COMMONWEALTH *of* LEARNING

PERSPECTIVES ON
DISTANCE EDUCATION

Emerging Trends in the Development of School Networking Initiatives

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Heba Ramzy, Editors

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The Commonwealth of Learning (COL) is an intergovernmental organisation created by Commonwealth Heads of Government to encourage the development and sharing of open learning and distance education knowledge, resources and technologies.

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PREFACE

Emerging Trends in the Development of School Networking Initiatives

Historically, the learning process took place within institutions such as schools, universities and colleges. The need to be part of such institutions was driven by the notion that access to information and knowledge was only possible by being present where the teacher was. New developments in information and communications technologies (ICTs) and their application to education and training have increasingly allowed learners to access information and knowledge from different sources.

The ability to access and process information using ICT is seen as an important and necessary part of any education and training system. In the developed world, the school component of the education and training system has made massive strides to ensure that all learners have access to information and technology. In the developing world, access is much more difficult due to limitations of the technology and the lack of infrastructure, good information resources and skilled teachers.

In addressing the issue of access to ICT and its use in the school system, many developed and developing countries have embarked on school networking initiatives. Schoolnets can be defined as the entities that facilitate collaboration between schools using ICT. However, in many countries, schoolnets as organised entities do not exist, but the activities generally associated with school networking are being carried out. These activities include:

- Soliciting hardware and software for schools
- Getting schools to collaborate on education initiatives using technology
- Networking to share electronic and other resources
- Training teachers in the use of technology
- Using technology for school management and administration
- Advocating the use of technology to support educational systems

Therefore, this report notes developments within countries and regions in the area of school networking.

The models for such school networking vary among countries. This report focuses on school networking models that have emerged in different regions and the emerging trends and issues that need to be considered. How are schoolnets and their infrastructure being used? How can they be used to support the process of learning, teaching, management

and teacher training? Schoolnets in developing countries have also been driven by the need to support the attainment of quality education at both the primary and secondary levels.

For this publication in COL's Perspectives Series, seven authors were invited to undertake regional scans of school networking developments in the following regions:

- Africa
- The Americas: North, Central and South America
- Europe and the Commonwealth of Independent States
- The Middle East
- The Pacific Region: Australia, New Zealand and the Pacific Islands
- South Asia
- Southeast Asia

The Commonwealth of Learning was fortunate to have attracted seven reputable authors and two experienced editors to provide a valuable international scan of school networking developments.

Sir John Daniel

President and CEO
Commonwealth of Learning

THE CONTRIBUTORS

Shafika Isaacs is currently the Executive Director of SchoolNet Africa (SNA), which promotes learning and teaching through the use of ICTs in African schools, in partnership with schoolnet practitioners and policy-makers in 31 African countries. She is based at the SNA headquarters in Johannesburg, South Africa (*www.schoolnetafrica.net*). Previously, she worked as a Senior Program Officer with the International Development Research Centre's Acacia Program, which promotes development in Africa through the use of ICTs. She is also formerly the Director of the Trade Union Research Project (TURP), a labour research service organisation based at the University of Natal in South Africa. During her 10 years at TURP, she specialised in research, training and writing publications on globalisation and the impact of changing technologies on the labour market and women's empowerment.

Sherif Kamel is an associate professor of MIS, the associate director of the Management Centre and the director of the Institute of Management Development at the American University in Cairo. From 1992 to 2001 he was the director of the Regional IT Institute. Prior to that he worked for the Cabinet of Egypt Information and Decision Support Centre. In 1996, he was one of the co-founding members of the Internet Society of Egypt. Dr Kamel has published many articles in IT transfer to developing countries, electronic commerce and decision support applications. He serves on the editorial and review boards of a number of journals: he is the associate editor of the *Journal of Cases on Information Technology* and the *Journal of Information Technology for Development* and the editor in chief of the *International Journal of Mobile Computing and Commerce.* Dr Kamel has served in the Executive Council of the Information Resources Management Association (IRMA) since 2000 as the director of communications. He is a graduate of the London School of Economics and the American University in Cairo.

Stephen Kemp, PhD, is a teacher, administrator and computer consultant with 27 years of experience at all levels from primary education to post-secondary. In addition, Dr Kemp has been a sessional lecturer at the Universities of Saskatchewan and Regina for over 20 years and has the distinction of designing, developing and delivering the University of Regina, Faculty of Education's first online course at the graduate level. He is the recipient of the Saskatchewan Association for Computers in Education (S.A.C.E.) Award of Merit as well as the Apple Canada Award of Excellence for outstanding achievement in educational computing.

Sanjaya Mishra holds a doctorate in Library and Information Science from the University of Delhi and a master's degree in Distance Education. Dr Mishra specialises in information and communications technology applicable for teaching and learning both at a distance and face-to-face. He had the first-hand experience of working at one of the regional centres of Indira Gandhi National Open University (IGNOU) for three years before joining the Staff Training and Research Institute of Distance Education (STRIDE) of IGNOU in 1996, where he was responsible for the revision of the course on communication technology for distance education. He has been trained by the World Bank Institute as a Master Trainer on Improving Training Quality through Peer Learning

and Distance Mentoring. As a trainer at STRIDE, Dr Mishra used innovative methods to conduct a training programme on self-learning material development. He also designed the prototype of IGNOU's first social science online programme.

Vis Naidoo joined COL in November 2000 as an Education Specialist, Educational Technology. His role is to work with Commonwealth governments and organisations to focus on educational technology policy and applications and its impact on education and training systems within an open and distance learning context. He is currently working with governments to support their educational technology policy processes, the application of ICT within basic and secondary schools, supporting schoolnet developments and the use of technology for teacher training. Prior to joining COL, Mr Naidoo was the Director of the Centre for Educational Technology and Distance Education, Department of Education, South Africa. During his five years in that role he was instrumental in shaping policy environment in the area of distance education and technology-enhanced learning. He holds a BSc degree and post-graduate diploma in Adult Education from the University of Natal, South Africa, and a master's in Adult Education from the University of Manchester, UK.

Zoya Naskova has worked extensively in international development, education and technology. She has established numerous Internet learning centres in schools in seven countries, designed and conducted professional development programmes for teachers internationally, developed curriculum for community service courses for Los Angeles inner city youth, managed a national environmental education campaign in Macedonia, conducted research for a US Senate hearing and taught numerous students, children and adults from around the world. Ms Naskova holds a master's degree in International Policy Studies as well as a bachelor's degree in English Language, Literature and Teaching. Some of the organisations she has worked for are Schools Online, Search for Common Ground, UCLA-LOSH, Concerned Citizens of South Central Los Angeles, Center for Strategic and International Studies, Center for Russian and Eurasian Studies, Center for Advancement of Public Policy, ASPECT Schools International, and Los Angeles Unified School District.

Heba Ramzy is currently the Manager of Corporate Social Responsibility Programs for Microsoft Middle East and Africa. She is responsible for initiating a number of programmes designed to integrate the use of ICT in learning through her work as the MENA Regional Director of Schools Online and as Director of the Kids and Youth Programs for the Regional Informational Technology and Software Engineering Center (RITSEC). Prior to this, she was the Director of Electronic Publishing and Kids Information Highway Department of RITSEC. In 1997, Heba created the internationally acclaimed Egyptian Web site for children, Little Horus (*http://little-horus.com*). She then went on to co-found the 21st Century Kids Clubs technology centres. In recognition of her commitment, she has received national and international awards, including an honorary award by Egypt's First Lady H.E. Mrs Suzanne Mubarak. Ms Ramzy is currently a member of the SchoolNet Africa Board of Directors. She holds an MSc from the London School of Economics in Analysis, Design and Management of Information Systems, and a BA in Business Administration from the American University in Cairo.

Carmelita Villanueva most currently worked as the Chief, Information Programmes and Services, UNESCO Asia and Pacific Regional Bureau for Education, Bangkok. In her professional life, she has helped to develop documentation and information systems in over 15 countries in the region, built national capacity by providing training on ICTs, introduced the use of ICT in secondary schools of ASEAN countries, and

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is at present setting up school networking. Ms Villanueva holds a bachelor's degree in Mass Communications, specialising in journalism, and a master's of arts in Mass Communications. She has over 50 publications and repackaged products to her credit dealing with topics on information systems, ICTs in teacher training, ICT indicators, schoolnet, adolescent reproductive and sexual health, population education, HIV/AIDS, and open and distance learning.

Derek Wenmoth was a teacher and principal in primary and secondary school positions, mostly in rural areas of New Zealand, before spending 11 years in teacher education at the Christchurch College of Education where he established the first distance teacher education programme in the country. This work included the establishment of regional projects, working with predominantly Maori communities in rural New Zealand. In 2001 Mr Wenmoth moved to the New Zealand Correspondence School as manager of the eSection, a research and development pilot created to establish methodologies and systems for the school to use in the introduction of online learning approaches to complement the existing paper-based, correspondence courses. In 2003 he was seconded to the Ministry of Education to develop an eLearning Framework for the whole of New Zealand that embraces all sectors of education, including early childhood, schools and tertiary. He is currently a director of Ultralab South whose mission is to research, apply and disseminate the benefits of new technologies in education.

CHAPTER 1

INTRODUCTION

Vis Naidoo

ISSUES CONFRONTING THE EDUCATION SYSTEMS OF THE WORLD

Throughout history, education has played an enormous role in the development of people, societies and nations and has become an important human right. Increasingly, education is and will continue to play a crucial role in people's lives as we move away from education within structures bound by time and space to education that is offered at any period of a person's life and in a variety of surroundings. This move is driven, in large part, by the changes in our society where there is a continuous need for information and knowledge gain, by the changes to how education is transacted and by the increasing use of information and communication technologies (ICTs) within the education system.

The right to education is captured in Article 26 of the Universal Declaration of Human Rights,[1] which notes that everyone has a right to education directed to the full development of the person. Sadly, this declaration has remained unfulfilled in many parts of the world. In an effort to ensure that the world adopts strategies to correct this and other inequalities, the international community adopted the Millennium Development Goals in 2001. The goals which relate to education are as follows:

- Goal 2:   Achieve universal primary education
  Target 3: Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling

- Goal 3:   Promote gender equity and empower women
  Target 4: Eliminate gender disparity in primary and secondary education, preferably by 2005, and to all levels of education no later than 2015.[2]

The Millennium Development Goal 2, calling for universal primary education by the year 2015, is based on the Dakar Framework for Action as adopted by the World Education Forum in Senegal in April 2000. The full text of the Dakar Framework for Action (UNESCO 2000) reads:

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[1]Universal Declaration of Human Rights adopted and proclaimed by the General Assembly of the United Nations on 10 December 1948 with the final authorised text adopted in 1950.
[2]UN General Assembly Resolution A/56/326, 6 September 2001.

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We hereby collectively commit ourselves to the attainment of the following goals:

- Expanding and improving comprehensive early childhood care and education, especially for the most vulnerable and disadvantaged children

- Ensuring that by 2015 all children, particularly girls, in difficult circumstances and those belonging to ethnic minorities have access to and complete free and compulsory primary education of good quality

- Ensuring that the learning needs of all young people and adults are met through equitable access to appropriate learning and life skills programmes

- Achieving a 50 per cent improvement in levels of adult literacy by 2015, especially for women, and equitable access to basic and continuing education for all adults

- Eliminating gender disparities in primary and secondary education by 2005, and achieving gender equality in education by 2015, with a focus on ensuring girls' full and equal access to and achievement in basic education of good quality

- Improving all aspects of the quality of education and ensuring excellence of all so that recognised and measurable learning outcomes are achieved by all, especially in literacy, numeracy and essential life skills

For this to be achieved, a number of different elements of the education system need to be in place. These include a policy and funding regime to enable universal primary education, infrastructure development, learner support materials, teacher training and the development of an appropriate curriculum.

It is apparent that all elements of the education system need to be developed to contribute to the goals. Therein lies the challenge faced by many developed and developing countries. With many countries facing limited budgets, poor planning and implementation, lack of infrastructure and personnel, meeting the Millennium Development Goals for education becomes very difficult. Further challenges in reaching the goals are the many national and regional conflicts and the increasing rate of HIV/AIDS and other communicable disease infections and death through other natural and people-driven disasters.

The challenges are particularly acute in the developing countries, especially in Africa, South and Southeast Asia and Latin America. The following statistics illustrate the problem (UNESCO 1998):

- The 1996 gross enrolment ratios in Africa for the first level of education (primary) was 78.3 per cent. That rate was reduced by more than half for the second level (secondary education) to 32.7 per cent. A further decline was noted for the third level of education (post-secondary) to 6.3 per cent.

- In comparison, Europe displayed in 1996 over 100 per cent enrolment for primary education, 99.2 per cent for secondary education and 41.5 per cent for post-secondary education.

These figures indicate that if Africa were to increase the number of enrolments in the secondary school sector, there would be a substantial requirement for financial resources, more schools and trained teachers.

In an attempt to meet these challenges and to develop strategies to achieve the education Millennium Development Goals, many education ministers, officials and educators

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are increasingly looking at the role of ICTs to support and enhance their efforts. In this context, ICTs can be defined as a combination of computing, broadcasting and telecommunications technologies, as seen in the use of multimedia computers and the networks and services based upon them. Their primary use is to aid information retrieval, storage, research and application, and there is ample evidence of the positive impact of ICTs in the education system (Haddad and Draxler 2002), which enable such systems to change to meet the Millennium Development Goals.

THE IMPACT OF ICTS ON SOCIAL, BUSINESS AND COMMUNITY DEVELOPMENT

"Major transformations are occurring in the formal education sector and other organisations that play a key role in enabling people to develop their new capabilities. These changes are partly the result of the increasing use of ICTs as enabling technologies for education and learning." In this statement, Mansell and Wehn (1998) identify ICT as one of the major drivers of transformation within the education sector and, in doing so, reflect the shift occurring within society.

This shift from industrial age forms of production to an information and knowledge age is characterised by "key technological developments of the recent past [which] are not predominantly about economic productivity, but more to do with innovative ways of producing, storing, transmitting, accessing and using knowledge and information" (Wright 2000). Such changes towards the knowledge and information age have been driven, in large part, by the rapid advances in ICTs. These changes have been primarily in the area of computing, with the onset of the digitisation of information sources, the World Wide Web and the Internet being the main drivers. Knowledge and information are fast becoming the drivers of countries' economies and societies.

In the context of the education system, the computer is the main type of technology that seems to be having the greatest impact and, indeed, seems to be placing the greatest challenge to education managers and teachers. Having access to the Internet and using the World Wide Web are important issues in this challenge.[3]

Increasingly countries are focused on improving access to computers and the Internet. These developments have been most noticeable in South and Southeast Asia, where it is expected that China, Korea and India will account for more than 72 per cent of the total Internet users in the Asia-Pacific region by 2005. Greater China, which includes China, Hong Kong and Taiwan, will eventually comprise nearly half of all users in the region, increasing from 39 per cent in 2000 (International Data Corp 2004).

These changes have also affected all sectors of the education system from the early childhood years, to primary, secondary and tertiary, adult and non-formal education to continuing professional development. The effect on the education system has been twofold:

1. To review the education system (often focusing on a few of the education sectors) so that learners leaving that particular sector have the necessary skills and competence to enter into the modern knowledge- and information-driven world

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[3] The Internet is defined as "a network of networks formed by connecting together of computers and computer networks around the world through telephone and high-speed data transmission lines," and the World Wide Web as "a set of software tools and standards that allow individuals to distribute and obtain information stored on the Internet" (Haughey and Anderson 1998).

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2. To use ICTs to support learning and teaching processes to enable information production, transmittal and storage

Various governments and Ministries of Education have adopted different strategies to address these two changes. One of the primary international strategies that has been adopted to address the use of ICTs in the education system, in particular within the school sector, is the development of schoolnets.

