplished around the world and what remains to be done
2. **Education: Making the Abstract Real:** showing that education is the primary agent of transformation towards sustainable development by increasing people's capacity to transform their visions for society into reality
3. **The Four Domains of Education for Sustainable Development:** which explains the vital role played by the following domains: Basic Education, Reorienting Existing Education Programs, Developing Public Awareness and Understanding of Sustainability and Training, in achieving sustainable development
4. **Linking DESD to other International Educational Priorities:** which outlines the links that DESD has with other international initiatives and notably those concerning education for which UNESCO is also the lead agency
5. **Key Themes in Education for Sustainable Development:** which lists, with explanations, the most important themes such as Overcoming Poverty; Gender Equality; Health Promotion; Environmental Conservation and Protection; Rural Transformation; Sustainable Production and Consumption and Intercultural Understanding and Peace that need to be dealt with in order to achieve sustainable development.

Section II, *Partnership Approach to the DESD,* describes a partnership approach to the development of a draft international implementation scheme for the DESD. It identifies a range of partners at the sub-national, national, regional and international levels who will need to be involved to ensure the successful implementation of Decade activities, underlining the fact that these activities have maximum impact upon education policy, programmes and practice around the world. It also outlines a range of possible strategies for enhancing participation, ownership and commitment by partners in the Decade. Emphasis is placed upon supporting initiatives at the local level and ensuring that structures at the national, regional and international level provide direction and guidance for local initiatives. The section comprises the following chapters:

(i) **Partners,** which defines the potential partners at the vertical (from local to international) level as well as the horizontal (governmental and non-governmental to private)

(ii) **Principles for Developing Partnerships,** which explains the reasons for considering vision; demonstration activities and networking as the three key principles designed to build participation, ownership and commitment to catalyse momentum for the DESD

(iii) **Community-based Processes,** including associations, school support groups, cooperatives, development committees, volunteer groups, etc., working at different levels individually or in cooperation with other groups, institutions or organisations

(iv) **National, Provincial and Local Government Processes,** illustrating the various ways in which government departments at various levels can provide both input and leadership

(v) **Regional Processes,** describing the role of the actors at the sub-regional and regional levels and ways in which they can contribute individually or in groups to the DESD

(vi) **International Processes,** which lists the existing international fora already engaged on the DESD and explains their modus operandi

(vii) **Monitoring,** which explains the rationale of the monitoring process

(viii) **Communication and Advocacy,** which sets out the work that UNESCO will accomplish in the area of communication and marketing by the beginning of the DESD in January 2005.

The concluding Section III, *Initiating the DESD*, sets out UNESCO's proposed schedule of activities aimed at catalyzing world society in preparation for the DESD over the period July 2003 – December 2005. They are organized under two heads:

(i) communication and advocacy, and

(ii) building momentum and support.

The full text of the Framework can be downloaded from UNESCO's website: <http://www.unesco.org/education/esd>

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Regional Workshops on Science & Technology Education (STE)

Following the recommendations of the Budapest World Conference on Science (1999), the Dakar World Forum (2000) and the Goa International Conference on Science, Technology and Mathematics Education (2001), UNESCO's Science and Technology Education Section organised a Consultation Meeting of STE experts from around the world and UNESCO regional specialists in Paris, September 2002. The objective of this meeting was to provide a regional orientation for UNESCO's STE programme in the coming years, as promoting exchange of ideas and experiences among its Member States for mutual benefit is one of UNESCO's major goals.

Following the recommendations made at the Paris meeting, the Science and Technology Education Section, in cooperation with its relevant regional offices, decided to hold four regional workshops for the Arab States (Beirut, Lebanon, 20-22 May 2003); for Latin America and the Caribbean (Santiago, Chile, 1-4 July 2003); for Africa (Windhoek, Namibia, 28- 30 July 2003); and for the Asia-Pacific (Tokyo, Japan, 20-24 October 2003*). Each workshop focused on the specific needs and priorities of the concerned region and the participants were called upon to make recommendations both for UNESCO as well as the regional actors in order to develop a joint strategy for the improvement of STE in the region.

The recommendations will eventually be compiled and disseminated among all UNESCO Member States of the region as well as outside the region in order to promote synergies and foster inter-regional/international collaboration among Member States.

Evaluation of Educational Curricula for the use of Model Activities in Science and Technology Education in the Arab States,

Beirut, Lebanon, 20-22 May 2003.

This Regional Workshop for the Arab States was organized by the UNESCO Regional Office for Education in the Arab States/Beirut, in collaboration with the UNESCO Regional Office for Science and Technology/Cairo and the Science and Technology Education Section, UNESCO/ Paris. Besides being part of UNESCO's science and technology education (STE) programme for the Arab States for 2002-2003, the workshop was also meant as a follow-up of work of the previous biennium in the region, in particular the development of educational materials on STE/STL (Project 2000+).

It was attended by 36 specialists and experts in science and technology education from 8 Member States*, UNESCO (Beirut and Cairo Offices), UNRWA and the Arab Bureau for Education in the Arab States (ABEGS) as well as local representatives from private educational institutions and publishers.

The Organizing Committee had also arranged for the participants to attend the Seventh Annual Conference for Science and Mathematics Teachers, organized by the Science and Mathematics Education Centre (SMEC) at the American University of Beirut (see below).

The main objectives of the workshop were:

1. To promote use of model activities and projects in the continuous training of teachers in STE
2. To enhance use of model activities and projects in teaching and learning at all levels (basic and secondary education)
3. To reinforce capacities of specialists and teachers in the Arab countries in the diversification of projects and education practices for sustainable development through efficient utilization of teaching/ learning resources
4. To develop the capacities of specialists and teachers in the Arab States region in environmental protection and to improve exploitation of educational areas (schools, environment, society)
5. To benefit from new information and communication technologies (ICT) in science and technology education.

Inquiry education and cooperation education were two methods used in the workshop programme to assist in the capacity building and knowledge sharing of specialists in STE. Arab States members of INGOSTE (International Network of Governmental Officers in Science and Technology Education) were active participants in the workshop. They highlighted the need for all Arab countries to nominate representatives in the Network. The agenda of the workshop included presentations, discussions and group work. All country representatives made presentations of their national

* A report on this workshop will be published in the next issue of ***Connect.***

* Bahrain, Egypt, Jordan, Lebanon, Oman, Saudi Arabia, Syria, Tunisia, Palestinian Authority

experience in the subject whereas representatives from organizations (UNESCO, UNRWA and ABEGS) presented the regional and international context for the development of STE in the Arab States region.

Participants were then divided into three groups corresponding to three levels of education: basic, secondary and continuing education and training. They were asked to evaluate and develop new educational materials related to STE at each of the three levels. Each group identified areas of strength within the educational materials, characteristics of innovative models/projects and evaluation mechanisms.

Group A: worked on evaluating and improving STE activities and projects in basic education. The group highlighted advantages and disadvantages of the activities and projects suggested for this level and presented characteristics of model activities as well as ideas for improving collaboration among the countries involved in the projects.

Group B: focused on evaluating and improving STE activities and projects at the secondary level. It underlined the advantages of the suggested activities and outlined the characteristics of model activities in secondary education.

Group C: dwelt on evaluating and improving the continuous training of teachers of science and technologies. The group also specified the advantages and disadvantages of the suggested activities and made suggestions regarding the training programme and strategies for selection of trainers and training.

In the light of the working papers and reports presented by the countries and the ensuing discussions, the participants made the following recommendations in relation to STE/STL materials in the education curricula:

1. To reinforce educational strategies of the Arab States countries in order to improve science and technology teaching/learning at all levels of education, continuous training of teachers and sharing of experiences
2. To emphasize the strong bonds that exist between science and technology as well as the mutual influence of the one on the other and furthermore recognize their influence on the learner, the society at large, the environment and sustainable development
3. To encourage Arab States countries that are not members of the INGOSTE to send representatives to participate in this network
4. To establish a communication network via internet concerning STE activities and projects
5. To establish national or regional teams of experts and specialists in charge of planning, supervision and evaluation of practices in STE for mutual benefit (with the possible support of UNESCO)
6. To incite national UNESCO teams to collect activity models and projects applied and improved in the Arab States countries and send them to the Regional Office for wider distribution to all concerned
7. To prepare a workshop in order to establish Arab States standards to design and plan the curriculum of sciences and technology in the light of international standards
8. To establish an STE database for experts and specialists

At the end of the workshop participants were given an opportunity to reflect on the administrative and technical programme of the workshop by means of evaluation forms. Most of the participants evaluated the workshop positively, though they judged that certain areas need improvement within the STE/STL programme, such as: the number of training workshops on the issues of STE development, which were too scare; the training period (3 days), which was too short; and opportunities for science and technology teachers to benefit from such training courses, which were not enough.

A more in-depth analysis of the evaluation forms is featured in the Arabic version of the report.

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STE for Latin America and the Caribbean

Santiago, Chile, 1-4 July 2003

This regional experts meeting was organised by UNESCO/Santiago in the framework of UNESCO's Science and Technology Education (STE) programme.

The Latin America and Caribbean region is characterised by great diversity both on the socio-economic as well as the educational front. STE, which is recognized as essential in order to live and compete successfully in today's world, is limited to a small privileged fringe of society. A 'democratisation' of STE is thus necessary if all levels of the population are to possess the knowledge and skills that can allow them to make the right choices and decisions in their daily life best suited to their advancement in society. Not only from the educational but also the ethical point of view, the primary focus of STE in the region should be on ensuring scientific and technological literacy for all.

Thus, this meeting was also placed within the framework of the new Regional Project for Education in the Latin America and Caribbean Region (PRELAC) (*v.* ***Connect,*** *vol. XXVII, No. 2002*). Its guiding principle was to develop a regional agenda capable of ensuring quality science education for all.

The meeting was inaugurated by Mr Segio Bitar, the Chilean Minister of Education, and counted on the presence of several high representatives from Ministries of Education of the region together with regional experts on STE. The following countries were represented at the meeting: Argentina, Bolivia, Chile, Colombia, Cuba, Dominican Republic, El Salvador, Guatemala, Panama, Paraguay, Peru, Uruguay and Venezuela.

The workshop revolved around the following major themes:

- Major problems encountered in quality and equity focused STE
- The place of scientific literacy and science for all in compulsory education
- Needs and challenges in science teacher training
- Good practices
- Associated educational institutes

The objectives of the meeting were to:

- Analyse and evaluate changes that have taken place in the past five years in STE planning and curricula and their impact on quality and equity in the education of children, adolescents and youths of the region
- Evaluate the extent to which scientific training for all is guaranteed in the region and how to achieve this effectively
- Analyse the propositions of regional experts that can contribute to a significant change in STE in the region
- Define a regional agenda and commitment on the part of nations to develop national agendas

After four days of intense discussions in plenary sessions as well as working groups, the participants arrived at the following general conclusions:

- UNESCO has a major role to play in filling lacunae, promoting equality and ensuring scientific literacy and quality science education for all for fostering a culture of peace
- Recognizing the diversity of the Latin American region as well as the right of the various populations to autonomy, stress should be laid upon promoting the rights of all populations and UNESCO should support actions related to quality science education for all in the interests of peace
- In the framework of the science education programme, it is hoped that horizontal cooperation will be strengthened among states, among international organisations – particularly the Convenio Andres Bello - represented in this meeting and likewise among governments, agencies and institutions of the region. It is also hoped that the network that has been constituted will play a leading role in this work.

Recommendations made by the participants were centred on the following five areas:

1. **Teacher training for basic and secondary level science teachers:** in which they were grouped under Pre- and in-service training; training institutes and their status; teacher trainers; and continuing training.
2. **Curriculum and contents:** with analysis of content and curricular organisation; determination of content and conditions for achieving equality.
3. **Research:** focusing on promoting research on STE as well as training of researchers; integration of teachers in research; identification and articulation of as well as support for research groups.
4. **Scientific literacy:** relating to promotion of non-formal STE activities as well as the Science-Technology-Society-Environment relationship; role of communication; interaction between scientists and the public
5. **National focal points:** dealing with the necessity of a focal point within each Ministry of Education and the specific duties assigned to him/her.