STRATEGIC RESPONSE: THE DEVELOPMENT OF SCHOOLNETS

A schoolnet is an organisation that encourages, through various programmes, the use of ICTs (mainly computers, e-mail and the Internet) for learning and teaching. Therefore a schoolnet can be defined as the entity that facilitates the collaboration between schools using ICTs for educational purposes. In doing so, a schoolnet could conduct the following activities:

- Soliciting hardware and software for schools
- Getting schools to collaborate on education initiatives using technology
- Networking to share electronic and other resources
- Training teachers in the use of educational technology
- Using ICT for school management and administration
- Advocating for ICT to support the educational system
- Collaborating on programmes and integrating them into the learning process

Schoolnets in different parts of the world have carried out various functions designed to support learners, educators, managers and policy-makers and their use of ICTs. Some of these functions include computer distribution, connectivity, intra- and interschool collaboration on education activities, content and curriculum development, teacher training on the use of ICTs in the classroom, ICT in education policy development and research.

Internationally, there are numerous examples of national and regional schoolnets (see *www.col.org/cense*). These national schoolnets arose under the influence of a number of factors that include, among other things, donor support provided for schoolnet start-up and innovative individuals spearheading the initiation of schoolnets (Isaacs and Naidoo 2003). A few schoolnets arose as a result of interventions from governments where government departments established such structures to support the use of ICTs in the classroom.

Noting the rapid increase in the number of countries that have launched schoolnets (and related organisational structures), the multitude of developments in the area of schoolnetworking, and the implications for policy, implementation, teacher development, infrastructure, content development, research and learner development, a study focused on the international trends of schoolnetworking was found to be necessary.

This study takes a global look at the schoolnet phenomenon within different regions. Individual authors were asked to report on Africa, the Americas, Europe (including Eastern Europe and Russia), the Middle East, the Pacific Region (Australia, New Zealand and the Pacific Islands), South Asia and Southeast Asia.

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REGIONAL SCANS OF SCHOOLNET DEVELOPMENTS

In conducting the regional scans, the authors were requested to provide an overview of the region, general indicators on the type of technologies available and used within the school education system and statistics that indicate the use of computers and the Internet within the education system. Within this context, the chapters on the regions also outline the drivers for schoolnet developments and the nature of the organisational entity (if present) that has developed. In addition, the regional scans focus on teacher training opportunities. Further details of how countries have used ICTs in the education system are presented in specific case studies.

- **Africa** has often been described as the most impoverished continent. Therefore developments in the area of ICT use in the education system and in particular the lead role of schoolnet organisations offers hope to Africa. This chapter captures the excitement that is in the air in Africa and provides a rich description of schoolnet developments. In identifying the salient features of African schoolnets, the author identifies the three stages that most schoolnets are currently in. These stages also have their differing organisational forms and resource models. The author provides further details of teacher training and professional development in the area of using ICTs and briefly focuses on Nigeria and the Western Cape Schools Network in South Africa for the case studies.

- **The Americas** (North, Central and South America) have made a rich contribution to current models on the use of ICTs in the education system. This contribution includes all sectors of the education system. In the schooling sector, the work done in Canada, the United States and some of the South American countries (e.g., Chile, Brazil) have provided the world with examples of what can be done using ICTs. This chapter provides an overview of some of these developments of the region and offers indicators of the type of technologies available and used within the school system.

- The countries of **Europe and the Commonwealth of Independent States** (CIS) also have vastly differing political, social and geographic features. While Europe and the CIS have attempted to create super regional governance and trading structures, this type of merger has had little impact on educational technology. This chapter highlights the great variation of ICT availability and use and the range of schoolnet organisations that exists. It also outlines regional and national initiatives and focuses on efforts by non-profit organisations working in the former Eastern bloc. The case studies of the European schoolnet and the work of Schools Online provide examples of the range of initiatives in this region.

- The countries of the **Middle East** (including North Africa) are perhaps the most similar from a geographic and social context. However, this chapter offers insights into the variations that are present in this region with respect to the education systems and the level of ICT access and use in the education system. The case studies of Egypt, Lebanon and Jordan illustrate the nature of government intervention, the role of development agencies and the rich range of initiatives being undertaken to promote the use of ICTs in the education system. While schoolnets do not exist, it is clear that there are various governmental and other organisations providing the types of support and services that a schoolnet typically offers.

- The countries comprising the **Pacific Region** (Australia, New Zealand and the Pacific Islands) are politically, socially and geographically very different. These differences are noted in the chapter and are further illustrated by the statistics on levels of ICT access and use. Based on these differences, countries have undertaken

strategies to encourage the use of ICTs in the education system that have been built on the local context and resource base. However, this region does have a rich culture of collaboration, which is more viable with the use of ICTs. The case studies chosen (Pacific Island Network, Virtual Schooling Services Pilot in Queensland, and Australia and the New Zealand Cluster School Networks) offer useful insight into how different countries have approached using ICTs in their education systems.

- The **South Asia** region includes India, Pakistan, Bangladesh, Nepal, Sri Lanka, Bhutan and Maldives and is home to about one-fifth of the world's population. This region has also experienced ethnic and regional conflicts, reflecting vast language, religious and ethnic divides. There are also very diverse issues and contexts that drive developments in the region. The author highlights the differences between countries with respect to these issues and contexts and shows how each country is addressing the use of ICTs in the education system. The chapter offers country analyses showing how ICTs are being used in the school education system. In focusing on developments within countries of the region, this chapter also notes where schoolnets and schoolnet-related organisations have been developed.

- The **Southeast Asia** region is one of extremes in all aspects from population, income levels, ICT penetration, culture and languages. This region consists of Brunei, Cambodia, East Timor, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam. The chapter focuses on ICT penetration of each country and its use within the education system. While noting that schoolnets are increasingly being seen as important to the support of ICT use in education, not all countries have established such entities. A recent programme of UNESCO (Bangkok) is supporting this development in participating countries. The schoolnets being developed offer a more government-driven model, one that contrasts with similar organisations in Africa (which is more donor-driven).

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CHAPTER 2

AFRICA

Shafika Isaacs

The story of schoolnets in Africa is the tale of a pioneering, innovative attempt to apply new information and communications technologies (ICTs) to resource-poor environments as a means of enhancing development in general, and education access, efficiency and quality in particular.

At the heart of the schoolnet process lies a fundamental transformation in the way learning and teaching takes place. Whilst some schoolnets, like the Western Cape Schools' Network (WCSN) in South Africa, can date their activities as far back as 1993, many took root in Africa in the late 1990s, essentially as a movement towards promoting community access to ICTs. Today it is estimated that more than 30 African countries are engaged in a school networking process and together they operate as a pan-African network of networks (see *www.schoolnetafrica.net*).

SCHOOLNETS IN AFRICA

"Schoolnet" is a catch-all phrase describing organisations and groups, both formal and informal, involved in promoting education through the use of new ICTs such as computer networks, e-mail and the Internet in African schools. Lately the word "e-schools" has also been adopted to refer to the same phenomenon: a network of schools that collaborate on the basis of a technical and electronic infrastructure. Such a technical network facilitates the development of a stronger collaborative social network among learners, teachers and sometimes non-school community members who use the technologies for learning experiences at local, regional and global levels. It also involves interschool collaborative projects at all levels to train teachers in the educational use of ICTs and content and curriculum development on ICT platforms. Table 2.1 describes schoolnets in Africa by their structure, services and sustainability (see *www.schoolnetafrica.net*).

This definition of a schoolnet is corroborated by recent research (Addo et al. 2003), which describes activities in which schoolnets in Africa are engaged:

- Teacher training in educational use of computers: 22 per cent
- Computer distribution and connectivity: 21 per cent
- Supporting policy on ICTs in education: 19 per cent

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Table 2.1: Schoolnets in Africa

Structure	Services	Sustainability
• Establishment and ongoing operation of a school networking institution/organisation • Minimum of five schools in regular communication and interaction on learning initiatives using ICT	• Computer distribution and connectivity services facilitated and co-ordinated by the schoolnet institution • Interschool networking and collaborative projects using the broad array of ICTs • Content and curriculum integration • Teacher training in ICT use to enhance teaching	• Year-on-year growth of the country schoolnet initiative • Financial sustainability increases from year to year with less reliance on external resources/ funding. • Steady year-on-year increase in human resource capacity with less reliance on external resources • Year-on-year consolidation of partnerships

- Technical skills training: 19 per cent
- Developing school curriculum using ICTs: 17 per cent
- No answer: 2 per cent

Addo and colleagues (2003) also note that awareness-raising activities about the role of ICT in education have also been undertaken through annual conferences on ICT in education, national Internet days, the promotion of collaborative projects and the sharing of experiences. Cyber-jeunes, a project based in Senegal, is an example of a schoolnet which has introduced different ways of integrating health, environmental issues and sexuality education into its programme through the use of ICTs.

This research shows that, contrary to popular belief, schoolnets in Africa are concerned not only with technological issues, but also with educational, capacity-building and institutional issues, and in some cases in influencing national policy. Evidently, schoolnets act as change agents in the paradigm shift in the education systems at the national level. As well, they have been a catalyst for including Africa in the global knowledge-based society.

TWO CASE STUDIES

Established benchmarks for schoolnet best practices do not exist as yet and are in the process of development. However, the two schoolnet organisations described below are well worth considering for their model interventions.

Western Cape Schools' Network

The Western Cape Schools' Network (WCSN) is arguably the oldest, most experienced schoolnet on the African continent if the definition above is applied. It was established in 1993 initially as an Internet service provider (ISP) for schools in the province and has subsequently developed as a "virtual ISP," meaning that it purchases Internet

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access accounts from a commercial ISP, resells them to schools nationally and adds an administration fee. It also provides technical support and maintenance services to schools, it has a dedicated call centre that acts as a help desk and provides Web-hosting and domain registration services for schools.

WCSN is a non-governmental organisation (NGO) which works in partnership both with SchoolNet South Africa, particularly on its Educator Development Network programme and the Western Cape Education Department, with which it has now connected all of its 1560 public schools to the Internet. In many of these schools, the connectivity is mainly available in the administration offices to facilitate efficiency in management and administration. WCSN continually does research into new and alternative solutions for cost-effective connectivity to e-mail and the Internet for schools. It offers schools a best practice consulting service with regard to new technologies.

The WCSN is also known for its periodic conferences, attended mainly by teachers from all over South Africa, that provide an opportunity for collaboration and exchange of experiences. Through their virtual ISP role and regular conferences, the WCSN has been able to generate revenue that has ensured their sustainability for a decade.

SchoolNet Nigeria

SchoolNet Nigeria (SNNG) emerged directly as a result of its interactions with other schoolnet formations through SchoolNet Africa, and particularly SchoolNet South Africa. It was officially launched in September 2001 with high-level support from the Ministries of Education, Communications and Science and Technology. It is a partner organisation of the Nigerian Education Tax Fund (ETF), which is a state fund based on 2 per cent taxation of company profits in Nigeria.

Since its launch, SchoolNet Nigeria has been involved in the following projects:

- It has initiated a print media project in partnership with MTN, an international cellular network company which involves educational information and curriculum-focused inserts in Nigeria's national newspapers. This ensures widespread distribution of education resources which is also a novel way of using traditional ICTs.

- It has established a Diginet project in partnership with Direqlearn, an international company that provides education technology solutions to schools and the Nigerian Education Tax Fund, which provides PC labs on an open-source solution to Nigerian schools. At the time of writing, 35 schools had been provided with PC labs of 20 computers and a server on a "thin client" network, including a curriculum software package called LearnThings, as well as training for teachers at each of the schools. These school-based labs function as cyber cafés and computer training centres for non-school community members after school hours.

- It has partnered with the World Bank on a civic education project called Civicicts, which is an e-mail–based collaborative project for learners and partners with SchoolNet Africa on a ThinkQuest Africa Project in Nigeria.

CONCEPTUAL FRAMEWORK

The conceptual framework within which schoolnets in Africa were initiated was based on the discourse of the "information society" and development. The information society is said to be characterised by the growing importance of information and knowledge in a

globalised economy. This growth, however, has given rise to a "digital divide," which is most extreme in Africa.

The digital divide has been conceptualised as the growing divide between those who have access to information through ICTs and those who have not. Many have argued as well that the digital divide is not only about disparities in access to technologies, but also about disparities in skills, capacity and local content, and that the digital divide is a function of existing socio-economic global disparities.

A few examples clearly demonstrate the manifestation of the digital divide within Africa and the context within which schoolnets operate (see *www3.wn.apc/org/africa*):

- There is a huge disparity in computer penetration in schools in Africa compared to Europe and the USA. PC penetration is 1:24 (one PC for every 24 learners) in European schools and 1:6 in the USA. In Mozambique, the ratio is 1:636, and only 20 out of 7000 schools have computers.

- One-third of the 21 million untrained teachers in the world are in Africa.

- Zambia lost 290 Ph.D. graduates in the last five years, which reflects the capacity constraints that Africa experiences.

- Africa has been referred to as a "downloading continent" since only 0.2 per cent of Internet content is considered African.

Another conceptual influence in schoolnet interventions is the extent and depth of Africa's education crisis and the need to rally behind the call to achieve universal primary education by 2015 espoused in the international initiative Education for All (EFA). With an estimated 42.7 million youth out of school in Africa alone, the EFA goals remain uppermost in development programmes, and schoolnets have been challenged to demonstrate how ICTs can facilitate and support EFA objectives.

Finally, there is growing understanding that education systems globally are undergoing transformation, precipitated by the increasing use of ICTs which have given rise to new, innovative ways of learning and teaching and which hold the potential for enhancing access, efficiency and quality of education in Africa (Mansell and Wehn 1998; Butcher 2001). These changes are attributable to the forms of networking, collaborative learning, knowledge sharing and interactive learning which ICTs facilitate (Heppell 2000). Haddad and Draxler (2002) suggest the importance of a new schooling paradigm precipitated by this information revolution.

CHANGE DRIVERS

Over the years, a combination of factors have contributed to the growth of the schoolnet movement in Africa. The main factors have been the facilitative role of the donor aid community, under the influence of attempts to bridge the digital divide, along with their programmes to achieve the EFA goals, the role of schoolnet champions, regional schoolnet programmes and private sector interventions.

These factors demonstrate that the growth of schoolnets in Africa is a function of the rapid emergence of the global knowledge-based economy, its concomitant shift in education processes and learning and teaching systems internationally, and attempts to counteract the exclusion of Africa from the globalisation process. The myriad international initiatives, coupled with limited private sector interventions to promote "digital opportunity," has provided the impetus for this change which is, notably, largely

externally supported although there is also evidence of leadership for this change emerging from within Africa.

Donor support

In 1996, the Canadian International Development Research Centre (IDRC) announced the establishment of its Acacia Initiative as its contribution to the African Information Society Initiative (AISI), which was a declaration of the United Nations Economic Commission for Africa (UNECA). The Acacia Initiative included, among other things, the establishment of telecentres and schoolnets as community access models for ICTs, and the formation of and support for schoolnets in nine African countries was a direct outcome (see *www.idrc.ca/acacia*).

Similarly, the World Bank, through its World Links for Development Program, promoted the establishment of schoolnets in a number of African countries. Subsequent regional programmes emerged as part of the broader endeavour to bridge the digital divide, with the growing support of the G8 nations and others which included the promotion of ICT use in schools in Africa. Among these were the Imfundo Project of the Department for International Development (DFID) and the Global Teenager Project of the Dutch-based International Institute for Communication Development (IICD).

Today more international donor organisations have ICT programmes in Africa which support the promotion of education to some degree and which will be influenced by the impending World Summit on the Information Society (WSIS – see *www.itu.int/wsis*) and the attention given to e-schools by the United Nations ICT Task Force. Similarly the development imperative to achieve the EFA goals also features prominently in the interventions of the international development and donor community (see Table 2.2).

All this suggests that the inclusion of Africa in the information society through the schoolnet movement has its impetus largely in externally driven, supply-side interventions.