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Partnerships to enhance Science and Technology Education in Southern Africa

Windhoek, Namibia, July 28-30 July 2003

This regional workshop for Southern Africa was organized by UNESCO/Windhoek in collaboration with the Namibia National Chamber of Commerce in the framework UNESCO's Science and Technology Education Programme in order to identify regional trends and priorities, facilitate regional partnerships and networking in STE as well as to develop proposals on UNESCO's' intervention in the region. The workshop was attended by 45 representatives from eight countries of the SADC (Southern African Development Community) region: Angola, Botswana, Lesotho, Malawi, Namibia, South Africa, Swaziland and Zimbabwe. Each national delegation included at least one representative from the Ministry of Education and one from the private sector. The aim of the workshop was to explore ways in which Private-Public Partnerships (PPP) and regional networking can improve the quality and quantity of STE at secondary level in order to respond to the needs of the growing economies of the participating countries.

The rationale of the workshop was that a continuous and vivid dialogue between education providers and potential employers is imperative in order to adapt STE contents to the demands of the world of work, as well as to match demand and supply for science education at policy level. Such a

dialogue should further remind the employing sector of its responsibility and its direct interest in investing and supporting an education that responds to its needs of skilled labour in the field of science and technology.

The specific objectives of the workshop were to:

- explore the potential and possibilities of partnerships to contribute to the enhancement and relevance of STE in the region
- arrive at an increased understanding of the demands the private sector and industries put on an STE which enables students to confront the challenges of the world of work
- identify barriers between formal/non-formal education and the world of work together with possible strategies to overcome them
- develop concrete proposals for partnerships between the private sector, NGOs and Governments to promote quality STE
- develop pilot projects for possible extra budgetary funding to be implemented in partnership with UNESCO.

At the workshop all stakeholders agreed that investment in STE is vital for economic and social development and that in order to improve STE in the region, both the public and the private sectors need to coordinate efforts and invest resources.

The private sector pleaded for a change from a supply driven education to a more demand driven one, the need for clear partnership frameworks and priorities, the necessity to be involved in curriculum development and other planning aspects of education and tax incentives.

The public sector called upon industries and businesses to invest in formal and in particular non formal STE, to provide expertise, to engage in exchange programmes and bursary schemes as well as to establish funds and support the establishment of centres of excellence.

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UNESCO STEE Activities in the Arab States

Seventh Annual Science and Math Teachers' Conference (SMEC VII)

Beirut, Lebanon, 23-24 May 2003

This international conference was organised by the Science and Math Education Center of the American University of Beirut (AUB) and supported by UNESCO/Cairo.

The SMEC conference is an annual event designed to promote the continued development of a professional community of science and mathematics (SM) teachers across Lebanon and the surrounding region. The specific aims of the conference are to:

- Provide an intellectual and professional forum for teachers to exchange theoretical and practical views on SM teaching/learning at the elementary, intermediate and secondary levels
- Provide a forum for teacher educators and researchers to share their findings with SM teachers with special emphasis on the practical classroom implications of their findings
- Provide an opportunity for SM teachers to interact with high calibre SM education specialists from abroad
- Contribute to the ongoing development of a professional culture of SM teaching at the school level in Lebanon and the surrounding region
- Raise awareness of SM teachers about the array of curriculum and supplemental classroom materials available to them through publishers and local distributors

The SMEC VII 2003 was attended by over 570 participants from the following Arab States: Bahrain, Egypt, Iraq, Jordan, Oman, Palestine, Saudi Arabia, Syria, Tunisia and United Arab Emirates as well as Iran, U.K. and U.S.A.

The main objective of this conference was the professional development of SM teachers, which is also one of UNESCO's priorities.

The major themes of the conference were:

- specialised ways of using language in teaching science and mathematics
- critical thinking in math and science
- implications of research in science and math education including ways for teachers to engage in research

The work of the conference was organised notably in plenary sessions, workshops, research presentations, practical interactive sessions, idea exchange sessions as well as a Publishers' Exhibition. All sessions and workshops were classified according to level: Pre-school, Elementary, Intermediate, Secondary, Advanced; with an indication of the main subject matter treated, such as math, science, science & technology, ICT, Chemistry, Biology or Earth Sciences.

The highlights of the conference were the keynote presentations: "*How to teach science and remain sane*" by Dr M. Stirrup and "*What's happening in elementary math classrooms around Lebanon: preliminary results from the MARA projec*t" by Dr M. Henningson. Dr G. Gholam and Dr. W. Ebeid pre-

sented a paper on "*Paradigm shift in mathematics education within the context of globalisation*" in an interactive session which was attended by more than 200 math teachers, inspectors and university professors.

The Proceedings of the conference are due to be published by UNESCO/Cairo.

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Experts Meeting on the Adaptation of the UNESCO Resource Kit on STE for the Arab states

UNESCO/Beirut and UNESCO/Amman are in the process of organizing an Experts Meeting on the adaptation of the UNESCO Resource Kit on Science and Technology Education for the Twenty First Century (*v.* ***Connect,*** *vol. xxiv, no. 4, 1999*) for the Arab States. The kit has already been translated into Arabic by the Directorate of Curricula at the Ministry of Education, Jordan.

The meeting, which will consist of 20 professionals from 10 Arab countries, UNESCO, UNRWA, ABEGS (Arab Bureau of Education for the Gulf States), and King Hussein Foundation – Jordan, will allow experts to reflect upon and suggest – if need be - modifications for the translated modules. It will also serve to consider practical aspects such as layout, printing and dissemination of the kit in the Arab States region. The adapted kit is expected to help teachers and curriculum specialists of the Arab States in teaching/learning of science and technology subjects in-school and out-of-school.

The meeting will also help to encourage non formal learners and NGOs to adopt the modules in their educational curricula. Follow-up activities in the form of training workshops on the kit for teachers and curriculum specialists will be arranged during 2004 – 2005.

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UNESCO Activities in the Asia-Pacific Region

National Workshop on Best Practices in Science and Mathematics

Quezon City, Philippines, 4-8 August 2003

This national workshop was organized by the National Institute for Science and Mathematics Education Development (NISMED) and supported by UNESCO Asia and Pacific Regional Bureau for Education, Bangkok.

The aim of the workshop was to build capacities of elementary and high school teachers in the documentation of exemplary science and mathematics teaching in the classroom.

Its rationale was that despite the work done for the last 40 years by the University of the Philippines National Institute for Science and Mathematics Education Development (UP NISMED) in developing and publishing curriculum materials – both print and non print – on teaching or facilitating the teaching of science and mathematics at the elementary and the secondary school levels, there is no material on best practices in classroom teaching. This lacuna is all the more regrettable that NISMED professionals have noted exemplary strategies and practices both in classrooms and in informal talks with teachers. These exemplary practices could be produced in print, video or electronic forms and disseminated to would-be teachers and teacher trainers, including faculties of teacher-training institutions. They could also serve potential users for adoption or adaptation in the context of their own teaching situations. Ultimately, they would be a valuable tool for other teachers as they give excellent insight into how science and mathematics teachers facilitate meaningful learning activities.

Ten science and mathematics teachers were invited to the workshop based on the following criteria:

a. recipient of a national/regional/division award in teaching in the last 10-15 years
b. effective practicing teacher recommended by either Supervisor or Principal or a teacher colleague
c. observed in the classroom by a UP NISMED staff member

The recommended participants were required to submit a 3-page description of the "*best practice*" together with an accompanying lesson/teaching plan and/or study activity. The "*best classroom practice*" features included: interactive and possibly integrated teaching strategies; assessment strategies; philosophy of science/mathematics teaching; examples of student work from the featured classroom; teacher's reflections on their classroom instruction; and a specialist commentary.

As follow-up, it is planned to organize an international conference on best practices in science and mathematics in 2004, hosted by the national institute.

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Mobile Training Team on Curriculum Reform in Science and Technology Education for Laos PDR and Cambodia

3-15 August 2003

In the framework of the Asia Pacific Programme of Education Innovation for Development (APEID), UNESCO/ Bangkok, and with funding from the Japanese Funds-in-Trust (JFIT), a Mobile Training Team (MTT) on Curriculum Reform in Science and Technology Education was organized from 3-15 August 2003. The MTT comprised two members from each of the Curriculum Development Centers of the Ministry of Education of Lao PDR and of Cambodia.

The four members of the MTT visited institutions in the Philippines and Malaysia with the objective of studying authentic experiences in innovative policies, practices and strategies on curriculum reform in science and technology in the host institution as well as its institutional partners. Concurrently, a UNESCO/Bangkok funded National Writing Workshop on Best Practices in Teaching and Learning Science and Mathematics, was held in the Philippines, in some of whose sessions MTT members participated. In Malaysia, they visited the Curriculum Development Center, some Smart Schools and the Technology Education Center in Kuala Lumpur and the Southeast Asia Regional Centre for Education in Science and Mathematics (SEAMEO-RECSAM) in Penang.

In the Philippines, the MTT members were given a comprehensive orientation on curriculum development in science and mathematics education (SME) in the Philippines: *Spanning 40 Years of Curriculum Development,* which features the development of three generations of textbooks by NISMED. The first generation textbooks (published from the late '60s to early '70s) were influenced by curriculum innovations in the US which stressed scientific inquiry. The second (early '80s) were oriented towards the applications of science and mathematics in real life, with emphasis on the environment. The third (late '80s to early '90s) focused on the interaction of science, technology and society together with problem solving.

Along with textbooks and guides, efforts in curriculum materials development in the '90s were expanded to other print formats, like science readers for children, self-learning modules for students and resource materials for teachers. The Institute also started developing video and microcomputer lessons together with visual aids and low-cost equipment to support its practical work approach. The development of a series of teacher resource materials, both print and non print, was the major activity of science and mathematics curriculum reform in the Philippines from 1993 to early 2000. These were prepared in conjunction with foreign-funded projects, the Philippines-Australia Science and Mathematics Education project and the Science and Mathematics Education Manpower Development Project (SMEMDP) supported by JICA. With the changing trends in SME worldwide and the privatization of textbooks in the Philippines, the NISMED started to develop in 1991 a thematic curriculum from Grades 1 to 8. Labelled "*Curriculum for the 21st Century*" or CD 21, it has a learner-centred approach and an integrated content. The latter focuses on a societal context to allow in-depth development of concepts, skills, and desirable attitudes useful for building a better future. Still in the development stage, the spiral curriculum from elementary to high school aims to develop Scientific and Technological Literacy for All, in line with UNESCO's thrust of STL/STE for All.

In Malaysia, orientation briefings were given on the Education Reform for Malaysia, Vision 2020, including the Smart Schools Development and the role of ICT in promoting quality education for all. The training of science and mathematics teachers from the region, and specifically from Cambodia and Laos PDR, at SEAMEO RECSAM was also observed and discussed.

These study visits will be followed up in the respective countries with national workshops by the end of the year, to share experiences from the study visits and to demonstrate hands-on SME reforms. Funding for the national workshops will also be provided by the JFIT grant for the MTT and with complimentary support from the UNESCO/Phnom Penh and UNESCO/ Bangkok.

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UNESCO APEID Regional Seminar on Environmental Education

Tokyo, Japan, 18-20 March 2003.

The UNESCO APEID Japan Seminar on Environmental Education was hosted by the Tokyo Gakugei University under the sponsorship of the Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT) and the Japanese National Commission for UNESCO.

The seminar theme was "Environmental Education and Sustainable Development," and it was organized within the framework of the 7th Programming Cycle of the APEID, UNESCO/Bangkok. Fourteen countries were represented at this seminar along with UNESCO/Bangkok: Australia, People's Republic of China, Fiji, India, Indonesia, Japan, Malaysia, Nepal, New Zealand, Philippines, Republic of Korea, Thailand and South Africa.