Table 2.2: *Bridging the digital divide in Africa.*

Year	Event
1996	Information Society and Development
1996	African Information Society Initiative
1999	African Development Forum
2000	Digital Opportunities Task Force
2000	UN ICT Task Force
2001	New Partnership for Africa's Development
2002	G8 Africa Action Plan and CEO Charter for Development
2003	World Summit on Information Society Geneva
2005	World Summit on Information Society Tunisia

Schoolnet champions

Dedicated schoolnet "champions" have played a pivotal role in the growth of the schoolnet movement in Africa. A schoolnet champion can be defined as a change agent who pioneers the paradigm shift towards ICT-enabled education through the agency of local schoolnet organisations. Usually a schoolnet champion is an individual who is not risk-averse, who is entrepreneurial in outlook, who leads and drives the establishment and growth of the national schoolnet organisation, often against all odds.

A number of schoolnets arose due to the dynamism of a few talented individuals of this nature: SchoolNet Namibia has a dynamic director who has skills in business development, working with children and ICTs; in Rwanda, the Minister of Education has championed the cause of school networking and, in some cases, teachers themselves have taken the initiative to drive the schoolnet process; Cameroon, Mali and Kenya also have examples of teachers playing a championing role. And because the schoolnet process in so many cases is driven by grassroots practitioners who have a direct hands-on approach in their dealings with schools, it is often characterised by strong rank-and-file participation within civil society formations organised around achieving specific social and developmental objectives.

Regional programmes

Another change driver in the African context is the influence of regional schoolnet programmes such as SchoolNet Africa (SNA) and its unique relationship with national and international partners in promoting school networking.

SNA is the first African-led, African-based pan-African schoolnet network. It is one of two continental schoolnet networks in the world, the other being European Schoolnet. It works as a "network of networks," which involves schoolnet practitioners, policy-makers, teachers, learners, researchers and schoolnet organisations operating in 31 African countries. It has established, in addition, a network of all regional programmes supported by international agencies in respect of ICTs in education in Africa.

SNA is an NGO which assumes the role of an advocacy and lobbying institution as well as providing support and resources for national schoolnet processes, which at times involves working directly with Ministries of Education. In its support function it develops the frameworks and learning capability among its network on education-intensive ICT applications for schools and develops specific regional programmes to support national initiatives. It places the emphasis on the national schoolnets being the implementing agencies at the local level.

SNA's regional programmes include the establishment of one of Africa's first multilingual education portals known as the African Education Knowledge Warehouse, the establishment of a content-rich programme involving collaboration among African learners in producing Web sites called the ThinkQuest Africa Program, the establishment of the African Teachers Network, a research programme, a policy support programme and the Connecting African Schools programme, which seeks to establish workable, affordable and sustainable technology solutions for schools. SNA also serves to build technical, managerial and policy capacity among its network of schoolnet champions in an attempt to strengthen the skills base in its network. It is, moreover, a gender-responsive organisation: it has mainstreamed gender issues in is programme and organisational operations, and has also dedicated women's empowerment programmes in an endeavour to foster gender equality.

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Finally SNA is a strategic partner of the burgeoning e-schools programme, a project of New Partnership for Africa's Development (NEPAD). NEPAD is largely an African inter-governmental programme whose objectives are to achieve growth and reconstruction within Africa.

The importance of regional programmes in the growth of schoolnets was evidenced by a regional workshop attended by schoolnet practitioners and policy-makers from 25 African countries to discuss their local experiences (see *www.schoolnetafrica.net/ botswanaworkshop*). A discussion on the start-up of schoolnets in countries where they do not exist in Africa and the support for existing schoolnet programmes featured prominently. This workshop occurred three years after the birth of SNA at a similar workshop held in Okahandja Namibia as part of the UNECA-led AISI programme (see *www.uneca.org*). Synergies with the more recently established e-schools programme of NEPAD, launched in June 2003, will not only contribute to awareness-raising and experience sharing, but given its African leadership, will also promote the importance of African solutions to its education crises.

Private sector intervention

There has also been limited private sector intervention in encouraging digital inclusion in African schools. Programmes like Intel Teach to the Future support the development of ICT capability among teachers in order to enhance their teaching. In some cases, the private sector initiatives partner with schoolnet organisations to implement their programmes. These initiatives, albeit limited at this stage, act as further impetus to the growth of school networking in Africa.

FEATURES OF AFRICAN SCHOOLNETS

Schoolnet evolution

The evolution of schoolnets in Africa has been uneven and varied. The process is still in its infancy on a historical scale (one year in some cases) and is influenced by imperatives to "catch-up" with the more technologically advanced countries.

Typically, schoolnet evolution and growth in Africa over the past few years has occurred in three stages: pre–start-up; start-up, and roll-out.

The **pre**–**start-up stage** is typically characterised by:
- The absence of a formally constituted schoolnet project
- The availability of one or two individuals to champion the school networking process
- Interest expressed by various groups and potential partners which sometimes take the form of a multi-stakeholder workshop
- A framework or business plan to establish a school networking project
- A proposal to pilot a school networking activity usually involving a few schools
- Donor support expressed or provided to assist the pre–start-up stage

The time frame and scale during the pre–start-up stage varies from country to country. Two typical examples are SchoolNet Tanzania and SchoolNet Sudan.

The **start-up stage** typically commences once a schoolnet has been formally constituted to facilitate school networking activities. Usually donor support has been provided to initiate the start-up stage. The schoolnet is typically engaged in the following activities:

- Piloting individual projects such as teacher training, installing computers in schools, developing content and providing connectivity
- Lobbying various stakeholders for resources and financial support
- Reaching a sizeable number of schools, learners and teachers through the schoolnet programme

The start-up stage is also typically the technology-push stage, although value-added training and education activities also commence simultaneously. SchoolNet Kenya and SchoolNet Malawi are examples of schoolnets in the start-up stage.

The **roll-out stage** is characterised by the existence of:

- A formally established schoolnet that facilitates connectivity at larger numbers of schools in various regions and provinces on a national scale
- The emergence of a national programme with strategic support and leadership from government ministries and the private sector
- The increasing value-added educational use of ICTs in schools coinciding with a programme to reach universal access to ICTs in school
- The beginnings of a sustainable programme

Examples of schoolnets in the roll-out stage are SchoolNet Namibia and the ICT in Schools Program in Botswana. Many schoolnets in Africa are in the pre–start-up and start-up stages with those in roll-out stage being exceptions.

This description of schoolnet evolution is somewhat simplified. However, it serves to explain the way schoolnets in Africa have tended to evolve and grow over the years progressing from one stage to the next. SchoolNet Mozambique is an example of a schoolnet that has evolved following these three stages, as it is now in roll-out stage.

Schoolnets as monopoly?

In some cases schoolnet organisations in Africa do not hold the monopoly on ICT activities in education, particularly in schools, in their respective countries. SchoolNet South Africa (SNSA) is a case in point.

Since 2000, when SNSA became an independent NGO, it has made great strides in promoting computer access to schools, teacher training and curriculum integration. However, other school networking activities have taken place in the country for some time. In fact, if the definition of school networking in Table 2.1, above, is applied, then it must be considered that school networking in South Africa dates back to the early 1980s with the formation for Community Education Computer Society (CECS) which first placed computers in former "black" schools. As well, in the early 1990s, provincial schoolnets were formed and promoted Internet access to schools. (In 1996 the provincial schoolnets collaborated to form SNSA which was formally established as a national organisation within a larger donor organisation, the IDRC.)

Besides these early developments, the following initiatives have also emerged since 1997:

- The Universal Service Agency Cyberschool Project, now reaching up to 130 schools

- Intel Teach to the Future Project, focusing on teacher training
- WCSN, serving schools in the Western Cape Province
- Gauteng Online, a government-led initiative to develop "smart schools" through ICT access in the Gauteng Province
- Khanya Project, integrating ICTs in schools in the Western Cape Province
- Multichoice, a private company supporting teacher training and curriculum development projects in South Africa
- Mindset, a recently established curriculum-focused television programme
- Direqlearn, promoting open-source education ICT solutions for schools
- Cisco's recently launched handheld project with schools in Soweto
- Solar Electric Light Fund Project, promoting solar schools to a number of schools in South Africa
- Netday, a computer refurbishment organisation servicing South African schools
- Freecom, a computer refurbishment organisation servicing South African schools
- Hewlett Packard's iCommunity Project, focusing on municipalities including schools in the Limpopo Province of South Africa
- Microsoft Digital Village, reaching young, school-based learners

In fact, a recent study by SNSA reveals that there are an estimated 34 ICT and education projects in the country. Many of these projects operate independently and others work in collaboration with SNSA, which demonstrates the dynamism of the school networking environment in South Africa. Indeed it also shows the potential SNSA has to act as a clearing house and co-ordinating mechanism for all of these initiatives.

However, in certain cases in Africa, the schoolnet organisation is the only structure promoting the educational use of ICTs in schools. For example, SchoolNet Namibia is a national programme targeting the involvement of all of the country's 1519 schools over the next five years. Similarly, SchoolNet Mozambique is a national government-led initiative.

Schoolnet organisational forms

Schoolnets in Africa assume various organisational forms, as follows:

- **Voluntary associations:** In a number of cases the schoolnets, especially those in the pre–start-up stage, are run by volunteers who have full-time jobs elsewhere but who are committed to the mission of school networking in their respective countries. SchoolNet Sudan, SchoolNet Mali and SchoolNet Benin are examples.
- **University outreach programmes:** Some schoolnets are incubated within existing institutions in order to emerge later as fully fledged independent organisations. For example, SchoolNet Mozambique was pre-dated by Internet para as Escolas, which was an outreach project of the Centre for Informatics at the University Eduardo Mondlane in Maputo before it became a project of the Ministry of Education. The University of Lesotho similarly promoted school networking in this way, demonstrating the role universities can play in supporting ICT-enabled education in schools. Notably, this type of organisation is typical of schoolnets in their pre–start-up and start-up stages. Cyber Jeunes, a project of the GEEP based at the Cheikh Anta Diop University in Senegal is another such example in the Francophone region.

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- **Non-governmental organisations:** A number of schoolnets are established NGOs that have strategic partnerships with government Ministries of Education, Ministries of Telecommunications, tertiary institutions, other NGOs and the private sector. SchoolNet Namibia, SchoolNet Kenya, SchoolNet Nigeria and SchoolNet South Africa are all examples.

- **Government-based institutions:** A few schoolnets have emerged as government-based, government-led institutions. SchoolNet Mozambique and the Smart Schools Program in Egypt are both flagship projects of their Ministries of Education and are products of national ICT strategies spearheaded at the highest level in their respective countries.

- **International networks:** Some schoolnets are characterised by organic ties to international agencies promoting ICTs in schools. The World Links Organisation is a good example of this where schoolnets in 10 African countries are associated with and supported by their parent organisation in Washington.

These examples suggest that the developmental stage of a schoolnet relates to the organisational form which it assumes. The organisational form is also informed by the extent to which national governments have implemented national ICT policies and programmes. Many schoolnets in Africa were established as civil society formations operating outside of the national government. However, as the schoolnet movement grows at the national level, the organisational form is changing to one where it becomes increasingly integrated within government institutions.

Resourcing models

A few resourcing models have emerged within the schoolnet movement in Africa which hold promise for the establishment of "made-in Africa" sustainable solutions. Addo and colleagues (2003) note that funding for schoolnets was obtained from a variety of sources, the most common being international donors followed by local business, member schools and, in some cases, governments. Donor funding was instrumental in the start-up processes for a number of schoolnets as part of donor-led initiatives to bridge the digital divide. In many cases, these support mechanisms were not accompanied by a shift away from donor dependency a few years down the line. The result has been that some schoolnets could not survive beyond their initial grants when their respective donor partners ended their support. The first attempt at establishing a SchoolNet Zambia is a case in point. However, renewed attempts at establishing SchoolNet Zambia are currently underway.

With the limited pool of donor funding available to support schoolnet start-ups in Africa, this resourcing model proves to be unsustainable unless the schoolnet management and leadership adopt a different approach to resourcing and sustainability. These experiences, however, have encouraged various schoolnet practitioners to find alternative resourcing solutions.

The ISP model

One model that appears to be very successful and potentially sustainable is the schoolnet as Internet service provider (ISP), which has been applied by SchoolNet Namibia and WCSN, and which is now being explored by SchoolNet Nigeria. This model is characterised by the schoolnet organisation acting as an ISP based on subsidised rates for Internet connectivity for schools. It relies to some extent on support and partnership with

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the national telecommunication ministries and regulators as well as local commercial ISPs. Such a model also encourages greater reach and scale to schools as revenue grows. The schoolnets that have tried this model have successfully shifted from their dependency on donor aid. WCSN reportedly scored a surplus of USD70 000 per year based on this model, which partly explains why it has been able to survive as an organisation for 10 years.

School-based telecentre model

The school-based telecentre model and school as cyber café model are both variations of the same theme and are sustainable at a school level. SchoolNet Nigeria's highly successful Diginet Project is one example. It allows for free educational use of cyber labs established by SchoolNet Nigeria until 3:00 p.m. For the rest of the day until 10:00 p.m. the labs function as cyber cafés, open to the community and the public at large. In this way, the school generates revenue which helps to sustain both the cyber lab in the school and the organisation. The Diginet project is currently being evaluated and it hopes to highlight the extent of its success.

Similarly the school-based telecentre model as applied in Zimbabwe by the World Links Organisation represents an attempt at financial sustainability and maximum utility of the ICT resources to meet both education and community needs (see *www.world-lings.org*).

Public-private partnership

In the quest for sustainability, schoolnet partnerships with both government and the private sector, both locally and internationally, are important to consider. The success of these partnerships is, however, varied. The private sector partnership with SchoolNet Namibia has helped build the reputation of private sector companies as agents concerned with education and the future of Namibian youth. Creative ways have been utilised to encourage private-sector buy-in ranging from donations of pizzas to young learners involved with setting up computer labs in schools to commission from sales of products as contributions to SchoolNet Namibia. Such contractual relations can be sustained over a longer period, hence holding the potential for continuous support for the schoolnet endeavour (see *www.schoolnet.na*).

SchoolNet Nigeria also offers a creative model of "social entrepreneurship," having partnered with a locally based enterprise, Direqlearn, which operates with a strong developmental imperative but which also seeks profitable solutions. This partnership includes the Nigerian Education Tax Fund (which collects 2 per cent of profits of all Nigerian companies as a contribution towards the promotion of education in Nigeria) which provided seed funding for the initial roll-out of its cyber labs in schools. This represents a unique model of partnership as it draws heavily on local financial resources and does not depend on external donor support.

Scale of operation

The question of scale of operation for most schoolnets was highlighted at a recent workshop which focused on using ICTs to support the education system, held in Gaborone, Botswana, 28 April–2 May 2003. Most of the schoolnet projects are small-scale pilot initiatives (see *www.schoolnetafrica.net/fileadmin/resources/workshop_report.zip*).

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Table 2.3 presents a rough estimate of scale of operation based on anecdotal reports given at schoolnet workshops. This data is perhaps the most reliable available at this stage, given the dearth of codified information on this subject.

The limitations of the small-scale initiatives are further compounded by their limited reach to learners. In Mozambique, a typical school has between 6000 to 7000 learners. The computer-to-learner ratio in schools with computers is typically 1 to 636.

However, if educational ICTs are to become a reality for many of Africa's learners and educators, then the scale and impact of investment needs to be increased manifold. Failing to do so runs the risk of creating an intradigital divide within African countries. To date, Egypt, Namibia and Botswana have demonstrated the shift towards a mass model which is also a function of national ICT programmes.

Table 2.3: *Computer penetration at schools in selected African countries (June 2003)*

Country	Estimated number of schools	Schools with computers	Per cent of schools with computers
Egypt	32,000	20,000	62.5
Ghana	35,000	32	0.09
Mozambique	7,000	20	0.29
Namibia	1,519	200	3.94
Nigeria	50,000	20	0.04
South Africa	28,700	5,000	17.36

ICT ACCESS MODELS

The search for affordable, sustainable access to ICTs in African schools has been experiment-oriented. Seven years of accumulated experience across the continent have established models which appear to work successfully. Many schoolnets have adopted a computer laboratory approach as a start. These laboratories are set up as local area networks and include between two to 40 computers. Many computer laboratories have been established either on the basis of new computers donated to the schoolnet through donor, government or private sector agencies or with imported secondhand or refurbished computers.

The Diginet Direct Openlab solution represents an innovative low-cost, sustainable and secure model of ICT access to schools which can also be replicated on a mass scale. It incorporates a "thin-client" solution where all processing takes place through a powerful server with the rest of the computers in the network being dumb terminals. The network is powered by an open-source operating system and education software, Linux Mandrake 9.0, and an education software package, LearnThings.

Connectivity is powered by a very small aperture terminal (VSAT) which has been allocated to each of the 35 schools in the initial pilot phase. This represents the largest VSAT programme for schools in sub-Saharan Africa.

The Diginet model is a total solution as it also incorporates a strong technical maintenance and support programme through a team of technical field officers and a call

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centre; it offers curriculum integration and teacher training in the use of the curriculum content.

The Diginet Direq Openlab Model represents one approach to be adopted by new schoolnet start-up projects. SchoolNet Africa is adding value to this model through its call for one million free computers for Africa which can be refurbished through locally established computer refurbishment centres run by youth who also deploy computers to the schools.

Connectivity models range from no connectivity to the Internet in the more disadvantaged schools to ADSL-empowered connectivity in the more affluent schools to VSAT-enabled connectivity, which currently serves as an experiment with SchoolNet Uganda and SchoolNet Nigeria taking the lead.

Technical innovation in this arena includes the establishment of solar schools which will be developed in South Africa as well as the use of other technologies such as handheld devices which are also being experimented with in South African schools.

At a policy level, the call for an education rate (e-rate) by SNA is an attempt to encourage an enabling policy environment for school networking. South Africa, Egypt and Senegal all have e-rate policies (Espitia 2001).

Specifically, the main obstacles to Internet access faced by African schools are:

- Lack of infrastructure generally, and network infrastructure in particular
- High telephone and Internet costs
- Limited expertise and ICT skills levels
- Lack of enabling policy environment (Isaacs 2002a).

Evidently, cost is one of the biggest constraining factors. For this reason, cost factors are considered when taking into account which software solutions to use in schools. This informs the preparedness to explore open source solutions for African schools. This issue of appropriate software solutions is currently under investigation by SNA and its partner organisation Bridges.Org, the initial findings of which are available on the SNA Web site (see *www.schoolnetafrica.net*).

Given the constraints of widespread computer and Internet access, it is essential that traditional ICTs such as radio, television and print media not be seen as less important as learner support materials than new ICTs such as computers, e-mail and the Internet. These media will continue to have a fundamental role in the provision of educational resources to learners (Addo et al. 2003).

EDUCATOR TRAINING

There are a few locally relevant educator training models that have been developed within Africa. A number of schoolnets utilise educator training models that have been developed by international agencies such as the International Education Resources Network (iEARN) and the World Links Organisation. One of the few that has been locally developed is Egypt's ICDL training for all its teachers. The shortcoming with ICDL training is that it does not integrate the use of ICTs in learning and teaching. However ICDL training remains an important step in fostering ICT literacy amongst teachers.

A well-established local model that integrates ICT literacy and the educational use of ICTs is SchoolNet South Africa's Educator Development Network (EDN) model which also offers a mentorship support programme. Fostering collaboration and peer networking among educators is further promoted by the recent establishment of the African Teachers Network, which includes teachers who form part of the local schoolnet organisations in Africa.

The previously mentioned conference on ICTs in African schools held in Botswana recognised the importance of an integrated approach to educator development and considered the need to integrate ICTs in pre-service educator training by connecting the teacher training institutions. Such an approach will go a long way in the shift towards systemic change in the teacher training systems at the national level in Africa.

CONTENT AND CURRICULUM INTEGRATION

The use of ICTs in developing interactive curriculum-based content represents the value-added use of ICTs in the formal school system. It is also the one area where schoolnet intervention has been relatively limited. The findings of a SchoolNet South Africa study bears testimony to this by suggesting that of all the 34 ICT-related projects in education in South Africa, what was missing were projects focusing on curriculum development and innovation and global communication between schools. This situation prevails across the continent.

Content development can be defined as the aggregation and creation of educationally relevant content usually developed by learners and educators but also by curriculum specialists and quality controlled by curriculum specialists. For some this process involves creating digital textbooks, although new learning in this area reveals that curriculum integration must also involve interactive learning processes and the use of collaborative tools in the platform on which the online curriculum is premised.

Existing content-related programmes among schoolnets in Africa remain extra curricular. ThinkQuest Africa (see *www.thinkquestafrica.org*), a project of SNA, is one example of a content development programme which encourages learners to develop content-rich Web sites in teams. Aidsweb, a project of the World Bank Institute (see *www.worldbank.org/ worldlinks/aidsweb*), is a similar initiative.

The shortcoming with existing content development projects, however, is that they are not part of the curriculum process in schools. Curriculum integration, on the other hand, places the emphasis on the use of the subject-specific curriculum content on an ICT platform to facilitate learning and teaching. Curriculum integration arguably represents the most important educational value-added use of ICTs, because the essence of school-based education revolves around the subject-based curricula, taught during school hours. The added challenge is that historically, curricula have been rigid and inflexible and premised on the notion that the school is the centre of learning and the teacher leads the classroom. However, the curriculum development process, quite outside of the impetus for change provided by ICTs, is also undergoing reform internationally. South Africa is a case in point where the entire curriculum system has undergone a reform process – a shift from apartheid indoctrination towards fostering critical and lateral thinking capability among learners. The integration of ICTs into the school-based curriculum is thus taking place at a time when curriculum change is under way.

In Africa, there are three ways in which schoolnets have approached digitised or online curriculum integration. The first is the "adopt model," which involves the wholesale

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adoption of existing digitised models of curricula developed elsewhere. For example the mathematics curriculum is well developed by Canada's SchoolNet. Schoolnets in Africa could (with permission from Canada's SchoolNet) simply adopt and use the digitised curriculum as is. This approach presupposes synergy between an international curriculum and the way it is applied locally. The adopt model is currently being used in Nigeria where teachers are using a software product called LearnThings based on the UK curriculum. SchoolNet Uganda similarly uses a product called Blackboard which is premised on the adopt model as well.

The second approach is the "adapt model," which suggests that existing digitised curriculum can be adapted to suit local conditions. SchoolNet Nigeria is in the process of adapting the LearnThings product to include curriculum content based on local curricula requirements.

The third approach is the "create model," which encourages the development of local curriculum content from scratch, taking into account local languages and that teaching takes place in the vernacular. This model is currently being applied by SchoolNet South Africa in its Educator Development Network programme where teachers are involved in developing content for science and mathematics in its 17 teaching modules. The create model is evidently extremely limited at this stage, although SchoolNet Africa will be initiating experiments with a number of schoolnets in its network.

One should guard against making a fetish of curriculum-based learning as more recent knowledge on learning capability suggests that the school and curricula are no longer the only centres of learning. However, the value-added use of ICTs in schools has to be focused on curriculum integration in the coming period of schoolnet evolution in Africa. An added concern is the importance of quality assurance and standards in the development of local curricula.

A series of collaborative projects have been introduced at international and regional levels which offer educational value to the learner. These include a teacher collaborative project run by the International Education Resources Network (iEARN) and World Links, the IICD's Global Teenager Project, ThinkQuest Africa and the World Bank's Civics project. Whilst many of these projects have been evaluated, they have not undergone any quality assurance process by schoolnets or education authorities to ascertain the education value they add, if any. Furthermore, they are largely extracurricular projects requiring after-hour commitment by teachers and learners, and therefore they raise a systemic limitation unless they are factored into a process that integrates them into the learning and teaching systems at school.

SCHOOL NETWORKING: CONCEPTUAL CLARITY OR AMBIGUITY?

Since the establishment of the schoolnet movement in Africa, much of its emphasis can be characterised as small-scale ("dribs-and-drabs"), pilot-centred, donor-dependent, gender-blind, "technology push" initiatives which manifest a one-sidedness and a limited conceptual clarity on the raison d'être for school networking. Arguably, these features are consistent with externally driven processes. Some commentators argue that the cumulative experience of school networking in Africa still does not demonstrate workable, sustainable Africa-relevant educational models of ICT application. For some the jury is still out not only on the pedagogical value of ICTs, but also whether they facilitate the Education for All objectives, a primary concern in Africa. This argument

suggests the importance of continuing with the test-bed approach until there is greater conceptual clarity on positive educational outcomes before scalability is even attempted.

Others argue however, that the past five years of piloting and small-scale intervention provide enough information on what works and what doesn't to commence the shift towards a mass model which will demonstrate social "impact" far more effectively. The alternative is to remain steeped in "piloting" which still informs the approach to ICTs for development in the highly influential international donor community.

A combination of these views – of continuing test-beds together with a stronger paradigm shift towards the mass model of self-reliance in the schoolnet movement – is imperative to catalyse any significant developmental difference in Africa's education systems. It proffers a continuous learning approach to school networking which recognises that "technology-push" has characterised schoolnets in Africa but which also acknowledges that the continent is only at the beginning of the learning curve; that schoolnet intervention needs greater emphasis on the educational integration of ICTs; that an appropriate ICT in education policy framework represents a major gap in the schoolnet movement; that a more concerted effort towards gender mainstreaming in school networking is an added consideration of such a conceptual shift; and that the drive towards systemic change should inform school networking interventions.

The South African Education Department's former Centre for Educational Technology introduced the concept of a "schoolnet value chain" which attempted an integrated approach to the application of ICTs in education. According to Isaacs and Naidoo (2003), the value chain raises the full range of technical, educational, institutional and financial considerations simultaneously. This provides a useful conceptual tool as governments deliberate over appropriate policy solutions to promote school networking.

THE WAY FORWARD

Table 2.4 provides a snapshot of the extent to which progress has been made in the African schoolnet movement (bearing in mind that SNA estimates 85 million learners, 600,000 schools and five million teachers in Africa).

The information in Table 2.4 suggests that significant progress has been made. In view of the discussions at the previously mentioned Botswana conference, the emergence of the NEPAD eSchools Initiative and the UN ICT Task Force eSchools Program as well as the impending World Summit on the Information Society, school networking is destined to flourish in the coming period.

However, the schoolnet movement in Africa is still in a growth phase. There remain many challenges and barriers to overcome, foremost being the achievement of Education for All (EFA) objectives, considered a high developmental priority in the education sector. The establishment of an educational ICT project for child ex-combatants in Liberia with the possible extension to Somalia and Sierra Leone represents a small beginning in this direction. However, because of the focus on youth in school through the schoolnet programme, a concerted effort is still needed to explore ways to reach youth out of school.

Developing a compelling case for school networking and convincing policy-makers and government decision-makers of the need to invest in ICTs in education and allocate budgets towards this endeavour remains a challenge. Africa is certainly better placed for a more strategic and co-ordinated implementation effort in educational ICTs with its

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concomitant positive educational outcomes. There is much reason for optimism, and this is best captured by the renewed motivation to learn by teachers and learners in Nigeria when they stated, with reference to the cyber labs in their schools, "[There is] a new excitement in the air."

Table 2.4: SchoolNet progress since 1996

1996	2003
• Limited teacher training	• African teacher training models • Estimated 210,000 teachers trained in ICT skills and use of ICTs in education
• Limited technology solutions	• Workable computer lab solutions including "last mile solutions"
• No curriculum integration	• Collaborative projects • Local curriculum integration started • Basic understanding of what curriculum integration means
• No ICT in education policy	• Four countries with ICT in education policy • Four countries with policy processes under way
• No consideration for EFA	• Beginnings of EFA integration: Online Child Ex-Combatants Project and Online Street-Children Project

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CHAPTER 3

THE AMERICAS: NORTH, CENTRAL AND SOUTH AMERICA

Stephen Kemp

INTRODUCTION

The school networking models that have emerged in the Americas (North, Central and South America) for implementing information and communication technologies (ICTs) pulsate with the same energy, passion and diversity as do the numerous cultures that comprise this vast area. As Dunayevich and colleagues (1999) note, "technological development and improvement is an extraordinarily dynamic and expansive process rapidly pervading and modifying the customs of each society. Information and communication technologies (ICTs) are no exception, and the level of their improvement demand changes in different areas, particularly in education."

To implement a network of ICTs in the educational systems of the developing world that addresses the unique educational contexts and is respectful of the diverse cultures, five critical elements must be established:

1. Schools and homes must be provided with *connectivity* (Carlitz and Hastings 2000) to the Internet through a sound and inexpensive technological infrastructure.

2. *Catalysts* (K&V Stief Associates 2001) must provide the impetus to finance the projects, create a model of implementation, develop a set of goals and objectives, write policy and procedures and establish the educational infrastructure.

3. A *culture* must be promoted that includes an educational and social vision for the implementation of ICTs.

4. Educational *content* must not only be appropriate for learners and be based on sound pedagogy, but also be exciting and interactive to take advantage of the potential of the technology to enhance learning.

5. *Competencies* must be developed, supported and maintained for both teachers and students (K&V Stief Associates 2001).

Figure 3.1 graphically describes the nature of the process for implementing ICTs in an educational environment. The model suggests that to progress to the outer levels, the

issues and challenges of the inner levels must be addressed and resolved before the process can evolve and grow. Further, the embedded nature of the model illustrates that there is no sudden leap from one level to the next; the process is recursive, with the inner levels becoming the context for the outer levels.

As the web of ICTs is being spun across the continent, so the threads are being joined together by a commonality of purpose and vision: to improve the quality of the educational experience for all regardless of age, location, economic status, social class, gender or ethnicity. It is a web of equity and equality. It is a web of collaboration and community-building. It is a web of education and empowerment.
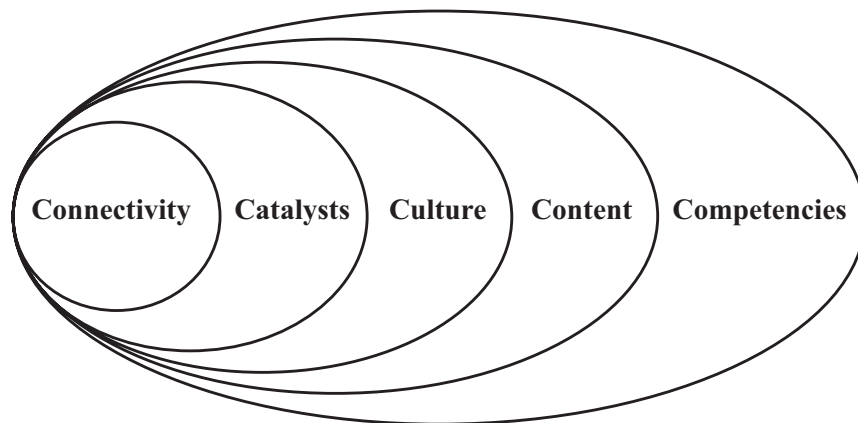
Figure 3.1: A model of the nature of implementing schoolnet ICTs in educational environments

WHY SCHOOLNETS?

In addressing the issue of access to ICTs and their use in the school system, many developed and developing countries have embarked on school networking initiatives. Schoolnets can be defined as the entities that facilitate the collaboration between schools using ICTs for education purposes. The focus of schoolnets is using computers and the Internet to support the education and training system.

As Hardin and Ziebarth (2000) suggest, "The traditional education system, being more evolutionary than revolutionary, is unlikely to transform itself any time soon into an environment that teaches and encourages collaboration as a part of learning; emerging technologies, however, can catalyse this change much sooner than it would happen otherwise." Carlitz and Hastings (2000) propose three reasons why school networks are at the vanguard of implementation models for ICTs across the region:

- **Isolation:** Wide-area computer networks can help end the isolation of students and teachers in the traditional classroom. Of course, networks will reach this end only if they are inexpensive enough to be made available to all students and teachers.