The participants shared experiences in educational programmes/activities on the global challenge of sustainable development and critically reviewed the concept of environmental education (EE) and education for sustainable development (ESD). They also discussed the future direction of EE in the Asia and Pacific region. At the symposium held on the 3rd day, in view of the UN Decade of Education for Sustainable Development (2005- 2014), several presentations were made by panellists exposing different viewpoints on ESD which were followed by debates.

Japanese interest in the celebration of the "Decade of Education for Sustainable Development" was catalyzed by the Japanese Prime Minister, H.E. Junichiro Koizumi's statement at the Johannesburg World Summit on Sustainable Development: "*my government, together with Japanese non-governmental organizations, has proposed that the United Nations declare a Decade of Education for Sustainable Development*". He also said that the Japanese government would provide no less than 250 billion yen in education assistance to developing countries over a five-year period as Japan attaches paramount importance to education on the basis of development and wants to share with the rest of the world Asian experiences in lessons learned especially in the area of cooperation on environment-related capacity building.

The 2004 UNESCO APEID Japan EE Seminar will be organized by the Environmental Education Center, Miyagi University of Education.

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UNESCO Activities in Latin America and the Caribbean

"Education, Science and Technology as Strategies for National Development"

Brasilia, Brazil (22-23 September 2003)

Buenos Aires, Argentina (25-26 September 2003)

This Seminar, to be held successively in the two capital cities of Brazil and Argentina, was organised by UNESCO/Brasilia in collaboration with UNESCO/IBE, UNESCO/IIPE (Buenos Aires), the Brazilian Ministries of Education and Science & Technology, the Argentinean Ministry of Education as well as the Santillana Foundation and the Roberto Marinho Foundation.

The objective of the seminar was to allow high level personnel, at the national and provincial level, from Argentinean and Brazilian Ministries to gain an understanding of the historical processes that have allowed some East Asian and European countries to substantially develop their Education and Science & Technology frameworks over the last 30 years. In this context, special attention was given to the specificities of the national systems of the selected countries, including their

performance as rated in the UNESCO/OECD report *Further Results from PISA 2000.*

Additionally, Brazilian and Argentinean authorities manifested their interest in getting access to internationally transferable lessons from these countries particularly on policies related to the following issues:

- Effective functional literacy
- Initial and continuing teacher training and compensation policies
- Evaluation and accountability policies and strategies
- Financing strategies at system and school levels
- School input policies, particularly in instructional materials
- Macro and micro level management

World renowned specialists from Finland, Ireland, Malaysia, South Korea and UK were invited as keynote speakers to share their national experiences with the Brazilian and Argentinean authorities and experts. Several Federal Ministers were also invited to serve as panellists.

The work of the seminar consisted in the presentations of the international speakers who shared their national experiences on overcoming educational challenges in their specific countries in the recent years. The presentations were followed by debates with national specialists on how bottlenecks for broad national development can be overcome by sound investment in education, science and technology.

The seminar was attended by over 60 participants consisting of top managers of the Ministries of Education and Science & Technology of the two host countries together with several State or Provincial Secretaries of Education and Science & Technology. Besides this core group, intellectuals and senior officers from the federal administration also participated.

The event attracted considerable attention from the media and is expected to lead up to a number of developments related to the themes of the seminar.

The proceedings of the seminar, containing the contributions of the international participants together with the outcomes reviewed and commented by the rapporteur, will be published in Portuguese, Spanish and English.

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STEE Activites Worldwide

Science and Technology Education in the Republic of Paraguay

For the Republic of Paraguay, the last decade of the 20th Century was marked by important changes in education, notably due to the setting up of the strategic plan for educational reform. The plan was initiated in 1993 with the aim of transforming the entire national educational system.

In 1995, with the technical support of experts from Harvard University, USA, a Policy Dialogue Group was established in order to implement the educational reform in collaboration with different sectors of society. The following year the Ministry of Education and Culture presented its project in a document entitled "The educational challenge: A proposition for dialogue on educational opportunities in Paraguay".

Concerning the incorporation of science and technology (S&T) in the educational reform, international cooperation has been vital in the matter of logistics and organisation. It has also proved fundamental for implementation at the technical and curricular level.

Improvement of the administrative infrastructure of educational institutions has included:

- Construction of class rooms
- Enlarging and rehabilitating school areas
- Installation of equipment in informatics in order to improve school management
- Installation of laboratories for science students
- Creation and updating of libraries for the use of communities as knowledge base

It has also included training and capacity building of teachers in educational technology as instruments for updating teachers' knowledge base and as pedagogical resource to improve their performance.

In 1997, after almost a decade of discussion among the different institutions and actors involved (ministries, universities, professionals, representatives of industries, research institutions and the national Congress) a big step forward was taken with the creation of a legal framework for S&T which led to the establishment of CONACYT (National Council of Science and Technology) and FONACYT (National Fund for Science and Technology). The principal objective of the CONACYT is to direct, coordinate and evaluate activities of the national systems of S&T with due regard to quality.

In the framework of the national strategy for S&T, a project on the integration of information and communication technologies in the national educational system has been developed for implementation from the coming year. Known as the TIC (Tecnologías de la información y communicación), the project aims to develop teachers' operational and pedagogical capacities for the effective use of technology as a fundamental resource for use of multimedia in the classroom as well as for updating their professional capacity.

Currently, Paraguay is increasingly faced with the digital divide. S&T is the basis of a new means of marginalisa-

tion in the society between the few who can accede to it and the majority who cannot. Although the private sector has the means to utilise S&T as a tool for modernisation and innovation, the public sector is faced with the lack of technological support added to that of specialised human resources. Furthermore, S&T continues to be limited to the urban sphere. All those living out of this sphere are either marginalized or live on the periphery of the knowledge society.

The challenge of making a quality education available to the entire population also implies facilitating access of the majority to modern technology. It means installing and strengthening regional networks of teachers, researchers, government servants who can coordinate joint actions that help confront common educational issues. At the academic level, it implies bridging the gap between curricular content and the world of work. It also means seeking strategic alliances with national and international institutions, industries and NGOs in order to reduce the digital and technological gulf that separates the most vulnerable sectors of society. Paraguay, like other Latin American countries, is strongly impacted – whether positively or negatively - by the transformations generated by scientific and technological progress and in this "global village" education continues to be the fundamental factor for the economic, social, cultural and political development of the people.

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Science and Technology Education in Peru

In Peru, as in any other country, STE represents a major challenge in the building of human resources that are essential for development. An integral and systemic educational programme that includes an STE adapted to an age of information and knowledge is a crying necessity. In Peru, lack of educational research accentuated by the closure of the National Institute of Educational Research and Development (INIDE) has slowed down the incorporation of educational advances made in science and diminished enthusiasm for reading. Furthermore, the closure in 1993 of the Science Museum (the first of its kind in Latin America which opened in 1979) has retarded science popularisation in the country.

Currently, the Ministry of Education and the National Council of Science and Technology (CONCYTEC) are working jointly to innovate the educational system. Thus, a Programme for the Popularisation of Science, Technology and Innovation (CTeI) has been approved in the context of the 20th State Policy of National Agreement concerning S&T development whose objective is "to promote at all levels of the population, particularly among children and youths, creativity, logic and critical reasoning, regard for Nature and positive insertion in the society of knowledge and information". In this context, the Draft Project of the General Law on the Promotion of Science and Technology for National Development, spells out the strategy of the CONCYTEC in the following terms: *Promotion, dissemination, divulgation and interchange in CTeI from the school level to the industry, including museums, fairs, national awards; identification and promotion of talent and adoption of continuing research and innovation.*

The aim of the strategy is to contribute to :

- setting up an integrated and systemic educational project in line with the national needs and progress made in S&T knowledge
- strengthening capacity building of national decision makers and research workers in S&T following research priorities
- fostering scientific and technological literacy in the Peruvian population

Strengthening capacity building in S&T for a more equitable participation of the population in the knowledge society, one of UNESCO's strategic objectives, is undoubtedly highly meritorious. However, it requires on the part of its Member States the commitment to promote and sustain projects and activities based on the best national and international practices in order to yield tangible results and qualitative improvement. To attain this goal, it is vital to promote STE at all levels. In order that nations progress, it is essential to undertake a number of actions such as capacity building of teachers and research workers, identification and promotion of decision makers in S&T, establishment of links between academia and industry, promoting S&T literacy among the population and ensuring the support of political leaders.

Thus, the main actions of the CONCYTEC are directed towards capacity building of experts in S&T with the objective of creating multidisciplinary teams in order to link up the work of scientists and teachers. In this context, agreements are being processed with universities for capacity building in content and pedagogy of experimental sciences. Three networks have been launched: the National Network of Science Clubs, the Network of Science Teachers and the National Network of Science Journalists. Finally, reconstruction and modernisation of the Science and Technology Museum, which had been closed for the past decade, has been undertaken – a long postponed debt to the Peruvian society.

In the framework of the World Science Day for Peace & Development (*v.* ***Connect,*** *vol.xxvii, no.3-4, 2002*), a National Science & Technology Festival, 6-8 November 2003, is being organised by the Peruvian National Council for Science and Technology (CONCYTEC), in collaboration with the Ministry of Education, the National Assembly of Rectors (ANR), the Direc-

tors of Public and Private Research Institutes as well as specialised Technological Institutes, Industrial societies, Forum of Technological Innovation and diverse NGOs.

The festival aims to assemble the entire chain of actors involved in scientific knowledge, from school children and university students to research projects, industries and specialised institutes, not forgetting the general public. It includes visits to research institutes in order to promote exchange of information between research workers and the public, as well as cultural and artistic events demonstrating the links between art and science in order to better sensitise the public to the importance of S&T. It is also an occasion to reflect upon the role of the public in the production and use of scientific and technological knowledge, as underlined in the Regional Meeting on STE in Latin America and the Caribbean, Santiago, July 2003 (see above).

The major objectives of this festival are to:

- reiterate the national and international commitment for promoting science for peace and development based upon the responsible use of science for the benefit of society, and more particularly for human security and eradication of poverty
- raise awareness in the public of the importance of science and fill up the existing breach between science and society

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Focusing Families on Science
USA

"***Science. It's Everywhere***" is the title of a new public awareness initiative of the Partnership for Science Literacy launched by the American Association for the Advancement of Science (AAAS) through a National Science Foundation grant to Project 2061. The message of this initiative is that science is all around us and a good science education can help give children a great foundation for success in life. It aims to increase awareness among parents and families – particularly those in Latino/Hispanic, African American and other minority communities – of the value of science literacy for all children. The initiative invites parents to make a difference in their children's science education by doing science activities around their home, exploring science centres and activities in their community and making sure there is quality science in their schools.

"*Science. It's everywhere*" combines grassroots efforts with a national multimedia campaign. Regional kick-off events hosted by local science centres took place in May and June in five diverse communities across the country: Los Angeles, California; Chicago, Illinois; Tampa, Florida; Lehigh Valley, Pennsylvania; and Austin, Texas. A free Family Guide to Science booklet presents useful information and hints on science activities for parents and families. The initiative's Website < www.Science Everywhere.org > is hosted by TryScience.org (see below) and provides additional information about science education along with links to electronic science resources for children and adults. The Partnership for Science Literacy draws on the expertise of Project 2061 and the AAAS Directorate for Education and Human Resources. The Partnership is building a coalition of local and national organisations to empower families to improve their children's interest in and learning of science.

For further information contact:
AAAS/Project 2061,
1200 New York Avenue, NW,
Washington DC 20005, USA.
E-mail: project2061@aaas.org
http: //www.project2061.org

TryScience

USA

(Http:// www.TryScience.org)

TryScience is a gateway to experience the excitement of contemporary science and technology through on and offline interactivity with science and technology centres worldwide. It believes that science is not only exciting, it is for everyone and that is why all are invited by *TryScience* and over 400 science centres worldwide to investigate, discover and try science themselves.

TryScience has been put up through a partnership between IBM Corporation, the New York Hall of Science (NYHOS), the Association of Science-Technology Centers (ASTC) and science centres worldwide.

New interactive content is added regularly to these areas:

Adventure: Thematic interactive experience
Experiments: Hands-on (offline) activities with an online component
Field Trips: Interactive science centre features, plus a science centre locator
Curious?: Short polls and activities based on a hot topic question, plus related news links
Live Cams: Live views from webcams at science and technology centres worldwide

MONDAYS of DISCOVERY

Discovering Science-in-the-Making at the CERN Geneva, Switzerland

Since May 2003, the CERN (European Organisation for Nuclear Research) has launched a new series of encounters called Mondays of Discovery to promote science and technology (S&T) for all.

The objective of this enterprise is to allow the public a hands-on experience of S&T, to discuss and exchange views directly with researchers in order to improve public understanding of science and technology. For the public is quite unaware that whether in physics, medicine, astronomy, micro-electronics…or other branches of S&T, CERN conducts research and develops and utilises its applications in ways that are sometimes unique and often spectacular.

CERN has since long been opening out to the public. Since 15 years a permanent exhibition, the Microcosm, is stationed at its site in Meyrin, Switzerland. Organised visits to this site where a number of scientists work, attract around 30,000 visitors from 42 nations annually. Since 4 years, Microcosm is being increasingly adapted to suit families and +12 yr old school children. Now, with the Mondays of Discovery, which with its hands-on approach to science is meant to remove barriers between specialists and the general public, CERN is rounding off its range of educational activities.

It has been possible to take up this challenge thanks to the goodwill and commitment of scientists. The first Monday of each month, the public is invited to discover the startling aspects of technologies developed by CERN through novel experiments. In this way, CERN opens to the public a window on the world of fundamental research, serving at the same time to demystify the work carried out in the world's biggest centre of particle physics.

Each Monday of Discovery will serve to reveal a different facet of the laboratory. Far removed from specialised conferences or key-note speeches, the aim of this exercise is to present science as alive and approachable through a veritable exchange with the public accompanied by demonstrations and experiments. Young or old, ignorant or knowledgeable, each one will be able to satisfy her/her curiosity through workshops where one can observe, touch - and even consume!

This programme was launched on 5 May 2003, the topic of the day being 'Cold', as CERN is constructing its future accelerator of particles (a 27 km long ring), which will be cooled to a temperature close to absolute zero (around -271ºC). Other topics treated in the following months:

- Examining matter through ultrasounds and electron microscopes
- Small scale astronomy: the first moments of the universe
- Crystals for medicine: heavy as lead and transparent as glass
- Perfect alignment – geometricians' tools
- The future Web – a planetary calculator
- Chips for listening – electronics to hear the sound of matter

Entry to Mondays of Discovery is free of charge. The sessions take place from 19:30 – 21:00 at the Microcosm Exhibition at Meyrin.

Further information from:
James Gillies, CERN,
Tel:+41.22.767.41.01
or Emma Sanders, Tel:
+41.22.767.69.44
http://www.cern.ch/microcosm

Centres, Networks, Associations,...

Malta Council for Science and Technology

The Malta Council for Science and Technology is the national advisory body to the Maltese government on science and technology policy. The MCST is responsible for identifying and addressing major science and technology challenges and issues of strategic importance for Malta, thereby contributing to the development of coherent and sustainable policy visions and initiatives.

The MCST's main remit is to encourage

investments and capacity building in science and research, with a view to promoting a culture for science, technology and innovation across the public, private and education sectors. One of MCST's major initiatives is the setting-up of an Innovation Relay Centre (IRC) in Malta within the current Innovation Programme of the European Community.

The MCST is also the national agency responsible for the management and co-ordination of Malta's participation in the Sixth Framework Programme for Research, Technological Development and Innovation (FP6).

In this regard, the MCST has set up the National Contact Point Organisation (NCPO) for FP6. The NCPO is responsible for information and awareness-building as well as matters concerning advice, assistance, training on procedures, partner search, proposal-preparation, training sessions and seminars for specific target groups.

In January 1996, the MCST launched The Science Popularisation Programme with the first National Science and Technology Week. The 6th edition of this event took place in March 2003. The two main tasks of this Programme are to raise a greater awareness of technological concepts amongst the general public, and to encourage more students to take up sciences at school. The objectives of these tasks are to ensure that no one is left out of the opportunities and debate on the threats presented by advances in technology and also to have a work force capable of meeting the technological challenges offered by transitions in the Maltese economy

During 1997, 1998 and 1999 open weeks were organised with industries, through which students had the opportunity to observe the application of scientific principles learnt at school, as well as the careers that exist for those who opt for a technological career. Two thirds of secondary schools participated in these events, involving over 150 collaborating industries. Other popular activities in this Programme include science weekends in collaboration with Local Councils, schools and technology providers in a particular area.

The Programme regularly participates in international fora that deal with science popularisation. In 2002 the Programme became a full member of EUSCEA, the European Science Events Association.

Further information on the MCST and its activities from:
http://www.mcst.org.mt/

ASIA-PACIFIC REGIONAL TECHNOLOGY CENTRE (APRTC)

The APRTC is an independent, non-profit NGO dedicated to improving the welfare and knowledge of developing country farmers and the promotion of sustainable agricultural practices. The goal of the APRTC is to improve the welfare and knowledge of rural communities through the promotion of sustainable natural resource management practices. A priority activity of APRTC is **agLe@rn**, an eLearning programme targeting the continuing educational needs of agricultural educators and other professionals who serve and support farmers and farming communities.

In most developing countries, rural communities are the backbone of the economy. Most of the people living in these areas depend on agriculture which is under increasing pressure from growing populations, increased affluence, a dwindling natural resource base and globalisation. Rural communities need to improve their economic performance, production and profits. And for this it is of utmost importance to protect the fragile natural resource base upon which their livelihoods depend. Sustainable natural resource management has to be a major component of any response strategy.

The Asia Pacific Regional Technology Centre (APRTC) was born from the realization that the key to meeting challenges in rural areas was through improving access to information and knowledge. Its founders were convinced that an educational programme utilizing new information and communication technologies could be more powerful than traditional approaches in achieving this goal. These new tools offer the ability to respond to today's realities and tomorrow's challenges. They are ideally suited to the rapid dissemination of knowledge from any place in the world to almost any place else and allow collaboration and discussion over vast spatial and temporal distances.

In an ideal world, rural communities would be able to directly access the information and knowledge they require and this is becoming a reality in many developed countries. In most developing countries, however, this is not yet feasible. The numbers involved are too great and the prerequisite ICT infrastructure and knowledge is not yet widespread. Given this situation, APRTC has chosen to focus its initial eLearning activities on meeting the continuing educational needs of agricultural educators and professionals. They are the individuals who can help farmers access the information and knowledge they need for better crop and farm management. And they are at least as much in need of better access to knowledge as the farmers themselves.

APRTC is aware that Asia's agricultural educators and professionals can play a pivotal role in promoting sustainable agriculture and improving farmers' livelihoods. Also that they have demanding jobs, travel extensively and also need time for their families. Without access to new knowledge and information they are in danger of losing their competitive advantage and their effectiveness is compromised. This is why APRTC has made its online agLe@rn programme for agricultural educators and professionals the primary focus of its overall educational

strategy in support of sustainable agriculture.

eLearning is "Internet-enabled learning", or "The use of network technologies to create, foster, deliver, and facilitate learning, anytime and anywhere." eLearning is the most recent evolutionary stage of distance learning - learning in a situation where instructors and learners are separated by distance, time or both.

APRTC's **agLe@rn** programme currently offers a range of on-line courses and is in the process of developing more. Together these will form a comprehensive curriculum of learning opportunities related to sustainable agriculture for agricultural educators and professionals in the public, private, academic and NGO sectors. Current courses either developed and implemented or under construction include:

- Digital Literacy for Agricultural Professionals
- Introduction to Integrated Pest Management (IPM)
- Integrated Pest Management in Cotton
- Integrated Pest Management in Irrigated Rice
- Basics of Vegetable IPM
- Responsible Pesticide Use
- Integrated Soil Fertility Management in the Tropics

All agLe@rn courses include continuous assessment and feedback mechanisms that allow for the measurement of student performance and provide a means to improve course content, usability and delivery.

For further information contact:
Robert T. Raab, Director
Asia Pacific Regional Technology Centre (APRTC) 28th Floor, Rasa Tower
555 Pahonyothin Road
Chatuchak, Bangkok 10900 Thailand
Fax: (66) 2 937-0491
Email: robert@aprtc.org URL: http://www.aprtc.org

Asia-Pacific Regional Technology Centre (APRTC) Scholarship Fund

Based on the knowledge that the majority of agricultural educators and other professionals who most need access to continuing educational opportunities are least able to pay for them, and with the initial generous support of the international crop protection industry, APRTC has established the agLe@rn scholarship fund to support deserving candidates from government agencies, academia and non-governmental organizations. More scholarship opportunities will be available in the future and APRTC is actively seeking more contributors and contributions to this fund.

In order to be eligible for a scholarship, candidates must:

1. be agricultural professionals working in a developing country
2. be involved in the promotion of sustainable agriculture
3. be working with farmers or students of agriculture
4. be in need of financial support to take advantage of an agLe@rn course
5. furnish a recommendation from their supervisor for participation in the course. (The supervisor can email this to info@aprtc.org)

More information on the APRTC homepage: *http://www.aprtc.org*

NEWTON NETWORK (NewNet) < http://www.newnet.sk/>

Slovak Republic

Newton Network (NewNet) is a virtual space for co-operation in projects and activities aiming to increase the interest of young people in science and technology.

NewNet is a Slovak initiative in the area of science and education established in the framework of the open method of co-ordination introduced by the European Council in Lisbon (2000). It was submitted by the Minister of Education of the Slovak Republic to the commissioners of the European Commission for science and technology.

In the area of science and technology the project reflects the Action Plan on Science and Society (approved by the European Commission in 2001) and in the area of education it aims at fulfilling one of the objectives of European education and training systems approved by the European Council in Barcelona (2002).

The project is focused on raising awareness of science and increasing the interest of young people in science and technology studies. Its main aim is to strengthen cooperation at the Community level (all Member states and candidate countries) and to develop new instruments for raising awareness of science and to increase recruitment for scientific and technical studies. Its characteristics are the following:

- NewNet is an open network of institutions and groups from European countries joined by common aims and objectives implemented by a set of individual projects.
- An integral part of its activities is the dissemination of its results outside the network.
- It promotes mutual co-operation among schools, universities, scientific institutes, industrial companies, non-governmental organisations, artists, museums, general public, etc.
- It supports harmonious development of children and youth by creating links between science and the following disciplines: geography, literature, drama, creative arts, history, economics, environment, and use of internet.
- Its target group is children and youths up to 18.
- NewNet is open for cooperation with countries outside the European Union.

NewNet activities focus on:

- Mapping existing national activities and their promotion
- Collecting all possible information about activities aiming at science education organised in different countries.
- Widely promoting obtained information to serve as an inspiration for others.
- Exchange of information through:
  - establishment of an internet site
  - a magazine, leaflets, thematic materials
  - videoconferences, discussions, seminars and conferences
  - short-term mobility
  - co-operation with media

NewNet aims to promote existing national activities and best practices at international level through its web site, national co-ordinators, thematic co-ordinators, conferences and training sessions.

Both organisations and individuals can be involved in NewNet activities (directly or via national co-ordinators). NewNet is based on the open co-ordination principle. Involvement in specific activities is voluntary and open for all the members of NewNet.

The NewNet web site functions in two languages: English and the national language where all the published reports are provided in an other language than English. The language of communication at the international level is English.

Any interested person or organisation can become a member of NewNet on submitting an application. **Membership is free of charge.**

The following are some thematic groups of NewNet activities: Science education in schools; Olympiads; Competitions in student scientific activities; Teacher education; Leisure time activities; Co-operation with research institutes; Exhibitions, museums; Conferences, workshops; Presentations, discussions; Science weeks; Science in media; Student science magazines; etc.

An activity, depending upon its characteristics, can figure in several groups.