- **Equity:** Connecting all schools to the Internet will provide equity of access to online information and create opportunities for all schools to publish online. This requires a reasonably priced infrastructure that all schools can afford to purchase, install and maintain.

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- **Reform:** Networks can be a powerful tool in support of educational reform. A widespread network infrastructure with easy access to information servers and tools for placing resources on servers will allow students, classes and teachers to produce online materials, do extensive collaborative work and broadly share instructional resources.

TRENDS IN CONNECTIVITY

North America

Connectivity has been defined in a report prepared for Industry Canada by the Conference Board of Canada (2002) as "the availability and use of information and communication technologies (ICTs), software, content and associated services — to facilitate communications and interactions for learning purposes — whenever and wherever." It is this definition that is used in the following discussion.

The northern region of the Americas has a highly sophisticated, comprehensive and inclusive technological infrastructure. Statistics from Internet World Statistics (2003) indicate that Internet usage in Canada has grown by 32.6 per cent over the past three years to include 53.1 per cent of the population. Similarly, the United States has experienced a remarkable growth rate of 93.4 per cent over the past three years. With 63.2 per cent of its population included, it now claims the highest number of people accessing the Internet in the world at 184.4 million.

Statistics from both the United States (Tabs 2002) and Canada (K&V Stief Associates 2001) indicate that close to 100 per cent of schools have Internet access, with a high percentage of both elementary (kindergarten to grade 8) and high schools (grades 9 to 12) accessing Web-based resources through high-speed lines.

Canadian classrooms are being connected to the Internet through the collaborative efforts of the federal, provincial and territorial governments, education associations and the private sector. In the report from SchoolNet's On-Line Connectivity Survey in April 2000 (K&V Stief Associates 2001)*,* Canada is cited as one of the most connected countries in the world and boasts the following statistics:

- There are 425,234 Internet-connected computers.
- Fifty-five per cent of connected computers are located in designated areas such as computer labs, while 34 per cent are located in classrooms.
- There is an 8:1 national ratio of students per Internet-connected computer.
- Seventy-nine per cent of schools are connected to the Internet via a dedicated access line.

In comparison, when the United States National Center for Education Statistics (NCES) first started estimating Internet access in schools in 1994, 35 per cent of schools had access. But in analysing the impact of ICTs in American public schools, Tabs (2002) reported the following:

- In 2001, 99 per cent of public schools in the United States had access to the Internet. The majority (55 per cent) were using TD1/DS1 lines, a continuous and much faster type of Internet connection than dial-up, and 5 per cent of schools were using dial-up connections.

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- Public schools have made consistent progress in expanding Internet access in instructional rooms from 3 per cent in 1994 to 87 per cent in 2001.
- Forty per cent of public schools reported that the operating system most frequently used on their instructional computers was Windows 98. Twenty-five per cent had Mac OS 7.6 or higher and 25 per cent had Windows 95.

Further, a report by the US Department of Education in 2000 revealed that "nearly all public school teachers (99 per cent) reported having computers available somewhere in their schools in 1999; 84 per cent had computers available in their classrooms and 95 per cent had computers available elsewhere in the school." Truly, connectivity is not a problem in North America.

Central and South America

The combined regions of Central and South America, commonly known as the Latin American countries (LAC), fall far short of North America when it comes to percentage of the population using the Internet. According to Internet World Statistics (2003), the range of Internet use for LAC ranged from a low of 1.6 per cent in Nicaragua to a high of 20.3 per cent in Chile.

However, it is encouraging that LAC is experiencing a phenomenal growth in Internet usage. During the past three years, usage more than doubled in six Central and South American countries (Internet World Statistics 2003): El Salvador experienced a 650 per cent growth rate, Guatemala 208 per cent, Honduras and Paraguay both 400 per cent, Brazil 186 per cent and Colombia 126 per cent. These statistics complement the findings of Hahn (2000) when he writes that "the rate of growth of hosts in many of the Latin American countries is amongst the highest in the world. For example, the number of hosts for Argentina, Brazil, Colombia, Costa Rica and Trinidad & Tobago doubled between January 1999 and January 2000. In this same period, Mexico had an impressive increase of 259 per cent."

Significant efforts are being made to extend and improve not only the quantity but the quality of Internet access to schools across the subcontinent. Countries such as Mexico, Chile, Brazil and Argentina have implemented specific schoolnet initiatives that aim to provide comprehensive access to the Internet for elementary and secondary schools. Dunayevich and colleagues (1999), in the most comprehensive survey of school networking initiatives undertaken in LAC, report that the Red Escolar programme in Mexico expects to provide a Media Classroom with five to ten computers each for 3000 elementary schools and 2000 high schools, the Enlaces programme in Chile has targeted 100 per cent of their high schools and 50 per cent of the elementary schools for inclusion in their net by 2000, Argentina has a target of providing Internet access for every one of their schools, and in 1998, Brazil had already incorporated 14 per cent of their schools into the Proinfo Network.

Summary and discussion

As Carlitz and Hastings (2000) report, "Cost and access are the primary concerns for educational and community networks, and network architectures that neglect these factors are unlikely to be sustainable for very long." While Internet access is readily available even to remote rural areas in North America, providing an inexpensive, comprehensive and high-bandwidth Internet connection to all areas continues to be one of the major challenges facing LAC. As the World Bank (1998) has noted, "the real challenge for

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school connectivity in LAC is to extend the reach of the Internet infrastructure to rural areas, specifically to the poorest schools. Today, few options exist for schools in the most remote areas to obtain connectivity, for few rural schools have access to a local ISP."

To improve community access to technology, several countries in the LAC have implemented a series of "telecentres," community access structures where the fusion of telecommunications, information, multimedia and computing functions help address a variety of community problems and needs (World Bank 1998). This approach is consistent with the implementation model described by Carlitz and Hastings (2000), who suggest that "it is important to consider the entire community as a unit when assessing alternatives for providing an economical infrastructure for school or community networking."

Thus we can see that the issues for connectivity are entirely different between North America and the LAC. While in North America schools have almost universal access to the latest technology utilising the fastest Internet connection speeds, in LAC the challenge is to provide inexpensive, reliable, high-speed, equitable access to all schools.

CATALYSTS IN IMPLEMENTATION

North America

The catalysts for implementation of school networks should perhaps, in many respects, include all levels of governmental agencies, private sector corporations, educational associations, state and provincial departments of education, post-secondary institutions, regional school divisions and local boards of education.

Canada's SchoolNet is a collaborative initiative between federal, provincial and territorial governments, education associations and the private sector. On March 30, 1999, Canada became the first country in the world to connect its public schools, including First Nations schools and public libraries, to the Internet. SchoolNet's mandate is to help Canadian schools connect to the Internet, increase access to ICT equipment, advance their understanding and support for the effective use of ICT in education, support student use and understanding of ICT, and support teachers' professional development by sharing of hands-on projects and learnware applications (Conference Board of Canada 2002).

In many Canadian jurisdictions, connectivity is the responsibility of school boards, which have wired schools and installed board wide area networks to varying degrees (K&V Stief Associates 2001). However, the provinces of Saskatchewan and British Columbia are providing centrally driven ICT networks through their Community Access and Provincial Learning Networks, respectively, to connect schools with other community sites such as libraries, government offices and service providers.

While a consortium of governmental levels, educational associations and private sector companies are the catalysts for the development of SchoolNet in Canada, in the United States it appears as though there is no such co-ordinated effort to join the stakeholders in this enterprise. Many state departments of education, educational associations and special interest groups, local school divisions, post-secondary institutions and private sector companies have created a myriad of school networks without the overall co-ordination and organisation from the federal government.

One exception is E-rate, a programme of the Federal Communications Commission administered by the Schools and Libraries Division of the Universal Service

Administrative Company that provides eligible K–12 public schools and libraries 20 to 90 per cent discounts on approved telecommunications, Internet access and internal connections costs. E-rate discounts are based on the number of students eligible for the National Free Lunch Program. Schools and libraries in low-income urban communities and rural areas qualify for higher discounts (California Department of Education 2003). Thus, in terms of financing the implementation of ICTs, the United States government has recognised the inequities in access that may occur in various regions of the country and has implemented a process to facilitate the connectivity of its schools.

The decentralised approach to implementing ICTs and school networks in the United States has created both opportunities and difficulties. On the one hand, the implementation model promotes and encourages a high degree of collaboration between public and private sectors, bringing together a wide range of approaches, subject matter experts and funding sources. On the other hand, the model can result in an extremely complex and dizzying array of stakeholders.

The difficulties inherent in such a model have been described by Kozma and Grant (1995) when they write that "network-based educational innovations are complex and intentionally confounded in design. Projects frequently have multiple components, funders and partners, and various factors that change concurrently. For example, each of the 19 Educational Technology Challenge Grants awarded by the Department of Education in 1995 involves a consortia of organisations that include schools, businesses, universities and research institutes, libraries, museums and community organisations. They combine a multiplicity of interventions, organisations and resources, with the aim of reforming the educational system and improving educational outcomes." The challenge in this model, therefore, is to co-ordinate, collaborate and communicate.

Two prime examples of this approach are the Science Learning Network (SLN), which originated as a three-year, USD6.5 million project funded by the National Science Foundation and Unisys Corporation, and the Consortium for School Networking (CoSN), a national non-profit organisation. SLN features as its founding members the Boston Museum of Science, the Franklin Institute and several elementary schools across the nation. CoSN members represent school districts, state and local education agencies, non-profit organisations, companies and individuals who share a common vision.

Central and South America

It is clear from a review of the literature that several Central and South American countries have embraced the concept of schoolnets and have directed significant resources to developing and fostering a co-ordinated approach to their implementation, while many others are addressing the challenges of establishing a modern technological infrastructure.

The World Bank Human Development Network has described the various approaches undertaken in the implementation of ICTs throughout LAC (World Bank 1998):

- Developing a national or regional plan for country-wide deployment of technologies (e.g., Barbados, Costa Rica, Chile)

- Implementing experimental projects using technologies to gain experience and knowledge for eventual country-wide deployment (e.g., Chile, Jamaica, Mexico, Paraguay)

- Undertaking a variety of small-scale projects that use technologies to meet regional or local objectives or as demonstration projects (e.g., Argentina, Brazil, Colombia)

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- Using technology to address educational equity issues (e.g., Costa Rica, Chile, Jamaica, Mexico)

- Using broadcast technologies (radio, television and, more recently, computer access networking) to develop and deliver improved educational content and pedagogy, especially to learners in remote areas (e.g., Bolivia, Dominican Republic, Honduras, Venezuela, Brazil, Mexico)

- Focusing technology investment on preparing secondary school students or school leaders for technology-based jobs (e.g., Costa Rica, Uruguay, Brazil)

- Creating new kinds of schools built around technologies as their core education delivery system, such as Telesecundaria (e.g., Mexico) and distance learning higher education (e.g., University of the West Indies)

Regardless of the implementation model employed, the role of the private sector is particularly important in LAC. Martinez (2001), in describing the state of ICT implementation in Guatemala and El Salvador, which have the fastest development and highest concentration of the Internet, notes that "these are countries with fully privatised telecommunications systems…that promote an accelerated development of telecommunications and the private offer of Internet services directed towards the population with spending power." Similarly Richero (2002) and the World Bank (1998) have identified the role of the private sector and the nature of the relationships between companies, corporations and ICT implementation as the subject of much-needed research and evaluation.

Summary and discussion

If there is one "megatrend" that describes the various models of implementation across the Americas, it would be that of collaboration. In North America collaboration has resulted in numerous online resources, databases and portals providing a myriad of resources to act as the fuel of the implementation process. In Central and South America, however, the collaboration appears to be directed more towards the purchase of hardware and the development of a technological infrastructure. Perhaps one might view this as a part of the unfolding or emergence of the ICT networks, so that once the connectivity issues such as computers, hosts, providers and adequate bandwidth are resolved, the collaboration in other aspects of ICT implementation such as content development can begin to take shape.

TRENDS IN CULTURE DEVELOPMENT

North America

The effective, sustainable implementation of ICTs requires a context — an enabling environment that remains structurally coupled to the numerous unique societies and cultures of the Americas. Defining the nature of that context is a critical aspect of the process of implementing ICTs. The development of a technoculture would include a model of implementation based on a vision that accounts for both educational and social goals, a clear elucidation of the role of technology, equity and accessibility of the Internet to all schools regardless of location.

From a Canadian perspective, K&V Stief Associates (2001) report that "there is a great deal of consistency in vision and direction for implementing ICT in K–12 across the

country." They go on to describe the three areas of current thinking about the most promising areas for integration of ICT in teaching and learning:

- Enhanced inquiry and problem-solving

- Expanded teamwork and collaborative learning

- New approaches to distance learning (or e-learning)

The development of a mature and stable national schoolnet has proven to be the unifying force from within which other provincial initiatives have emerged. Each province has created departments, consortia or associations within their respective education ministries that are actively pursuing a number of approaches for integrating ICTs. Having moved beyond a basic technological literacy for most teachers, the vision now has become one of moving technology from the periphery of education planning as a tool to enhance, towards technology as "a new environment for learning and teaching" (Hardin and Ziebarth 2000).

The U.S. Department of Education (1996) has described computers as "the new basic" of American Education, and the Internet as "the blackboard of the future." In support of this vision of the role and importance of ICTs in the United States, the E-rate programme clearly addresses the issues of equity and accessibility that are of paramount importance. Providing discounted rates for Internet access to schools and libraries in low-income urban communities and rural areas is an approach that resonates with the model of implementation and the social role of ICTs proposed by Gómez and Martinez (2002) for the LAC: "To take advantage of the potential of ICTs for development in the region, there is an urgent need to integrate a social vision of ICTs for development, to bolster the creation of new knowledge, and to promote concerted action among governments, the private sector and civil society organisations." Again, the nature of the model is collaborative, seeking to create partnerships with a variety of associations, organisations and corporations in order to create resources, supports and services.

Central and South America

Several reports from Central and South America that examine the development of a culture to promote the implementation of school networks and ICTs in general exhort the national governments to clearly define their vision. The World Bank (1998), for example, states:

> Many governments stand at the threshold of the 21st century without clearly defined plans and strategies about the use of educational technology — but they are making major new investments anyway. Each country in LAC will need to prepare its own educational development plan and related investment strategy — but only after a careful assessment of basic education issues and how technology can be used to meet national goals and objectives within the planning framework.

Richero (2002) concurs. In her assessment of the situation in LAC, she writes that "technology has to be seen as playing several simultaneous roles in education: a pedagogical role (facilitating learning situations), a cultural, social and professional role (enabling the creation of new communities of practice), and an administrative role facilitating management and data-handling procedures within the school."

Given the extraordinary rates at which the LAC is connecting to the Internet, technological infrastructure is being created and hosts and providers are appearing, the pressure on the national governments to implement and integrate ICTs in education is

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enormous. However, the need to approach the implementation process in a systematic, systemic and equitable manner is just as critical. While educational technology has been an important aspect of North American education for decades, the recent introduction of the Internet has no context to support its growth and development. A review of the specific content developments in LAC certainly provide ample evidence of the energy and enthusiasm with which the LAC has accepted the challenge. Organisations such as the World Bank are at the forefront of international responses in support of the LAC. Again, as is so clearly the case in North America, collaboration will be the key to success in developing a culture of equity, access and empowerment.

Summary and discussion

In North America, a well-established, comprehensive technological infrastructure and several decades of integrating ICTs into K–12 education has created the proper context for implementing ICTs. The biggest challenges now appear to be in creating quality learning communities.

In Latin American countries, given the extraordinary rate at which technology is being introduced, the challenges and issues are different. A context, an environment and a culture that promotes the equitable access to the Internet for all regions in every country have yet to be created. Rushing headlong into the new millennium, the LAC is faced with connectivity and catalyst issues that need to be resolved, while at the same time needing to clearly identify vision and goals for ICTs. If the portals and Web sites that have already emerged are any indication, however, this challenge will be regarded as more of an opportunity than an obstacle.

TRENDS IN CONTENT DEVELOPMENT

North America

Quality educational content is essential for "engaged pedagogy" (World Bank 1998). Educational content must not only be appropriate for a wide range of learner skills and styles and promote critical and creative thinking, but also be exciting and interactive in order to take advantage of the potential of the technology to enhance learning.

Canadian provinces and territories are developing and supporting initiatives such as learning object repositories for content in four basic areas (K&V Stief 2001):

- Learning resources that might be used by students to support inquiry and problem-solving in all subject areas
- Learning resources for teachers to use in planning programmes for their students (lessons, units, learning objects, etc.)
- Online courses, particularly at the secondary level, or online modules that could be combined with classroom activities in all subject areas
- Specialised courses to prepare students for related further study and careers

Of particular note is the Grassroots Project initiated under the umbrella of Canada's SchoolNet. This programme is designed for teachers to promote and facilitate the effective integration and use of ICTs in the classroom. Funding is offered to schools that complete a project following the programme's guidelines. These projects, which are initiated, designed and implemented by the teacher and students, are curriculum

relevant, focus on learning activities carried out using the Internet and result in the creation of a Web site. Since the beginning of the programme in 1996, over 29,000 SchoolNet GrassRoots projects have been created by Canadian teachers and students (see *www.schoolnet.ca/grassrootes/e/home/index.asp*).

Canada's SchoolNet provides a wide variety of other services and resources to Canadian educators and students:

- **Learning resources** are available online and offer links to more than 7000 education-related Web sites (see *www.schoolnet.ca/home/e/resources*).

- **@SchoolNet Today** hosts all the latest information on new e-learning projects, interactive Webcasts and educational contests with daily postings on the SchoolNet Web site (see *www.schoolnet.ca/home/e/today*).

- **SchoolNet Magazine** compiles feature stories about how students, teachers and parents are using ICTS in their learning strategies (see *www.schoolnet.ca/magazine/e*).

- **Schoolnet's Online Educators' Forums** provide educators with the opportunity to participate in forums focused on the most important issues affecting education in Canada (see *www.enoreo.on.ca/schoolnet/forum/e*).

- **SchoolNet Network of Innovative Schools** offers funding support so that education leaders can help K–12 schools implement, share and promote creative and ICT-based learning initiatives (see *www.schoolnet.ca/nis-rei/e*).

- **Library Net** aims to promote the use of the Internet in libraries for lifelong learning and community and economic development by providing Canadians with affordable access to the Internet through public libraries (see *http://ln-rb.ic.gc.ca/*).

- **First Nations SchoolNet** helps Canada's First Nations schools connect to the Internet through a regionalised, community-based approach and encourages First Nations schools to integrate ICT usage into learning environments to develop tailored e-learning content and tools that reflect their cultures and values (see *www.connect.gc.ca/en/220-e.asp*).

In the United States, no centralisation of content development and delivery is apparent. While portals and repositories of educational content are continuing to be developed, the decentralised approach to their development requires educators to surf through innumerable Web sites in search of the learning object, lesson, unit plan or Web-based resource needed. The following is a representative sampling of specific school networking Web sites:

- **Global SchoolNet Foundation** (GSN) partners with schools, communities and businesses to provide online collaborative learning programmes that prepare students for the workforce and help them to become responsible global citizens. GSN is a not-for-profit educational organisation that has been linking classrooms around the world since 1984 (see *www.gsn.org*).

- **The Consortium for School Networking** (CoSN), a national non-profit organisation, is a leading voice in education technology leadership. Their mission is to advance the K–12 education community's capacity to effectively use technology to improve learning through advocacy, policy and leadership development. Members represent school districts, state and local education agencies, non-profit organisations, companies and individuals who share a common vision (see *http://cosn.org*).

- **Science Learning Network** (SLN) is an online community of educators, students, schools, science museums and other institutions demonstrating a new model

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for inquiry science education. The project incorporates inquiry-based teaching approaches, telecomputing, collaboration among geographically dispersed teachers and classrooms, and Internet/World Wide Web content resources (see *www.sln.org*).

- **Project MOST** has created a consortium of Missouri state-wide educational leaders to plan a programme of educational reform and technological innovation. The consortium holds a commitment to an integrated teacher support system and network infrastructure designed around the needs of teachers implementing an integrated math and science curriculum through project-based learning and computational science techniques. Project MOST supports the needed systemic change by planning the implementation of a network infrastructure which creates a community of educators which leverages knowledge and experience across the community; an electronic teacher support system designed around the practices and challenges of teaching and learning; and a consortium of change agents with a cohesive vision and common set of tools for supporting teacher professionalism and school restructuring (see *http://tiger.coe.missouri.edu/~most*).

Central and South America

In both Central and South America, the design and development of educational content is a major challenge. While the commonality of language across LAC, with the exception of Brazil, promotes content development and enhances the possibility of sharing of resources, nonetheless, several countries in the region have undertaken noteworthy projects that include portals, repositories, databases, virtual museums and content-specific Web sites.

- **Red Escolar**, Mexico, promotes reading, writing and math skills, develops an interest in research and teamwork, and facilitates access to information sources and specialists using e-mail and discussion forums (see *http://redescolar.ilce.edu.mx*).

- **TareaWeb**, Mexico, assists K–12 students with ICTs and learning (see *www.tareaweb.com*).

- **Educar.org**, Dominican Republic, Educar República Dominicana, Portal gubernamental (see *www.educar.org/*).

- **Enlaces**, Chile, has the target of allowing primary and secondary schools to form a nationwide school community able to interact regardless of their physical location or socio-cultural characteristics (see *www.enlaces.cl*).

- **RedEs**, Argentina, will be built on the basis of existing programmes, such as the following, to which its activities will be linked (see *www.esc.edu.ar*):

    º Red del Plan Social Educativo (**Social Education Plan Network**) is a project that gives access to the Internet to those benefiting from the Plan de Becas (Scholarship Plan).

    º Red Telar (Todos en la Red) (**Everyone in the Net**), a project that, based on the Red de Escuelas, provides schools with pedagogical content and promotes learning projects carried out by teachers and students.

    º Red Electrónica Federal de Formación Docente Continua (REFFDC; **Federal Electronic Network for Continuing Teacher Training**) provides distance training to teachers in every school in Argentina.

    º Biblioteca Nacional de Maestros (**Teachers' National Library**), is an organisation that plans to co-ordinate and manage a consortium of educational information jointly with Centro Nacional de Información Educativa (**National**

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Center of Educational Information). The consortium members are documentation centres, pedagogic libraries, community libraries and multimedia resource centres at schools.

   º Proyecto de Descentralización y Mejoramiento de la Educación Secundaria (**Project for Decentralizing and Enhancement of Secondary Education**), subsidises computers, infrastructure, and other goods for schools.

   º Red Federal de Información Educativa (**Federal Educational Information Network**) supplies reliable statistics to be used to plan, monitor and evaluate the educational systems as well as changes in it.

- **Educ.ar**, Argentina, is a Spanish-language education portal that was created by the Ministry of Education, Science and Technology, with the goal of democratising education and socialising knowledge by providing interactive educative services to all community members. Through the use of the Edcar education portal, the ministry seeks to fulfill its two goals: to provide educational qualifications to all members of society, and to equip and connect Argentinian public schools. The site provides information for the general population about distance education programmes and resources, and allows students to access online activities for many subjects (see *www.educ.ar/educar/index.jsp*).

- **Educar**, Chile, is an education portal which allows access to information about four main themes: educational resources, student resources, family resources, and research. In each of these areas, students are able to gain information and do research for their classes, create a Web site, chat with other students, and access personal e-mail. The site offers students the opportunity to utilise the educational resources found on the Internet and gives them the invaluable opportunity to connect with other students in various cities across Chile (see *www.educarchile.cl*).

- **Mutirao Digital**, Brazil, began as a project of the Sao Paulo Rotary Club. This programme sought to create the necessary infrastructure to allow for access in public schools. Though the programme began solely in Sao Paulo, it has since expanded and is now being implemented in a thousand public schools across Brazil, with neighbouring countries also showing interest. The philosophy of Mutirao Digital is that to invest in education is to invest in the country's future. The programme primarily seeks to educate teachers and public school administrators, encouraging them to incorporate the use of the Internet and other digital resources into their repertoire as powerful teaching instruments (see *www.mutiraodigital.com.br*).

- **KidLink**, Brazil, is a site of the non-profit Norwegian organisation KidLink Society, which seeks to encourage children to participate in a global dialogue. Students are required to submit personal presentations and their opinions about what they hope for the world in the future. KidLink resources are also used in combination with online curriculum, allowing students to discuss specific content areas, sharing specific and cultural knowledge. Through the use of electronic conference sessions (chats), e-mail, fax and videoconferencing, students are able to interact with others around the globe. KidLink also offers two additional projects, Khouse and Kfamily, which seek to democratise the Internet and to socialise the poor youth of Brazil through access (see *www.kidlink.org/portuguese/brasil*).

- **Conexiones**, Colombia, employs the newer teaching strategies by placing more responsibility on students to become actively engaged in learning through experimentation and problem solving (World Bank 1998) (see *www.conexiones.eafit. edu.co/*).

- **Nueva Alejandría**, Argentina, is an independent Internet site that offers teachers curriculum support and online activities for many subjects. Some programmes

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link up with schools in Argentina to encourage students from different regions, backgrounds and neighbourhoods to interact. Nueva Alejandria also helps schools link up with schools in other countries. Online and classroom activities about peace, conflict resolution and tolerance are provided. Online activities can be performed individually or by the entire class. Teachers' guides and activities that require no online component are provided (World Bank 1998) (see *www.nalejandria.com/index.htm*).

- **Arte Latino,** Dominican Republic, is a Spanish language reference site with brief informative entries on Latin American music, art, literature and poetry. The site contains biographies of famous composers, painters and writers, including images or texts of their work. Arte Latino also provides information on important genres in the history of Latin American Art (World Bank 1998) (see *www.arte-latino.com*).

Summary and discussion

The value and importance of the role that content development plays in the successful implementation of ICTs has previously been noted. As Carlitz and Hastings (2000) write, "Connectivity alone does not create a networked environment of value to schools and communities. More important is the quality of information available over the network and the ability of schools and communities to use the network as their own publishing venue." It is at this point that the recursive and evolutionary nature of the model for implementation of ICTs becomes more evident. Once the connectivity has been achieved, the stakeholders and role players have been determined, and the projects have been initiated, the next issue is determining what to do with the capacity. Demands for quality content in turn can lead back into needs for increased bandwidth and multimedia capabilities, which then in turn precipitate a response from the catalysts, particularly in terms of vision, goal-setting and financing.

Regardless of the model of implementation followed, the online resources, databases, student projects, teacher supports, professional sharing and dialogue, training and professional development programmes that are mushrooming across both North America and LAC are exponentially opening up new horizons and possibilities for students in all countries and regions.

TRENDS IN COMPETENCY DEVELOPMENT

North America

In has been noted that "perhaps the greatest challenge faced by all Canadian jurisdictions at this time is preparing all teachers, not just a thin line of early adopters, to be effective in technologically enhanced learning environments now possible in most schools" (K&V Stief Associates 2001). It is clear from a review of numerous Web sites and schoolnets that similar challenges are being faced and addressed in both Canada and the United States.

The U.S. Department of Education's report on teachers' use of technology (2000) describes the state of professional development in supporting American teachers in the implementation of ICTs:

- In 1999, approximately one-third of teachers reported feeling well prepared or very well prepared to use computers and the Internet for classroom instruction, with less

experienced teachers indicating they felt better prepared to use technology than their more experienced colleagues. For many instructional activities, teachers who reported feeling better prepared to use technology were generally more likely to use it than teachers who indicated that they felt unprepared.

- Teachers cited independent learning most frequently as preparing them for technology use (93 per cent), followed by professional development activities (88 per cent) and their colleagues (87 per cent). Whereas half of all teachers reported that college and graduate work prepared them to use technology, less experienced teachers were generally much more likely than their more experienced colleagues to indicate that this education prepared them to use computers and the Internet.

- Most teachers indicated that professional development activities on a number of topics were available to them, including training on software applications, the use of the Internet and the use of computers and basic computer training (ranging from 96 per cent to 87 per cent).

Teachers in both countries can access a wide range of professional development opportunities, including local, regional and national conferences with workshops, post-secondary courses, summer courses, online courses, seminars and in-services dealing with all aspects of ICTs and their integration with education. In addition, Web sites such as the Digital Education Network offer online tutorials for popular software programmes and online courses in the basics of ICTs; Project MOST offers an electronic teacher support system designed around the practices and challenges of teaching and learning; and The Busy Teachers' Web Site K–12 (see *www.ceismc.gatech.edu/busyt*) aims to provide teachers with direct source materials, lesson plans or classroom activities with a minimum of site-to-site linking, and to provide an enjoyable and rewarding experience for the teacher who is learning to use the Internet.

Central and South America

The situation in the LAC is much more basic than in North America. Because of the dramatic increase in enrolments across Central and South America in the 1990s, the need for school networking as a medium for professional development and teacher training is radically different. The World Bank (1998) describes several of the challenges:

- Access to knowledge about teaching methods

- Designing and developing strategies to use technologies to reach teachers in remote locations, who usually are neither prepared pedagogically nor in the content of the curriculum at their assigned grades

- Restructuring pre-service education, which must now prepare teachers for new contents and pedagogical techniques using technology

- Preparing both practising and candidate teachers in ways to incorporate technologies into their teaching, and to understand more fully the information handling skills their students will need

- Accessing better information about teaching (Many LAC countries have created distance education programmes that use television, video and networking technologies to reach teachers in remote areas.)

In response to these challenges, the Enlaces, Proinfo and RedEs schoolnet projects direct significant resources to the professional development of teachers in their countries. The Enlaces Project (Chile) describes a two-year training programme and technical support,

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the Proinfo Project (Brazil) provides training in the application of technologies to daily tasks and the RedEs Project (Argentina) has established a distance education model to provide professional development.

Summary and discussion

Press (1996) succinctly describes the seminal role played by teachers in the implementation process when he writes that "networking infrastructure includes people as well as wires and servers." Despite the disparity in terms of the technological literacy of teachers between North America and most of LAC, the basic issue is the same: how to create a professional teaching community. While the school networks are being used to promote the learning aspect of the equation, all school networking initiatives are equally concerned with providing supports, skills and resources to the teaching side.

CONCLUSION

While there are numerous issues and challenges facing all educational jurisdictions — from Nunavut in the north to Cape Horn in the south — in their attempts to implement ICTs, several larger, over-arching trends have emerged. For each of the levels in the model of implementation described above, certain major trends and issues have appeared.

Connectivity

How can a technological infrastructure be created to promote equity, accessibility and education for the new millennium?

All of the promise and potential of ICTs to transform and improve an entire generation is contingent upon the technological infrastructure and the ability of schools in all regions of the continent to access the Internet. Connectivity equals opportunity. Without connectivity there can be no cross-cultural projects, no interdisciplinary projects, no problem-solving, no "engaged pedagogy." Overcoming hurdles such as connect costs, adequate bandwidth and providing sufficient numbers of computers to schools, community centres or telecentres in all communities is crucial to unlocking the potential that school networks and ICTs hold for education.

Catalysts

What is the nature of the collaboration of the partners in the implementation process?

Described another way, perhaps the seminal issue is whether or not to centralise. At some point in every model of implementation, every national government has extended co-ordination and management, be it at the financial, technological or pedagogical levels.

Closely tied to this issue is the nature of the relationship between the government agencies and departments and the private sector. Can the two partners and stakeholders in the success of the initiatives work together to promote equity, access and social development on a larger scale? Examples from both the United States and Canada demonstrate that this can, indeed, produce content that is truly revolutionary in approach and design. As LAC struggles with connectivity issues, the nature of the relationship between the public and private sectors will loom large.

Culture

What is the role of ICTs?