For further information contact:
IUVENTA
Budkova 2, 81104 Bratislava,
Slovak republic.
Fax:+421-2-592.96.121
E-mail: newnet@iuventa.sk

International Union for Science Communicators (IUSC)

Mumbai, India

The decision to establish the International Union for Science Communicators (IUSC) was taken by delegates attending the International Conference for Science Communicators, Pune, India, 2000. An *ad hoc* international committee of 9 experts from Bangladesh, Brazil, France, Ghana, India, Japan and USA, were entrusted with the task of writing the constitution and the National Centre for Science Communicators (India) with the process of registering it in Mumbai, India.

The International Union for Science Communicators aims to incite active co-operation and association among groups and individuals throughout the world - including developed as well as developing nations, interested in promoting as a necessary part of culture, the dissemination of science in the public and in particular amongst children for furthering scientific temper into society and individuals and for eradication of fallacious resorts to irrational beliefs. It will alert the society against misuse of science, which results in threats to peace as well as to social and cultural diversity. It will also help the society to make use of science in defence of solidarity, tolerance, social justice and equality which reflect the culture of science.

The following categories of membership are foreseen: For organisations, Full membership and Associate membership; and for individuals interested in the promotion of the culture of science worldwide, Individual membership.

For further information contact:
A.P.Deshpande
General Secretary, IUSC.
E-mail: anant_d@vsnl.com
http:www.mavipa.org/NCSC

Centre For Indigenous Environmental Resources (CIER)

Canada

The Centre for Indigenous Environmental Resources (CIER) is a national, non-profit organization pursuing local, regional and international initiatives. Founded in 1994, it was created for the express purpose of establishing and implementing environmental capacity-building initiatives for First Nations.

CIER is committed to the development of the education, research and technical resources needed for communities to acquire greater ability to meet and deal with the environmental issues and initiatives we face. CIER believes that unique indigenous rights, needs, goals and perspectives must be included and addressed in all capacity-building. Integral to this process is CIER's willingness and commitment to create and strengthen partnerships with other indigenous, environmental and concerned organizations.

CIER has three primary goals:

1. To build capacity in First Nations by providing technical expertise and advice, particularly in the environmental assessment and remediation fields.
2. To initiate, promote and increase First Nations' input in all environmental issues, and without exception, those that affect their lands, which is of critical importance to the long-term health of their communities.
3. To develop and enhance the links between all First Nations in Canada and indigenous peoples throughout the world, to ensure our significant contribution in international environmental matters.

In education and training, CIER has two major programmes: Continuing Environmental Education (CEE) and the National Environmental Education & Training Program (NEETP).

- Continuing Environmental Education (CEE)
  The intent of the Continuing Environmental Education (CEE) Programs is to continue CIER's commitment to educational opportunities to learn about environmental issues affecting First Nations including incorporating indigenous ecological knowledge and western technological and scientific knowledge into any framework. Five areas are being developed in the Continuing Environmental Education area at CIER: Youth, Adults, Community, Professional and Corporate.
- National Environmental Education & Training Program (NEETP)
  The programme is guided by the goal of developing the capacity to engage in environmental protection initiatives on First Nation lands, and has a specific focus within the environmental protection field: environmental assessment, including environmental impact assessment, auditing and monitoring. It provides First Nation youth with interdisciplinary indigenous and western environmental knowledge and skills in the area of environmental protection. It comprises 15 months of class instruction and a 3-month field practicum component.

For further information contact:
Centre for Indigenous Environmental Resources Inc.
3rd Floor - 245 McDermot Avenue
Winnipeg, Manitoba, Canada R3B 0S6
Fax: 204.956.1895,
E-Mail: earth@cier.ca

Association Action for Sustainable Development « le RONIER »

Togo

The association Action for Sustainable Development « Le RONIER », established by a group of young volunteers with university and other socio-professional backgrounds, aims to promote education for development, information and public participation in the sustainable development process in Togo and the entire world.

The major programmes of the Association focus on Education for All, right to a healthy environment, community health and sustainable agriculture. Its on-going actions include:

- EE in villages and schools of the Zio district
- Organisation of a theatre festival for schools in Tsévié
- Biological market gardening
- Awareness raising and contacts for the protection and conservation of the Havé natural forest of 100 acres in the Zio district
- Support to 3 associations – of which two women's – in the production of rice in the Zio river valley

All these activities are being carried out on a purely voluntary basis. After having participated in the Johannesburg World Summit on Sustainable Development, the Association would be interested in giving greater visibility to its work in the field through sharing and exchange of experiences with other partners.

For further information contact:
Association Le RÔNIER,
BP 03, Tsévié, Togo

ECO-UNESCO

Ireland

ECO-UNESCO, Ireland's only environmental organisation specifically for young people, has been involved in environmental education (EE), conservation and international projects for over 15 years. By means of a wide range of EE as well as conservation programmes, services and resources, ECO-UNESCO incites young people to take positive and creative actions for nature protection.

ECO-UNESCO's aims, directed towards the youth, are the following:

- to raise awareness, understanding and knowledge of the environment
- to promote the protection and conservation of the environment
- to promote personal development through practical environmental projects and activities.
- to promote environmental education

Recognising the value of action-oriented learning and interaction with the natural world, ECO-UNESCO promotes a dynamic and positive approach to EE through inclusive, relevant and enjoyable programmes. It organises environmental events, facilitates workshops, produces educational resources, provides environmental training programmes and runs the annual Young Environmental Awards. Its activity-based workshops investigate themes such as waste, biodiversity, air, habitats and trees. These are oriented towards youth groups and services, schools and community groups and include concrete activities such as river clean-ups, tree planting, bird box erection and wildlife habitat conservation. ECO-UNESCO works with a wide variety of partners including government departments, local authorities, NGOs and business. ECO-UNESCO is member of national and international associations such as the World Federation of UNESCO Clubs, Youth and Environment Europe (YEE), Council of for Environmental Education (CEE), Tree Council of Ireland and National Youth Council of Ireland (NYCI).

ECO-UNESCO has recently launched a new CD-ROM entitled ***Your Environment: Your Choice*** – Protect your local environment in conjunction with the Department of the Environment, six local authorities (Country Councils) and The Wrigley Company.

This stimulating, interactive educational tool is designed to encourage young people to take an active role in the protection of their environment and to develop positive environmental practices including water conservation, energy saving, recycling, habitat conservation and good anti-littering behaviour. Interesting facts on a range of issues are supported by interactive games and ideas for practical activities, encouraging students to bring their knowledge into the local community. The CD-ROM covers topics such as biodiversity, water, air, waste, litter, energy and sustainable development making it a useful teaching-aid for a number of second level subjects including science, geography, environmental and social studies and many of the transition year subjects. It is also a very useful and fun tool for youth leaders, youth organisations, youth services, community groups and others who want to carry out practical environmental projects with young people.

The six County Councils will distribute it to schools, libraries and youth groups in their areas.

For further information contact:
Elaine Nevin, National Director,
ECO UNESCO, 26 Clare Street,
Dublin 2, Ireland.
E-mail: ecounesco@eircom.net
or
Suzanne Mc Cormack, Whelan
Communications The Digital Hub,
157 Thomas Street, Dublin 8, Ireland.
E-Mail: niamh@kratos.ie

Doing it & Telling it

Environmental education and contemporary realities

Bulgaria

Place: Department of information and teacher training at Sofia University "St. Kliment Ohridski" .

Target groups: Science teachers, experts in education from regional educational boards, university lecturers, authors of schoolbooks.

Objectives:

– To stimulate an intensive rethinking of EE in the different types of schools.
– To introduce an innovative model of EE integrating all school subjects in developing environmental culture, consciousness and behaviour in all students and the community.
– To offer integrating concepts for teaching sustainable living and development.
– To propose new technology for evaluation of EE.

Resources: Financial support and encouragement was received from the Ministry of Environment and Water resources.

Methodology: A worksheet of advantages and disadvantages of EE together with a proposal of an innovative model of EE was sent to 60 people of the target groups. A workshop was then organized to discuss the new proposals for advancement of EE at different levels. Valuable ideas were exchanged on the new approaches and the new requirements for contemporary EE. Every participant received the book "Conceptualisation of EE" comprising all the advances in EE and outlining the trends for the establishment of an innovative teaching model. All the ideas were summarized in a brief article and published in the

magazine "Education and qualification" of the Department. The participants visited a special exhibition of students' creative work on nature and sustainable development.
Evaluation: Every participant expressed his opinions on the workshop anonymously. The proposals were summarized. The approval of the workshop was unanimous. Two proposals deserve mentioning: a workshop of this kind should become a tradition and should be organized each year; well-organized activities in EE of students should be shown on TV for dissemination.
Results: A regular modular programme and a course for teacher qualification "Environmental Education for Sustainable Development" is offered to teachers at the Department. Teachers involve students in the improvement of school environment.
Sent by: *Prof. Zdravka Kostova, Lecturer in Biology, Department of Information and Teacher Training, Sofia University, Bulgaria. e-mail: zbkostova@yahoo.com; URL: http://zdravka_kostova.tripod.com*

Readers are invited to send us their ***FIELD experiences in Science, Technology, Environmental Education activities*** *involving the teaching/learning process - but not necessarily limited to students and teachers. They should be as brief as possible and set under the following headings:*
Place: Locality where the activity was carried out
Target Groups: For whom the activity was intended
Introduction: Background information - reasons for initiating the activity
Objectives: What was the activity expected to achieve?
Resources: Materials/funds needed for the activity
Methodology: The way in which the activity was carried out
Evaluation: How was the activity judged? By whom?
Results: Did the activity produce any concrete changes in the target group(s)?
Selected experiences will be published with the name and address of the author. Please address your contributions to: ***Doing it and Telling it*** *(address on last page)*

News & Publications

With permission of the Queensland Studies Authority, Science Years 1 - 10 Syllabus Core Content is now included in the website located at: http://www. uq.edu.au /_School_ Science_Lessons and its contents are linked to the collection of databases of experiments in physics, chemistry, earth sciences, and biology for middle schools, and experiments in science and agriculture for primary schools. Middle school teachers of science and geography may find this website useful for selecting rich tasks appropriate to their classes. The website lives in S322 of the School of Education, University of Queensland, and is still being edited, so any feedback on its use would be appreciated. Contact: *J.Elfick @mailbox.uq.edu.au*

In the framework of the **Project on Institutional Development of Science and Technology for the Unified Health System** being carried out by the Brazilian Department of Science and Technology in Health in collaboration with UNESCO/Brasilia, three documents have been published in Portuguese:

- Methodology for the Elaboration of a National Agenda of Priorities in Research and Technological Development in Health
- Proposal for a National Policy on Science, Technology and Innovation in Health
- Guidelines for Planning Science and Technology Actions in Health

For further information contact: *Director, UNESCO/Brasilia, Caixa postal 08563, 70070-914 Brasilia DF, Brazil. Fax: (55-61) 322-4261 E-mail: UHBRZ@UNESCO.org*

ALERTAVERDE.COM (*v.**Connect,** Vol. XXVII, No.3-4, 2002*) has created two new sections entitled:

1. Energías (http://www.alertaverde.com) in which all the materials developed on this very timely topic by the specialists of the parent organisation Mainumbí will be put up; and
2. Capacitacion (Capacity building) (http://www.alertaverde.com/capacitacion/index.jsp) which features all the activities of Mainumbi concerning this capacity building of educators with brief descriptions of the courses and the places where they were carried out.