As Dunayevich and colleagues (1999) write, "The use of ICTs as a teaching aid demands a redefinition of the concept itself: the extraordinary availability of information supplies and specific programmes that can be used in education poses new challenges to the entire pedagogic model."

Will ICTs prove to be more than simply an "add-on," as feared in the K & V Stief Associates Report to Canada's SchoolNet (2001), or can the models of implementation aspire to higher goals such as those described by Richero (2002)?

Technology has to be seen as playing several simultaneous roles in education: a pedagogical role (facilitating learning situations); a cultural, social and professional role (enabling the creation of new communities of practice) and an administrative role facilitating management and data handling procedures within the school.

Content

How do national governments create quality learning communities?

Content development represents the fuel of the implementation of ICTs across the Americas. Unless resources can be designed that promote active learning using the best pedagogical principles and practices of online learning, then much of the potential of school networks will not be realised. Collaborative efforts abound, and numerous examples exist to raise the expectations and standards of educators in all regions of the continent. Once the technological questions have been answered, once the catalysts have formulated a vision and elucidated a set of goals and objectives for the implementation of ICTs in their countries, the next challenge will be to provide the online resources to create a culture of empowerment and knowledge-building.

Competencies

How do national governments create professional teaching communities?

The specific issues may be different in North America and LAC; however, the basic challenge is to create and sustain a vibrant, skilled, quality teaching force capable of utilising the technology to improve the educational experience for all students. In North America, where technology has been in schools for the past two decades, the challenge is to enhance the basic technological literacy which most teachers possess. In Central and South America, the challenge is to enhance the basic teaching literacy which many teachers do not possess.

To realise the enormous potential that effective implementation of ICTs holds for all countries in the Americas, technological infrastructures must arise that promote equity and accessibility, partners in the process must work together in a sense of collaboration, a vision of ICT must be developed to enhance both the educational as well as the social aspects of the societies, and quality learning and professional teaching communities must emerge. Given the enormous advances made in this vast and diverse region in but a decade, there is every reason to be optimistic.

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CHAPTER 4

EUROPE AND THE COMMONWEALTH OF INDEPENDENT STATES

Zoya Naskova

A REGION OF GREAT DIVERSITY

The Continent of Europe is a region of great diversity, culturally, politically and economically. This diversity is reflected in the stage of development of educational technology. The availability of computer technology in schools varies greatly among the countries of Western Europe, Eastern Europe and the Commonwealth of Independent States (CIS).

A key factor that affects the drive towards school networking in these countries is the level of government involvement, which ranges from providing computer equipment to schools, to ministry-run national education Internet service providers (ISPs). Many Western and Central European governments have taken the initiative to integrate information technologies into school practices. But in the less economically developed countries, especially those in Eastern Europe and the CIS that have undergone a period of economic and political transition in the last decade, governments have not been able to take leadership in this field. In these countries, a great number of education technology initiatives have been driven by outside foreign aid funds and non-governmental organisations (NGOs), such as the Open Society Institute and Project Harmony, among others.

Greater and more highly developed school network developments exist in the more-developed counties; however, there are examples of some smaller-scale school networks in less-developed countries which have achieved notable success and are functioning quite well helping schools in their efforts to advance the use of technology for teaching and learning.

In all countries of the region, however, the integration of information and communications technology (ICT) in education practices is still relatively new, and there is much more to be done to take full advantage of the opportunities available. One especially weak point is the lack of ICT-based resources in local languages throughout Europe and the CIS, especially in the smaller nations and ethnic groups. Better-developed school networks within each country, as well as internationally, would help schools share

experiences and resources and create a quantity of high-quality bodies of educational content in the multitude of languages spoken on the continent. Locally relevant content will give ICT meaning: ICT will make sense for teachers and learners only when it can offer something that they understand and can use to improve their lives in tangible, measurable ways.

THE TECHNOLOGY LANDSCAPE

The vast differences between the countries and regions of Europe can most clearly be observed in the availability of modern technologies for students and teachers in the schools and other educational institutions. According to the Organisation for Economic Co-operation and Development (OECD) publication *Education at a Glance 2002*, the ratio of computers to students in Europe varies substantially, from a median of six in Norway to 36 in Portugal and 57 in Liechtenstein (see Table 4.1). Fifty per cent of this equipment in Norway, 35 per cent in Portugal and 79 per cent in Liechtenstein is connected to the Internet, as reported by school principals and weighted by student enrolment.

Some Eastern European countries have made great progress in this area, despite having undergone fundamental political and economic transition in recent years. For example, Estonia has surpassed more-developed countries like Italy and Hong Kong on the percentage of Internet users. In 2000, all secondary schools in Estonia had computer facilities and 75 per cent had Internet connections. This achievement was a result of the Tiger Leap programme, launched by the Estonian Ministry of Education with the objective of modernising the educational system. The success of this programme is due to the initiative of the country's leadership and the co-operation between schools, universities, local governments, private enterprises, public institutions and the third sector-funds and foundations. (See *www.esis.ee/ist99/tiigrihype.html*.)

However, in other countries of Eastern Europe and the CIS, computers are much less present in schools. For instance, the latest data show that in the Republic of Macedonia there are approximately 188 students per computer (see Table 4.2). It is not certain how up-to-date this equipment is, however current records show that out of the total of 1836 computers in schools, only 524 have CD drives, and out of 239 schools, only 44, or 18 per cent, have some sort of Internet connection (compared to 40 per cent in the Czech Republic and 84 per cent in Finland).

Other factors besides economic resources contribute to the persistent differences between Eastern and Western Europe in the integration of ICT in education. High on the list are basic environmental factors, such as political stability and the ability of local and regional bureaucracies to focus on technology and education. Macedonia, for example, is still recovering from years of conflict and unrest in the region. The situation is similar in other conflict-ridden areas. Government officials in those countries continue to focus on more fundamental issues of social infrastructure and security. ICT in education is not yet seen as a high-priority investment opportunity.

Computer usage by students also varies from country to country. For instance, according to the OECD, 6 per cent of the young people in Finland use computers almost every day, compared to 16 per cent in Sweden and 23 per cent in Denmark. Approximately 38 per cent of the 15-year-olds in OECD countries use computers on a weekly basis at school (almost every day or a few times a week). In Germany and Hungary, 14 per cent and 58 per cent of pupils, respectively, access computers on a weekly basis (see Table 4.3).

Table 4.1: *Ratio of students to computers in Europe (2000)*

(*Total number of students enrolled in the school divided by the total number of computers for the school in which 15-year-olds are enrolled, by quartile, type of institution and location of school, weighted by student enrolment*)

| | Ratio of students to computers | | | Ratio of students to computers, by school location | | | | | | | |
| | | | | Fewer than 3000 people (village) | | From 15,000 to 100,000 people (town) | | Over 1,000,000 people (close to the centre of a city) | | Over 1,000,000 people (elsewhere in a city) | |
	25th percentile	50th percentile (median)	75th percentile	50th percentile (median)	% students represented in the sample	50th percentile (median)	% students represented in the sample	50th percentile (median)	% students represented in the sample	50th percentile (median)	% students represented in the sample
Austria	5	7	15	10	6	6	28	4	5	15	11
Belgium	7	11	18	20	4	10	51	8	1	a	a
Czech Republic	9	15	28	19	6	15	40	13	2	16	10
Denmark	6	8	11	6	29	9	25	9	8	11	3
Finland	6	8	12	7	17	9	34	10	15	8	6
France	6	11	15	9	7	9	52	57	1	8	3
Germany	14	22	31	18	6	23	43	15	2	22	4
Greece	14	28	83	18	8	32	38	33	9	17	6
Hungary	5	9	15	12	1	8	39	10	10	7	9
Iceland	7	10	13	m	m	m	m	m	m	m	m
Ireland	10	14	19	14	28	16	13	12	12	9	8
Italy	7	12	19	9	2	13	54	a	a	12	12
Latvia	4	5	12	19	18	29	27	23	6	a	a
Liechtenstein	31	57	88	4	21	a	a	a	a	a	a
Luxembourg	8	9	11	a	a	8	19	a	a	a	a
Netherlands[1]	6	10	14	a	a	10	63	a	a	a	a
Norway	4	6	9	5	38	8	20	a	a	a	a
Poland	8	26	45	7	3	27	41	39	7	4	2
Portugal	20	36	100	20	4	27	39	101	7	26	1
Spain	14	21	29	12	2	21	32	22	4	29	5
Sweden	7	8	10	8	23	8	34	10	4	4	1
Switzerland	6	9	16	9	12	9	25	a	a	a	a
United Kingdom	6	8	9	8	10	7	35	8	4	8	4

Notes: m = missing; a = not applicable

1. Response rate is too low to ensure comparability.

Source: OECD PISA database, 2000, www.oecd.org

Table 4.2: *Availability of computers in schools of the Republic of Macedonia (2000)*

	Number of schools	Available computers for instruction	Computers with CD drives	Schools connected to the Internet/ WWW	Number of pupils	Ratio of students per computer
Elementary schools (grades 1–8)	155	613	182	11	253,997	414.35
High schools (grades 9–12)	84	1223	342	33	91,424	74.75
Total	239	1836	524	44	345,421	188.13

Source: Ministry of Education and Science of the Republic of Macedonia

Table 4.3: *Frequency of use of computers at home and at school by 15-year-olds in selected European countries (2000)*
(Mean percentage of 15-year-olds who reported using computers at school almost every day, a few times each week, between once a week and once a month, less than once a month and never)

	Use of computers at school				
	Almost every day	A few times each week	Between once a week and once a month	Less than once a month	Never
	%	%	%	%	%
Belgium	5	26	32	12	25
Czech Republic	4	24	34	11	26
Denmark	23	36	26	11	4
Finland	6	41	30	16	7
Germany	4	14	25	20	37
Hungary	7	58	19	5	10
Ireland	4	22	25	14	35
Latvia	6	35	26	12	21
Liechtenstein	5	24	50	11	10
Luxembourg	10	26	34	12	17
Norway	6	22	33	28	11
Scotland	18	39	18	14	12
Sweden	16	29	27	17	11
Switzerland	5	17	37	20	21

Source: OECD PISA database, 2001, www.oecd.org

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Table 4.4: *Nature and location of ICT training on the Internet and multimedia for teachers (1998–1999)*

(Percentage of schools in secondary education where ICT training on the Internet and multimedia are available, by location of training and type of training course, expressed as a percentage of students)

	Introductory course for Internet use (retrieve information, send/receive e-mails, etc.)				Advanced course for Internet use (e.g., creating Web sites/developing a home page, advanced use of Internet, videoconferencing)				Special course with digital video and audio equipment			
	Lower secondary education		Upper secondary education		Lower secondary education		Upper secondary education		Lower secondary education		Upper secondary education	
	In-house ICT courses available	External ICT courses available	In-house ICT courses available	External ICT courses available	In-house ICT courses available	External ICT courses available	In-house ICT courses available	External ICT courses available	In-house ICT courses available	External ICT courses available	In-house ICT courses available	External ICT courses available
Czech Republic	18	20	43	16	3	10	12	16	2	2	3	6
Denmark	63	44	m	m	11	34	m	m	15	34	m	m
Finland[1]	51	44	m	m	15	36	m	m	3	16	m	m
Hungary	22	45	m	m	2	27	m	m	n	13	m	m
Iceland	22	73	84	40	5	63	35	54	1	21	9	19
Italy[1]	43	19	47	16	21	9	24	6	6	4	11	6

Notes: m = missing; n = negligible or zero

1. Country did not satisfy all sampling criteria.

Source: International Association for the Evaluation of Educational Achievement (IEA)/SITES. In *Education at a Glance: OECD Indicators 2001*, OECD 2001.

Large gaps between countries and regions persist in the area of training teachers to integrate information technologies in their practices. OECD data show differences in availability of basic (hardware and software) training, while all country figures drop drastically when it comes to Internet and multimedia training for teachers (see Table 4.4).

Even when there are teacher training programmes, they often focus on building ICT skills, without much attention being given to the pedagogical issues of integrating technology into teaching practices. Much more needs to be done to raise the awareness and skill level of educators to effectively use information technologies as active, constructivist learning tools.

DRIVING FORCES

The larger and more highly developed school networks in Europe have been championed by governments of the more-developed European counties, most of which are associated with the European Union (EU). Larger regional initiatives by the EU have also stimulated and promoted national government programmes. Ministries of Education often partner with business, especially telecommunication companies and Internet service providers, in their efforts to offer Internet access to schools and other educational institutions. Other initiatives have been driven by local and international non-profit organisations, which frequently collaborate with national Ministries of Education because education has been quite centrally controlled in most European countries. In some instances, however, teacher and student networks have grown somewhat independent from the national education authorities.

Large regional initiatives in the European Union

Following the EU's "dot com summit" in Lisbon in March 2000, the European Commission (EC) set out a blueprint for action called eLearning: designing tomorrow's education, which was part of the comprehensive eEurope Action Plan approved in June 2000 (see *http://europa.eu.int/information_society/eeurope/action_plan/pdf/actionplan_en.pdf*). This initiative of the EC seeks to mobilise the educational and cultural communities, as well as the economic and social players in Europe, in order to speed up changes in the education and training systems for Europe's move to a knowledge-based society. An eLearning Action Plan was adopted by the Commission in March 2001, setting the following objectives (see *http://europa.eu.int/eur-lex/en/com/cnc/2001/com2001_0172en01.pdf*):

- To provide all schools with access to the Internet and multimedia resources by the end of 2001

- To equip all classrooms with a fast Internet connection by the end of 2002

- To connect all schools to research networks by the end of 2002

- To achieve a ratio of 5 to 15 pupils per multimedia computer by 2004

- To ensure the availability of support services and educational resources on the Internet, together with online learning platforms for teachers, pupils and parents, by the end of 2002

- To support the evolution of school curricula with the aim of integrating new learning methods, based on ICTs, by the end of 2002

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The plan also laid out these targets:

- To ensure that all school-leavers have had the chance to become digitally literate by the end of 2003

- To provide all teachers with appropriate training, adapt teacher training programmes accordingly and introduce measures to encourage teachers to make real use of digital technology in their lessons, by the end of 2002

In May 2002 the eEurope 2005 Action Plan was adopted, to succeed the eEurope 2002 plan (see *http://europa.eu.int/information_society/eeurope/news_library/ documents/eeurope2005/eeurope2005_en.pdf*). This Action Plan aims "to provide a favourable environment for private investment and for the creation of new jobs, to boost productivity, to modernise public services and to give everyone the opportunity to participate in the global information society" by "stimulating secure services, applications and content based on a widely available broadband infrastructure."

In the EU, for example, the Directorate General for Education and Culture within the EC sponsors several programmes designed to improve the availability and use of ICT for learning (see *http://europa.eu.int/comm/education/ntechnologies_en.html*). Examples of these EU programmes include the Comenius, the Minerva Action, and eLearning. All are encompassed within the Socrates programme and its various separate actions. (Socrates is Europe's education programme and involves around 30 European countries. Its main objective is precisely to build up a Europe of knowledge and thus provide a better response to the major challenges of the new century: to promote lifelong learning, encourage access to education for everybody and to help people acquire recognised qualifications and skills).

The Minerva Action under Socrates II (2000–2007) seeks to promote European co-operation in the field of open and distance learning (ODL) and ICT in education. The Action has three main objectives (as stated on their Web site – see *http://europa.eu.int/ comm/education/socrates/minerva/ind1a.html*):

- To promote understanding among teachers, learners, decision-makers and the public at large of the implications of ODL and ICT for education, as well as the critical and responsible use of ICT for educational purposes

- To ensure that pedagogical considerations are given proper weight in the development of ICT and multimedia-based educational products and services

- To promote access to improved methods and educational resources as well as to results and best practices in this field

The Minerva Action supports numerous projects on diverse themes (cross-culturally, joint content development, lifelong learning, networks and projects supporting the ODL community, ODL integration, teacher or trainer training) implemented by educational institutions, non-profit organisations, public authorities and/or private companies in the EU.