Mainumbi has also published a new interactive CD-ROM, developed and designed by its specialists, entitled "Energía: el motor de la vida" (Energy: the motor of life). For a free demonstration as well as eventual orders: *http://www.alertaverde. com/cd/3/info.jsp*

An innovative Japanese product that has the potential to save millions of people from malaria every year is for the first time being manufactured in Africa - the continent where 90 per cent of the world's malaria deaths occur. UNICEF, the World Health Organization and the Acumen Fund, which jointly announced the breakthrough, said the transfer of the Japanese technology to an African manufacturer was made possible by an international public-private partnership aimed at greatly reducing malaria deaths. The new technology extends the efficacy of insecticidal bednets from about one year to more than four years without being retreated. Known as "long-lasting insecticidal nets", the new product is a powerful weapon for fighting malaria, which kills more than one million people annually, most of them children under the age of five. For further information, contact: *Mohammad Jalloh, UNICEF Media,*

New York: (212) 326 7516; Maria Cheng, WHO, Geneva, Switzerland: (41 22) 791 3982; Victor Chinyama, UNICEF Eastern and Southern Africa Regional Office: (254) 20 622218; Rustom Masalawala, Acumen Fund, New York: (212) 566 8821 Ext. 103; Damien Personnaz, UNICEF, Geneva: +41 22 909 5716 .

Forthcoming Conferences, Workshops, Courses...

4th Regional Congress: *Search for SEAMEO Young Scientists (SSYS),* Malaysia, **8-10 March 2004.** Organised by the SEAMEO-RECSAM, the main aim of this conference is to encourage young learners to apply scientific and technological knowledge and skills to problem-solving activities for the benefit of the society. Further information from: *The Secretariat of SSYS, SEAMEO RECSAM, Jalan Sultan Azlan Shah, 11700, Gelugor, Penang, Malaysia. Fax: 60-4-657.25.41*

CASTME International and CASTME Europe Conference: *Linking Science, Mathematics and Technology Education and their Social Relevance,* Cyprus, **15-18 April 2004,** organised by the Commonwealth Association for Science, Technology and Mathematics Educators (CASTME) in collaboration with the Cyprus Mathematical Society, Intercollege, University of Cyprus, under the auspices of the Ministry of Education and Culture of Cyprus. Further information from: *Dr Gregory Makrides, Chairman of Local Organising Committee, Dean – Intercollege, 46 Makedonitissas Avenue, P.O.Box 24005, CY1700 Nicosia, Cyprus, Tel. +357-22841555, Fax: +357-22352059 e-mail: makrides.g@intercollege.ac.cy http: //<www.intercollege.ac.cy> < www. castme. org>*

International Conference *INDIGENOUS KNOWLEDGES*: *Transforming the Academy.* Theme areas: Food, Wellness, Nature, Local Knowledge Generation and Transfer. Penssylvania, USA, **27-29 May 2004.** Further information from: *Nancy Eckard, Conference Planner, The Pennsylvania State University, 225 The Penn Stater Conference Center Hotel, University Park, PA 16802-7005, USA. Fax: 814-863-5190. E-mail: nzm1@outreach.psu.edu (http:// app.outreach.psu.edu/IndigenousKnowledges/)*

The *10th International Congress on Mathematical Education* will be held under the auspices of the ICMI (International Commission on Mathematical Instruction) in Copenhagen, Denmark, from **4-11 July 2004.** Further information from: *Chair, International Programme Committee, Mogens Niss, IMFUFA, Roskilde University, PO Box 260, DK-4000 Roskilde, Denmark. E-mail: ICME10-IPC@ruc.dk http://www.icme-10.dk*

Master of Arts in Environmental Education and Communication at the Royal Roads University, Victoria B.C., Canada, is a leadership programme focusing on developing the competence and skill of educators and communicators who have an interest in, or a responsibility for, presenting environmental information to audiences. Building on both theoretical and practical knowledge and skills, this interdisciplinary programme aims to provide solid grounding in environmental studies and sustainability, learning theory, communications theory, environmental education, educational programme development, philosophical and cultural analysis, research methods and programme evaluation. For more information contact: *Dr. Richard Kool, Royal Roads University, 2005 Sooke Rd., Victoria, BC, Canada V9B 5Y2. E-mail: rick.kool@royalroads.ca http://www.royalroads.ca/ste*

Publications

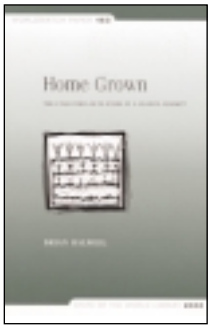
Innovations in Science and Technology Education, *Vol. VIII* (2003, 348 p.) Ed. E. Jenkins. The eighth volume of this series examines STE at a crucial time in human history: the start of a new century and a new millennium. Significant contrasts in the state of STE in different parts of the world as well as differing attitudes towards STE became apparent both at the Budapest World Conference on Science(1999) as well as the Goa International Conference on Science, Technology and Mathematics Education (2001). This volume attempts to present a worldwide panorama – albeit not exhaustive – of the state of STE based on the experience of renowned specialists in the field. Price 16 (+s&h). Order from: *UNESCO Publishing, 1 Rue Miollis, 75015 Paris, France.* ***http:www.unesco.org/publishing***

Guidelines for Policy-making in Secondary School Science and Technology Education (2003, 56 p.) by E. Jenkins. This UNESCO publication aims to help ministries of education and others with similar responsibilities, to identify, improve, strengthen or develop policies for school STE. Keeping in mind the diversity of educational systems and responsibilities, these guidelines, which do not aim to be taken as ready-made prescriptions, cover notably curriculum planning and materials, courses, teaching methods, practical work, gender, teacher recruitment and training, monitoring and assessment. For copies contact: ***Connect*** *(address on last page).*

Scientific and Technological Literacy for All: *Experiences in India* (2003, 79 p.) Compiled by A. Mukherjee, V.S. Varma. This report and the accompanying CD ROM are the outcome of a UNESCO /Delhi-UNICEF- University of Delhi project on making science more interesting for girls of primary and lower secondary levels (*v.* ***Connect,*** *Vol. XXVII, No.1-2, 2002*). The project, which was carried out in five Indian states involving around 70 schools and over 100 teachers, helped develop and test new teaching materials for teachers to use as complementary resource materials. The CD ROM contains a film on the evolution of STL (Scientific and Technological Literacy for All) scripts in two schools in Delhi and the articulation by STL practitioners of their ideas and experiences. For copies contact: *Director, UNESCO/Delhi, UNESCO House, B-5/29 Safdarjung Enclave, New Delhi 110029, India. E-mail: newdelhi@unesco.org*

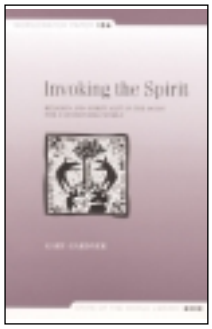
Participation and Sustainable Development: *New Strategies, Old Challenges,* is a multilingual CD ROM (English/French/Spanish/Portuguese) produced by the Federal University of Rio de Janeiro, holder of a UNESCO Chair on Sustainable Development and containing a selection of research work done by the Interdisciplinary Studies of Communities and Social Ecology (EICOS) programme of the university. The purpose of the CD ROM is not only to acquaint the user with the work of the programme but also to present some practical examples of community work treating fundamental questions on sustainable development, participative research, participative techniques in communities and methodologies addressed to specific groups such as disadvantaged women. For copies contact: *Programa EICOS-UFRJ -Instituto de Psicologia, Av. Pasteur, 250 Praia Vermelha, Rio de Janeiro RJ, Brazil CEP 22290 240 Fax: 55 21 2295 3185 http://www.eicos.psycho.ufrj.br*

La Réserve de Biosphère de Mananara-Nord: *Un défi pour la conservation et le développement intégrés* (The Mannanara-North Biosphere Reserve: a challenge for conservation and integrated development) (2002, 188p.) by C. Huttel, L. Touber, M. Clüsener-Godt. This publication is the report of a project conducted jointly by the Man & the Biosphere programme of UNESCO and the Association Nationale pour la Gestion des Aires Protégées (ANGAP) for the conservation and sustainable development of the Mananara-North Biosphere Reserve in Madagascar. ***In French only.*** For copies contact: *Dr M. Clüsener Godt, Division of Ecological Sciences, UNESCO, 1, rue Miollis, 75732 Paris Cedex 15, France. Fax: (33-1) 45.68.58.04 E-mail:m.clusener-godt@unesco.org*



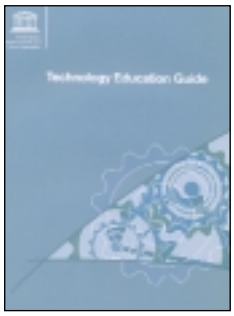
Home Grown: *The Case for Local Food in a Global Market,* Worldwatch paper 163 (2002, 83 p.), by B. Halweil. The author makes a strong case against a worldwide increase in reliance on food grown 'elsewhere', the tonnage of food shipped between countries having grown fourfold during the last 4 decades. Although global trading in food offers a wider variety of food to the consumer, it also means enormous fuel consumption for transportation, loss of quality for the transported food, loss of local varieties as well as erosion of local economies. Price US$5 (+s&h). For copies contact: *Susan Finkelpearl, Worldwatch Institute, 1776 Massachusetts Avenue, NW, Washington, DC 20036, USA. E-mail: sfinkelpearl@worldwatch.org*

Science in Indian Media (2002, 174 p.) by D. M. Salwi gives an overview of the present status and future potential of science communication in India. In an age where communication and the media are increasingly important to get through to the public the vital messages of science and technology, this book, although based solely on the Indian experience, provides a meaningful insight into a number of issues which are common to many other developing nations. Price: US$4.50. For orders contact: *Vigyan Prasar, C-24, Qutab Institutional Area, New Delhi 110 016, India. E-mail: vigyan@hub.nic.in http://www.vigyanprasar.com*



Invoking the spirit: *Religion and Spirituality in the Quest for a Sustainable World,* Worldwatch paper 164 (2002, 62 p.), by G. Gardner, documents how religious institutions around the world are going green and providing a push to the environmental movement. The author provides examples from around the world where religions are using their influence to promote sustainability and states that collaboration between environmentalists and religious institutions could change the world. Price US$5 (+s&h). For copies contact: *S. Finkelperl (address above)*

UNESCO Technology Education Guide (2003, 168 p.) M. J. Dyrenfurth, K. Langer, D. Wahl (Compilers). The result of a collaboration between UNESCO and WOCATE, this guide aims primarily to increase in students technological literacy i.e. the technological understanding and capability necessary to live and work in a technology based society. With the help of this guide students can develop a better understanding of the role of technology in society; nurture an appreciation for the importance between and among technological systems; solve technological problems through the application and use of tools, materials and processes; investigate and study the technological world of the past, present and future; and analyse technological systems and the impact of these systems on the environment and society.



The Guide is divided into 4 units: *What is Technology?; Communication and information technology; Materials and processing technology; and Energy and power technology*. Each unit is further divided into topics with distinct sections for knowledge, skills and attitude acquisition ending with instructional and learning activities for instructors as well as students.

The primary strategies used in this Guide consist of brief instructor-led presentations integrated through a student (individual or group) project method. Instructors are encouraged to employ all other available strategies, e.g. field trips, community service, contracted work, etc., that fit the situations and do not take advantage of the students. For copies contact: ***Connect,*** *(address last page).*

Fish Trouble, *a teacher's guide to fisheries education activities,* developed by the Center for Sustainable Fisheries at the Rosenstiel School of Marine And Atmospheric Science in collaboration with Audubon's Living Ocean Program is now available at: http://csf.rsmas.miami.edu/projects.html. The activities were developed by fisheries experts in conjunction with educational specialists and teachers. The guide is meant to provide teachers background information on fisheries, hands-on activities for students, demonstrations as well as discussion on thought-provoking topics. The guide is not meant to be used as an entire curriculum but so that teachers can pick and choose from the activities included what works best for their classroom and their students. Each lesson has many accompanying activities for different grade levels marked low, intermediate and advanced (for elementary, middle and high school). A print version will be available soon. For more information contact: *Dr. Ellen Prager, Assistant Dean, Rosenstiel School of Marine and Atmospheric Science, University of Miami, 4600 Rickenbacker Csy, Miami FL 33149, USA. Fax 305 361 4711.*

PAMOLARE (Planning and Management of Lakes and Reservoirs focusing on Eutrophication) is one of UNEP/IETC's major thrusts in the Freshwater Management Programme. In this context, a training package has been developed by the International Lake Environment Committee Foundation (ILEC) and Kyoto University. *PAMOLARE*'s numerical models for PCs can be used for capacity building and decision making. The models have been designed to consider a variety of variables for a given freshwater body and range from simple to structurally dynamic models that bring the phyto and zooplankton components into context. PAMOLARE provides training and contains a help-menu to assist users in understanding the basics of modelling. It also has a multiple choice test and lake concept sub-menus under Training including basic information about limnology. The models have been calibrated in different lakes around the world and have been tested in workshops in Africa, Europe and Latin America. Further information from: *UNEP/IETC, 2-110 Ryokuchi Koen Tsurumi-ku, Osaka 538-0036, Japan. Fax: (81-6) 6915.0304.*

Learning and Teaching Secondary Science with ICT (192 p., 2003) edited by R. Barton addresses the question of how ICT can be used to enhance secondary science education. The book intends to enable teachers to make the most effective use of the ICT tools available. The contents are presented from a teacher's perspective, considering such issues as selection of resources, lesson planning, impact of ICT on classroom organisation and how ICT affects assessment of pupils' work. Useful for anyone involved in science education including practising science teachers, trainee teachers and their tutors and mentors. Price £16.99 (pb) + £3.50 (Europe), £5 (rest). Order from: *Marketing Dept, Open University Press, McGraw-Hill House, Shoppenhangers Rd, Maidenhead, Berkshire, SL6 2QL, U.K. Fax:+44(0)1628.635.895 E mail:enquiries@openup.co.uk http://www.openup.co.uk*

The ***Journal of Baltic Science Education*** *(JBSE)* is an international scientific journal issued by the Scientific Methodical Centre "Scientia Educologica", Lithuania, emphasizing theoretical, experimental and methodical studies in the field of science education. It is published twice a year in March and October. Representing a variety of cross-disciplinary interests, both theoretical and practical, the JBSE invites manuscripts on a wide range of topics, especially in areas such as: Didactics of natural sciences; Theory and practice in science teacher education; Integrated science education; scientific and technological literacy; General and professional science education; and Philosophical, political, economic and social aspects of science education. Further information from: *Scientific Methodical Center "Scientia Educologica", Pagegiu str. 43-1, LT-5410 Shiauliai, Lithuania. E-mail: vincentas.la@takas.lt; gamtamokslinis@one.lt*

The ***AMUCHMA*** newsletter (no. 27) on the history of mathematics in Africa, as well as all earlier issues are avail-

able on the web page: www.math.buffalo.edu/mad/AMU/amuchma_online.html

Down To Earth 200 Special Issue – a compilation of articles published in *Down To Earth* from May 31, 1992 till September 15, 2000 covering such diverse topics as: Biodiversity, Biotechnology, Climate Change, Ecosystems, Energy, Environment Education, Pesticides, Pollution, Poverty, Science & Technology, Toxic Waste, Traditional Water Harvesting, Watershed Management, and many more. Price US$10 (Rs.290 for India). Order from: *Society for Environmental Communications, 41, Tughlakabad Institutional Area, New Delhi 110062, India. E-mail:sales@cseindia.org or goutam@cseindia.org. For online payment: http://csestore.cse.org.in/store1.asp?sec_id=1&subsec_id*

Sciences au sud, the journal of the Research and Development Institute (IRD), France, has published a special bilingual English-French issue devoted to the International Year of Freshwater. For copies contact: *IRD, 213 Rue La Fayette, 75480 Paris Cedex10, France. Fax: 33 (0)1- 48.03.08.29. http://www.ird.fr*

XI IOSTE SYMPOSIUM

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Lublin, Poland, 25 – 30 July 2004

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It will consist of keynote lectures, paper & poster sessions, workshops and open discussions.

Further information from: *Dr Jaros_aw W. Dymara, Department of Chemical Education, Maria Curie-Sklodowska University,Pl. M. Curie-Sklodowskiej 3,20-031 Lublin, POLAND*
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UNESCO INTERNATIONAL SCIENCE, TECHNOLOGY & ENVIRONMENTAL EDUCATION NEWSLETTER

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Science and Technology Education in the Arab world in the 21st Century

The Full Text by Saouma BouJaoude
Science and Mathematics Education Centre (SMEC)
American University of Beirut, Lebanon

Science and technology education in the Arab world in the twenty-first century

Saouma BouJaoude

The twenty-first century offers both a promise and a challenge. Remarkable advances in electronic technologies in general, and information technologies in particular, hold out the promise of new scientific discoveries, improved living standards, better communication, increased production and greater access to information. Moreover, advances in medical technologies and in medicine more generally, in agriculture and in the economies of many countries point towards significant improvements in health and quality of life. Many of today's children can expect a bright future full of opportunities, success and happiness. However, many other children, possibility the majority (Vargas, 2000), face obstacles that stem from a lack of educational opportunity and a lack of access to quality health care as a result of poverty, overpopulation and violence. They will also bear the brunt of decreasing environmental quality, wider and increasingly brutal armed conflict, and unequal opportunities between the sexes. The future of these children, especially the girls, is bleak. They will not be able to reach their potential. Consequently, preparing students for the twenty-first century should be one of the priorities of educational and political leaders around the world.

UNESCO (1994) underscores the value of scientific and technological literacy as a universal requirement if people are not to become alienated from the society in which they live, or be overwhelmed and demoralized by change. Meanwhile, research has shown that many students in both developing and developed countries lack the necessary knowledge and skills in science and technology to function effectively in the modern world (AAAS, 1989; Eisenhart, Finkel, and Marion, 1996; ETS, 1988; Halloun, 1993; Miller, 1989; Ogawa, 1998; Shamos, 1995). Students graduating from schools in the twenty-first century need the scientific and technological knowledge and skills that will permit them to be industrious and creative members of society. They also need to develop attitudes that will encourage them to use their knowledge and skills responsibly when taking everyday and professional decisions. Students must also develop those skills that are particularly important for effective functioning in the world of work, a world that is very fluid and ever-changing, and in which the traditional bases of economic competition have changed and continue to change (Koller, 1995). This requires students to develop a thorough knowledge and understanding of basic scientific and technological concepts, allied with problem-solving and critical-thinking skills that they can apply in a variety of situations. In addition to developing a profound understanding of these concepts, students must learn to identify and analyse problems, and to explore and test solutions in a variety of in-school and out-of school situations. A strong conceptual base and essential thinking skills must thus be the new basics and the focal points of teaching and learning science and technology in the classrooms of the twenty-first century (Resnick,[1[1][1]] 1999).

But what science and what technology should students study and how should they study them? What characteristics should students have in order to be considered scientifically and technologically literate individuals? What qualities do graduate students need to succeed in an increasingly scientifically and technologically rich world?

Science and technology, however, do not only bring benefits. They also may have negative consequences. It is important, therefore, that students see science and technology as activities with important benefits and burdens and as endeavours that have positive and negative implications for the world beyond the school.

Science and technology in the Arab World

Science Education

[1[1][1]] See http://www.instituteforlearning.org/Interview.html, http://npeat.org/profdev/research.htm, http://instituteforlearning.org/content.html, and http://austinschool.org/tools/learning_guide/Guide_pol.pdf

What are the important issues that face science and technology education in the Arab world? The two major problems that face Arab science education are the level of access to, and the quality of, education. The problems of access are manifest in the enduring high levels of illiteracy, especially among females, in some Arab states. Many Arab states are attempting to increase access to education through a variety of programmes and strategies. This is evident from the increase in student enrolment at all educational levels in recent decades and the decrease in illiteracy among the population in general and among women more specifically. However, the illiteracy rates are still generally very high. Basic literacy is no longer sufficient. The need now is for scientifically and technologically literate individuals who can function in a global village characterized by intense competition and the rapid production of knowledge. In such a world, 'catching up' is extremely difficulty even for those who are highly educated and trained.

Even when the problems of access are addressed, a very serious problem in the Arab world is the low quality of the education experienced by students at all levels. The problem of quality is manifest in outdated curricula and teaching methods, an emphasis on theoretical science education to the neglect of hands-on and practical activities, a lack of access to computers (or the use of obsolete equipment) and to the Internet, the low quality of science and technology education programmes, a lack of teacher support to implement new teaching methodologies and the use of new technologies, and inadequate budgets to improve the quality of education.

There have been many attempts to reform science curricula in the Arab world. The Arab League Educational, Cultural and Scientific Organization (ALECSO) has been instrumental in promoting science and technology. As early as 1989, ALECSO published an Arab strategy for science and technology. This was followed by an Arab strategy for information in the Internet age in 1999. In 1994, the Organization published a strategy for biotechnology in Arab countries and subsequently made available a reference book on the integration of subjects at the basic level of education in 1996. More recently, ALECSO published model audio-visual educational tools packages for teaching and learning in the field of renewable energies. This will be distributed to training centres in the Arab world[2[2][2]] along with a number of dictionaries that are aimed at standardizing usage of science and technology terminology in the Arab world.

According to Sleem (1996), a number of Arab states have adopted science frameworks developed by ALESCO. These curricula have the advantage of being developed by Arab experts who were in tune with the needs of Arab society. Other countries have adopted or adapted science education reform projects developed in the West to their different needs. A third group of countries has contracted Arab curriculum design specialists to develop their curricula.

Nashwan (1993) analysed the science curricula of eleven randomly selected Arab countries. He found that these focused on the theoretical aspects of science, neglected the applications of science in novel and everyday situations, and did not develop students' abilities to use investigative, problem-solving and thinking skills. They also ignored students' interests, backgrounds and environments, paid no attention to creativity and imagination, did not attempt to address students' unacceptable beliefs in myths and superstitions, and did not help them to understand their bodies and take care of their health and hygiene. Nashwan concluded that science curricula in the Arab world should not be focused solely on helping students to know scientific facts but should also assist them to apply scientific knowledge to solve everyday problems.

Similarly, Badran (1993) conducted a study to assess the quality of science curricula and textbooks in seven Gulf States. The results of this study indicated that the curricula did not benefit from the new technologies in teaching science and did not address social and environmental problems associated with the applications of science and technology. Moreover, Badran found that the contents of school science textbooks appeared to be copied from foreign books with no emphasis on local science-related social and environmental problems or on the applications of science in technology and in everyday life. To make matters worse, these textbooks were outdated and lacked any emphasis on inquiry type activities.

Science teaching in most Arab states suffers from an overemphasis on teacher-centred approaches and on pedagogies that encourage memorization. Such approaches neglect the development of critical thinking, problem-solving capability, and inquiry and investigative skills. While it is hard to find studies that have attempted to investigate the nature of science teaching across the Arab world, studies in individual countries and recommendations for change in reports on Arab education almost always

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[2[2][2]] For more information about this project. See http://slis.uwm.edu/alecso/Abstracts/MdlTeachpack.htm

reveal the need to adopt new and more student-centred teaching methods (e.g. Abd-El- Wahed, 1996; Al Sharki, 1993; Badran, 1993; Nashawn, 1993, 1996; Sleem, 1996[3][3][3]). Moreover, many studies have shown that teachers do not emphasize the nature of science and that, like their students, they have an inadequate understandings of it (Al Attar, 1993; BouJaoude, 1996; Haidar, 1999).

There has been a variety of projects to improve the quality of science teaching in Arab states. Many of these have focused attention on improving teaching methods, on developing computer literacy and on updating teachers' science content knowledge (Abd-El- Wahed, 1996; UNESCO Regional Office for Science and Technology, 2000). In many cases, however, the projects have been of limited scope and duration, and have suffered from the familiar problems of teaching at the pre-college levels. That is, they were trainer- rather than learner-centred with attention focused on theoretical issues rather than on practical and useful classroom teaching skills. The enormous number of pre-service and in-service teachers who need to be trained or re-trained and the lack of human and material support to implement their training resulted in what can be characterized as 'one-off' training experiences in which large numbers of teachers were trained together then left to solve their own problems in the classroom. Most of the pre-service and in-service training programmes lacked the necessary follow-up mechanisms to help teachers or to investigate the impact of training and university education on teachers' classroom practice. Moreover, teachers were rarely provided with supplementary instructional materials or with the training to produce these materials, materials that are essential if teachers are to implement student-centred teaching and inquiry approaches to teaching science. In short, many of the teacher-training programmes in the Arab world attempted to do worthwhile things but failed to implement them satisfactorily. Finally, there have been many attempts to implement distance learning in teacher education in a number of Arab states (e.g., Egypt). These attempts suffer from the problems that have plagued traditional teacher preparation and training approaches, namely, they were trainer- rather than teacher-centred, focused on the dissemination of information, and lacked teacher follow-up and support strategies.

Technology education

The second half of the twentieth century brought extraordinary advances in electronic technologies in general and in information technologies in particular (Abd-El-Khalick, 2001*a*). "These advances have profoundly impacted the nature and practices of the scientific enterprise. Computation is becoming an increasingly crucial aspect of scientific investigation. Breakthroughs in micro- and super-computer hardware and software design, and developments in networking capabilities are rendering the analysis, modeling, and visualization of complex systems an increasingly important component of various scientific disciplines" (Abd-El-Khalick, 2001*a*, p.2). These modern-day technologies have become an integral part of science (Lane, 1999), and this has important implications for teaching science at the pre-college level.

Technology education in the Arab world, i.e., technology as an *end* (American Association for the Advancement of Science (AAAS), 1990, 1993; National Council of Teachers of Mathematics (NCTM), 1987, 1991, 1995) and the use of technology in science teaching, i.e. technology as a *means* (Bereiter, et al., 1997; Hannafin and Land, 1997; McCluskey, 1994; Scardamalia and Bereiter, 1996), are in their infancy.[4][4][4] There have been several attempts to increase access to, and the use of, technology in many Arab states (UNESCO Regional Office for Science and Technology, 2000). Also, Arab countries have realized that technology is not a luxury, but a necessity for catching up with, and competing in, the global economy and workplace. However, as is the case with efforts to improve teachers' skills, the attempts at reform have been limited in scope, duration and impact. Many factors have contributed to this situation, the most important of which is the lack of material and human resources.

However, one cannot group together all Arab states when discussing technology and its use in education. On the one hand, there are countries that have the resources to place a computer or a number of computers or any

[3][3][3] See also the final reports of the fourth and fifth Regional Conferences of Ministers of Education and Ministers Responsible for Economic Planning in the Arab States (Abu Dhabi,1977 and Cairo, 1994).

[4][4][4] There are many instances of successful use of technology in the Arab world. However, these are very limited. The aim here is to provide a general picture of the state of technology education in the Arab world. The discussion that follows is based on the author's impressions gleamed from participating in several conferences that aimed to assess the state of technology education in the Arab world, the most recent of which was a conference held in Amman, Jordan between October 20 and 21, 2001. Other conferences included the first and second scientific conference on the future of science and mathematics teaching and the needs of Arab society held in 1993 and 1996 in Lebanon and Tunis respectively.

technological device in each classroom, provide access to the Internet for each student or teacher, or equip the latter with individual computers. On the other hand, there are countries where it is very hard to find one computer in the school and where the basic infrastructure required to support the introduction of technology is not available. However, even in countries where computers and other technologies and access to the Internet are available, education systems are plagued with very serious problems. These include the absence of human resources to train the huge number of teachers and students who need training and the lack of coordinated and clear strategies to implement technology education in the classroom (Abu Shakra, 1993). One other very serious problem is the lack of educationally and culturally appropriate software programmes, matched to the needs of Arab students and aligned with science curricula in Arab states. When considering using the Internet in the science classroom, one serious problem is that many Arab students and teachers lack the necessary language skills to 'surf' and benefit from the Internet in a meaningful way.

Recommendations

What are the problems to be solved and the issues to be addressed for improving science and technology education to fulfil the promise and confront the challenges of the twenty-first century? Teachers and students of the first few decades of the twenty-first century should work in school environments that are positive, supportive and demanding. These schools should implement integrated curricula that are up to date, flexible and intellectually rigorous. Teachers and students should have access to well-equipped science and technology laboratories and classrooms. They should value education, science, and technology, be reflective and thoughtful about the advantages and disadvantages of science and technology, and be productive and reflective problem solvers. These characteristics are detailed below.

The first priority remains that of building sufficient schools to enrol all school-aged students in Arab countries where this is still a problem. Government budgets and loans or grants should not be the only sources for building schools. Community and business involvement is also important. This involvement provides resources to build schools, and equip their science and computer laboratories, but more importantly, it strengthens the spirit of ownership of the school by the community as well as its sustainability. These community-supported schools provide short- and long-term advantages for all the students, especially girls, and the community.

Secondly, increasing access to well-equipped schools should move hand-in hand with improving education by reforming teacher education programmes, providing teachers with the appropriate means to help their students, and designing and implementing up to date curricula, teaching, and evaluation methods. Teacher-education programmes appropriate for the twenty-first century are those that prepare technologically and scientifically literate teachers. Teachers who are not themselves scientifically and technologically literate cannot prepare students to be so. Moreover, continuous follow-up in classrooms to support teachers' work is essential. The traditional role of inspectors as enforcement officials who attempt to impose rules and requirements from a central office far from where the real action is, i.e., the classroom, is not appropriate for education in the twenty-first century. Rather, teachers in general, and science and technology teachers in particular, should be coached and provided with enough flexibility to innovate and introduce new technologies and topics within a general national framework.

What changes should take place in teacher preparation programs in order to prepare professional teachers who can prepare their students for the future rather than for the past? The following are a number of trends and directions that need to be emphasized to approach the goal of preparing professional teachers. According to Smylie and Conyers (1991) teacher preparation programmes should move from:

a. a. a deficit-based to a competency-based approach, in which teachers' knowledge, skills and experiences are considered assets. This approach will help to shift teachers away from dependency on external sources for the solution to their problems and toward professional growth and self-reliance in instructional decision-making.

b. replication to reflection, in which practising teachers focus less on the transfer of knowledge and more on analytical and reflective learning. This reflective approach will sharpen teachers' skills in problem solving, determining students' needs and conducting action research that is designed to develop new knowledge and skills related specifically to their schools and classrooms.

c. learning individually to learning together, in which teachers learn to work cooperatively to address instructional and other school-related problems. If cooperation is vital for students, it is no less essential for teachers. This implies that teacher education should focus on fieldwork and on

collaboration between schools and universities, and place an emphasis on the co-construction of knowledge about teaching. It also implies that teachers should be provided with support after they start teaching. The emphasis on the induction phase of teaching, typically the first year of teaching, and the use of experienced master teachers in this phase is one way of inducting new teachers into the profession.

d. d. a teacher who thinks that students' minds are empty vessels to be filled to one who encourages students to construct their own knowledge. A teacher must act as a facilitator, providing experiences that enable students to construct meaning for themselves. Teachers must abandon the idea that the external learning situation including the teacher, classroom, books, and experiments are the only determinants of learning and espouse the notion that students' prior ideas and learning are essential for successful teaching. This shift entails different approaches not only to planning and teaching but also to assessment and evaluation.

e. a teacher as a 'finished product' to teacher as a lifelong learner. Today, teacher education is talked of as a lifelong experience that extends from admission to a teacher-education programme to retirement. In this context, science teachers should always be ready to learn and incorporate new knowledge and technologies into their teaching. They should be able to change in order to help their students meet the needs of a changing world. This flexibility may be achieved in a variety of ways, including conferring temporary certification followed by permanent certification after a number of years. Another method of encouraging teachers to become lifelong learners is to give merit pay based on involvement in science teaching-related professional development activities that can take a variety of forms. These include: programmes of individually guided staff development that encourage teachers to plan and engage in activities to promote their own learning, schemes of observation/assessment that provide teachers with objective data and feedback regarding their classroom performance that can be used to identify areas for professional growth, programmes of professional development that engage teachers in developing curricula, programmes and instructional improvement projects to solve school-related problems, and involving teachers in inquiry by requiring teachers to identify an area of instructional interests, collect the relevant data and make changes in their instruction on the basis of interpretation of that data.

One should not forget the important role that technology is currently playing and will continue to play in the lives of science teachers. Lifelong learning therefore should necessarily include an important role for technology.

Realizing the above goals requires qualified scientifically and technologically literate teacher educators who, according to the Association for the Education of Teachers in Science (AETS, 1997), will possess: good subject matter knowledge and skills, and have inquiry/research experiences within their discipline, together with a sound knowledge of science process skills and an adequate understanding of the philosophy, sociology and history of science; a good knowledge of, and skill at, teaching science, especially those skills relating to the pedagogical content knowledge of their discipline; documented expertise in the development and implementation of curriculum and instructional materials in school settings; expertise in a variety of assessment approaches, including traditional and alternative methods of assessment; an in-depth functional knowledge of the relationships between learning outcomes, instructional strategies, and approaches to assessment and evaluation; the skills necessary to apply, in an appropriate manner, different research approaches to answer significant questions in science teacher education; and expertise in the development of educational products/materials or professional development programmes that are informed by the research literature, allied with a good knowledge of, and experience in, science teacher development, including the design and implementation of workshops and institutes.

Thirdly, updated flexible, and rigorous curricula that emphasize thinking and problem-solving are essential if Arab students are to do well in the twenty-first century. Science and technology curricula that emphasize breadth rather than depth are inappropriate. If students are to be able to think, they need a deep and coherent knowledge base, the necessary skills along with encouragement and opportunities to use them, and evaluation systems that reflect these desired outcomes. Moreover, they need the skills to reflect upon what they have learnt. From this stems the importance placed on the nature of science and technology, and its inclusion in the characteristics of scientifically and technologically literate individuals. Understanding the nature of science and technology helps students reflect upon both, to relate them to their own lives and to realize the importance of lifelong learning.

Fourthly, understanding the nature of science and including it in science curricula may have another advantage. Students who are religious sometimes find it hard to reconcile their religious and scientific beliefs if science is considered as the only truth. However, when science is taught as one way of knowing and understanding the natural world, students may feel less threatened by it and consequently may pursue careers in science.

Fifthly, having access to the Internet at present requires students to master at least one language other than Arabic. Consequently, very serious efforts are needed to improve the quality of foreign language instruction at all education in schools. The emphasis needs to be on teaching scientific and technological terminology to provide students with the necessary tools to access information. This does not preclude emphasizing the learning of Arabic and trying to write science in this language. Rather, it provides students with the competitive advantage of knowing another language.

A sixth point is that the popular adage that technology will improve our world and enhance competitiveness is misleading. Technology and science by themselves do not help people to advance. It is the serious effort that is exerted by each individual to understand and use science and technology that bring about advancement, thus the importance of effort-based schools discussed above. Additionally, the driving forces behind any important advancement are the values placed on education, science and technology, and their methods. Memorizing terms, even whole science books, is useless if the methods and values of science and technology as well as their limitations are not appreciated.

The seventh characteristic is that living in a technologically and scientifically rich environment requires students to think carefully about, and reflect deeply on, the interactions of science, technology and society, the benefits and burdens of science, and the ethical and moral issues associated with science and technologically related problems and solutions. Integration, even partial, of school science with other curriculum subjects could be one way for students to appreciate the relationships between science, technology and society as well as the moral and ethical issues associated with them. Moreover, this integration can be instrumental in giving meaning to health and environmental concepts and the role that science and technology can play in sustainable development.

An eighth characteristic is that technology should be considered as an end by itself as well as a means or a tool for accomplishing educational and everyday tasks. Schools should therefore have technology curricula and programmes that exploit and integrate learning technologies in the teaching of all subject areas.

Finally, science and technology have been traditionally considered male subjects. This bias cannot and should not be sustained in the twenty-first century. Depriving women of the opportunity to fulfil their potential and aspirations is indefensible on moral as well as economic grounds. The rights of individuals to pursue their ambitions are supported by all international conventions. Moreover, squandering the productive potential of half the population may deprive nations of their competitive edge in the global economy.

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