Schools and Ministries of Education around Europe have collaborated on various other initiatives. One is Netd@ys Europe, an initiative of the EC to promote the use of new media in the areas of education and culture (see *www.netdayseurope.org*). The initiative encourages and supports the development of multimedia projects that demonstrate good-quality educational content, and it provides an open platform to showcase such projects and develop educational and cultural links.

eSchola is another initiative, a campaign for e-learning in Europe — an event to provide an opportunity for schools and teachers to learn together and from each other about the use and impact of new technologies in education (see *www.eun.org/eun.org2/eun/ en/eSchola2002_About/entry_page.cfm?id_area=245*). It features @Europe, an online forum where teachers and pupils find collaborative projects, the eXplora Challenge Web-based competition for secondary school students, and the School Channel broadcasts from schools all over Europe. Other eSchola features include examples and best practices of ICT in learning, online learning events such as workshops, live chats, forums and ICT expert discussions, as well as ICT tools for the classroom presented by e-learning companies and organisations.

In addition, 23 European Ministries of Education have partnered to form the European Schoolnet for the purpose of "developing learning for schools, teachers and pupils across Europe" (see *www.eun.org/eun.org2/eun/en/index_eun.html*). European Schoolnet, "the gateway to education in Europe," manages a number of projects promoting ICT in education and offers numerous resources for teachers, school leaders, pupils and policy-makers. (See the case study below for further discussion on this initiative.)

The engagement of the EC on a regional level has facilitated a greater scale of effort which individual countries may not have been able to achieve on their own. Moreover, a regional approach has enabled international networks, offering teachers vehicles for collaboration across borders and emphasising the European dimension of education. The EC has been able to mobilise resources and motivate business involvement more, and with these greater resources it has been able to develop longer-term strategies. Also, large-scale initiatives contribute to the creation of an educational market for electronic educational aids, making them more commercially viable for content developers. EU resources can address digital gap issues among European countries, stimulating development in the poorer countries, which, if left on their own, would most likely lag behind their wealthier neighbours.

National government initiatives

Individual government bodies, usually Ministries of Education, alone or in co-operation with international and/or non-profit organisations, have made various efforts to improve the ICT infrastructure of schools, connect schools to the Internet and advance the level of ICT integration into the education practices and curricula.

The European Schoolnet partner countries have developed their own national school networks. Most of these provide connection to the Internet for schools, online information on various education initiatives, education resources and Web spaces that act as hubs for collaborative projects. Here are a few examples:

- **Kennisnet** is a non-profit organisation set up by the Netherlands Ministry of Education, Culture and Science as a partnership of Dutch education organisations, business and the Internet provider community. The network is constructed and managed by Nl.tree, a joint venture set up for this purpose by Dutch cable companies where each company is responsible for connecting schools in its own service area. During 2002, more than 11,000 schools and other educational institutions, libraries, museums and content providers — a total of some 2.5 million users — were connected to the Internet via Kennisnet. The network also features the Kennisnet education portal, providing access to secure educational content for users without advertisements (see *www.kennisnet.nl/portal/overkennisnet/forourinter nationalvisitors*).

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- The Portuguese Ministry of Science and Technology has lead a national initiative called **The Program Internet in School**. The National Scientific and Research Network (RCCN) was expanded so that all grades 5 to 12 schools, cultural associations, libraries as well as some grade 1 schools can be connected to the Internet. This programme located the equipment in school libraries and "aimed at stimulating schools to use Internet for educational purposes, supporting the production of scientific and technological content" (see *www.uarte.mct.pt/eng/internet-escola*).
- **Írisz-SuliNet** is Hungary's national ICT programme for school education, which since 1996 has connected every Hungarian secondary school and about 30 per cent of the primary schools in their network.

In many cases, governments co-operate with business, usually telecommunication companies and Internet providers. For instance, in April 2000, the Russian government, in co-operation with the oil company YUKOS, formed the non-profit organisation Internet Education Federation with the goal of furthering the development of Internet-education in the country. Their five-year project proposed to open Internet education centres in 50 regions of Russia, where more than a quarter million high school teachers would become skilled at utilising Internet-technologies in the teaching process (see *www.fio.ru/about.php*).

Other examples of national school networks are Virtual School Austria, the Norwegian Schoolnet, Slovenian Education Network, the Swiss Education Server, the Swedish Schoolnet, the Estonian Educational and Research Network and the Icelandic Educational Gateway. Countries that have established national school networks have the advantage of the economy-of-scale effect, where on a national level they can mobilise greater resources and make greater progress in offering access to the Internet and online education content to their constituents.

Initiatives by non-profit organisations

OSI

The Open Society Institute (OSI), sponsored by the Soros Foundation, has played a vital role in equipping educational institutions throughout Eastern Europe and the CIS (see *www.soros.org/internet*). Early in the 1990s the OSI Internet Program (OSI-IP) offered e-mail and Internet access to various institutions, including some schools. In some cases the various national Soros Foundations became service providers, offering free connectivity to educational institutions but also subsidising their connections through fee-for-service activities. In the Republic of Macedonia, for example, in 1997, OSI-IP sponsored an aggressive national campaign to provide connectivity to medical centres, universities, secondary schools, NGOs and libraries throughout Macedonia through grants of modems, e-mail/Internet servers and connectivity subsidies.

The OSI Network Library Program (NLP) (originally "Regional Library Program") supported the development of libraries in the region through a variety of activities. Presently, for instance, OSI Macedonia is implementing the School Libraries Project, which aims to modernise school libraries by equipping them with computer technology, Internet connection and library literature and software, as well as applicable professional development programmes for school staff. During 2001 and 2002, the programme networked 16 elementary schools throughout Macedonia (see *www.soros.org.mk*).

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There are other examples of OSI teacher professional development efforts in the area of connectivity. For instance, in 1997, OSI-IP and the Mellon Foundation co-funded an "Internet Academy" in the University in Bucharest to teach students and teachers from non-science and technical disciplines to use the Internet effectively.

In many developing countries there has been an emphasis on using school ICT "labs" as community ICT centres in order to make resources available to a larger audience. This idea has worked well in some communities, but has faced resistance in others because of the special place schools are seen to have in society and the issues presented to school management by opening to the public.

One example is the Community Centers Program South Eastern Europe, created by OSI and the Mott Foundation in support of the Stability Pact for South East Europe and based on the principles and philosophy of the OSI Youth Initiative 2000.[1] The initiative is a regional project, which aims to strengthen the efforts of the countries of southeastern Europe to foster peace, democracy, respect for human rights and economic prosperity in the region. Twenty-six centres have been established in schools and other different hosting institutions in seven countries (Albania, Bosnia-Herzegovina, Croatia, Kosovo, Macedonia, Montenegro and Serbia). These centres are to address the Priority Areas of Action set by the Stability Pact in the area of "community education," which aims to maximise the use of resources by encouraging joint use of existing infrastructure and expertise. This goal is to use schools to promote social inclusion and democratic values, as well as to enhance co-operation between school and community, local and regional initiatives and national authorities with a view to linking formal and non-formal education (see *www.osi.hu/ccp/bp_history.html*).

The Soros Foundation and the Open Society Institute has also supported the development of iEARN networks in Eastern European countries. iEARN is an international network of teachers and students who engage in educational projects online with peers in their countries and around the world, although they are often not recognised by education authorities. The development of national iEARN programmes in Bulgaria, Macedonia, Romania and most other Eastern European countries has been helped by local small grants for school programmes and technology, as well as by the establishment of formal local iEARN networks as non-profit organisations. Moreover, a number of special projects have established smaller iEARN networks around particular topics. One such project is Balkan Voices, a programme of collaboration among students and teachers in the Balkan and neighbouring countries (see *www2.arnes.si/~sskkssb2s*).

Small-scale school network initiatives

As mentioned earlier, there are also numerous small-scale school networks, often established for more specific educational purposes, in both developed and developing countries. These networks are often products of various non-profit organisations working to "bridge the digital divide" or just utilising ICT as a tool for other educational purposes.

- **Schools Online,** an American non-profit organisation, in co-operation with local telecommunication companies (BTK, MtNet), Ministries of Education and NGOs (Svest, iEARN, IMOR), provided ICT-equipment and Internet connection for a number of schools in Bulgaria, Macedonia and Russia. A programme of professional

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[1] Youth Initiative Fund is a grant-giving programme offered by the Open Society Institute, New York and administered at a national level by the Euroregional Center for Democracy. The programme aims at supporting the cross-border co-operation by financing activities that bring together youth from across southeastern Europe.

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development training and support was established and some efforts have been made to link schools in networks using basic collaboration forums like Yahoo Groups and iEARN. Moreover, initial efforts have been made to encourage the development of Web-based local language educational resources in Macedonia for teachers, where there is almost nothing available. Two projects have been implemented through a small grant competition: an astronomy site and an art education site.

- **Project Harmony**, also an American non-profit organisation, has established and been operating more than 150 Internet access computer centres in universities, schools and libraries in Russia, Armenia and Azerbaijan since 1996. This was accomplished mostly with the help of grants from the U.S. Department of State and other funding sources. Their Internet School Linkage Program uses the Internet to create partnerships between American and NIS high schools to work on joint school projects. Project Harmony currently manages and provides educational support to a network of over 500 NIS schools. Project Harmony has also been actively engaged in technology training programmes for professionals, educators and students, providing hands-on training, both in technical aspects and in the application of online technologies (see *www.projectharmony.org/programs/internet/past/islp*).

- The **Project Harmony Armenia Connectivity 2000** effort is establishing an online school network for the Armenian education system, which so far includes Internet computer centres in over 100 schools around the country. The goals of this project are to "strengthen the capacity for Armenian educators to enhance civic education and to participate in online collaborative projects with international partner schools by providing …the educational leadership, technical equipment and support to ensure that use of the Internet is integrated into the academic programme of participating schools in a way that strengthens democracy and supports civil society and cultural understanding" (see *www.projectharmony.org/am/PHSite/eng/eng_AC2K.html*).

- The **Azerbaijan School Connectivity Program** (ASCP) has established Internet computer centres in 10 schools, providing training to Azeri educators. It facilitates online collaborative projects with partner schools in the United States and other countries. Project Harmony is establishing a network Web site (ASCP Online School Network) and interactive Internet space for educators and collaborators in English and Azeri languages, with links to partner school home pages, archives of civics-related curricula and online project models, interactive communication tools for online events and collaboration and links to related resources and organisations. ASCP is utilising an applications service provider called WebCrossing to create online private workspaces, chat rooms, message boards and discussion lists for Online School Network (OSN) activities. Project Harmony plans to provide ASCP participants with a dynamic central repository and venue for real-time programme interaction in order to enhance co-operation among OSN schools and partners (see *www.projectharmony.az/ascp.html*).

One of the major issues that small-scale initiatives face is sustainability. Information technology infrastructure and programming are cost-intensive, and without long-term planning and commitment of resources, results tend to be erratic. For instance, when an organisation sponsors a school's Internet connection for two years, if the issue of connectivity cost is not addressed, when the project is completed chances are that the school will not have the resources to maintain the connection. A more systemic approach is necessary, where ICT becomes a priority included in the long-term planning and budgeting of school systems, ensuring the necessary commitment of various levels of society, from government leadership and school authorities to business and society in general.

In summary, several key factors emerge as the main drivers behind sustained, successful integration of ICT in education practices. The first prerequisite is an environment of sustained political and economic stability that allows authorities to focus on issues other than basic survival. This factor might be taken for granted in the developed nations of Western Europe, but it continues to be a major concern in some Balkan nations and in the CIS. Another key driver is widespread appreciation by national and regional authorities of the importance of ICT skills in improving economic and social prosperity in an increasingly information-based world. This appreciation is necessary to build consensus within and among governments on the need to commit resources to ICT in education. The various and robust EU ICT programmes are good illustrations of this. Once consensus is reached on the value of ICT, governments must commit to forming the organisational structures required for effective planning, co-ordination and execution of ICT education efforts.

Perhaps the most obvious key driver is the availability of resources — both financial and human — needed to start and sustain ICT education programmes. In many cases, local government resources for ICT in education are augmented through partnerships with industry, other governments and NGOs. When all of the relevant drivers come together, they can then promote the creation of ICT education content and materials in local languages and generate opportunities for teachers and schools administrators to access training in order to maximise the effectiveness of ICT as an educational tool.

CASE STUDY: EUROPEAN SCHOOLNET

European Schoolnet (EUN) is an international partnership of 23 EU member states and European Free Trade Association (EFTA) countries as well as partner countries in central Europe, in co-operation with the EC.[2] Its goal is to "provide insight into the use of ICT in Europe for policy-makers and education professionals…through communication and information exchange at all levels of school education using innovative technologies, and by acting as a gateway to national and regional school networks" (see *www.eun.org/ eun.org2/eun/en/index_eun_corporate.cfm*). EUN also seeks to establish public-private partnerships and build long-term partnerships with companies and organisations committed to supporting educational innovation. Presently, some of its corporate partners are SUN Microsystems, Intel, IBM and Apple.

This consortium offers a number of learning programmes and online communities for teachers, students and school administrators, such as the educational portals eSchoolnet, the educational place for kids and teenagers Zap**,** EUN School Managers Centre (EUNSMC), European Schoolnet's News and the EUN Community. The site also provides links to a number of EU projects addressing various aspects of ICT learning including Virtual School, myEUROPE, the European Network of Innovative Schools (ENIS), Comenius Space, eSchola, eXplora, European Treasury Browser (ETB), Celebrate, the European Schoolnet Validation Network (ValNet) and others.

eSchoolnet is an educational community featuring e-learning news, online training, European curriculum resources, school practice ideas, collaborative school projects, online learning communities and a virtual magazine (see *www.eun.org/eun.org2/ eun/en/index_eschoolnet.html*). The collaborative tool, Virtual School, is a Web site created by teachers from different European countries that contains learning resources on various educational subjects. The School Managers Centre (SMC) addresses the

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[2]Partner countries in Schoolnet are Austria, Belgium, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Israel, Luxembourg, Malta, The Netherlands, Norway, Poland, Portugal, Slovenia, Spain, Switzerland, Sweden, and UK.

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needs of school administrators featuring, among other things, a growing community of European principals online. Safe is a project that addresses issues of Internet safety in schools, while the European Treasury Browser aims to build a "Web educational resource metadata networking infrastructure for schools in Europe."

Some of the EUN projects aim to create and promote innovative approaches in the use of ICT for learning in the European countries. One such example is CELEBRATE, a 30-month, EUR5 million project supported by the EC, which aims to give EU schools access to a large-scale pilot of an online content repository, a collection of "learning objects" (LOs) and components that can be used to create LOs and to explore a methodology for using them for educational activities and services. A pilot database has been developed where schools can contribute and receive LOs. CELEBRATE includes 22 public and private sector partners, and in financial terms, this is the largest project yet undertaken by European Schoolnet.

The European Network of Innovative Schools (ENIS) is another EUN project, a network of more than 400 schools in national "networks of innovation" in 19 countries established for the purpose of disseminating best practices, encouraging further innovation and experiencing new organisational and pedagogical solutions.

Project EUN-CLE aims to create a multilingual international collaborative environment for young people and to bring together seamlessly a substantial quantity of multilingual content and services. Considering the multitude of official languages spoken in Europe, this is a valuable aspect of the services a regional initiative like European Schoolnet can offer, and it will be even more important when "smaller" eastern European languages join the EU.

The greatest value of EUN may be that it has conducted research and produced content, which could benefit all European countries. It has also created a place where educators can exchange ideas and experiences and learn from each other. This regional approach emphasises the European dimension of education as well.

Being a large-scale, regional initiative, the European Schoolnet has been able to consolidate resources and expertise in e-learning from a multitude of European countries and position itself well for promoting ICT in education in Europe. EUN has helped build a more viable European e-content market by establishing cross-border means for sharing content. This is particularly important for members of smaller language groups, which are spread across few national borders.

These economy-of-scale effects have also played a role in the countries that have developed their own national networks. Comprehensive national initiatives have been able to attract big players and to negotiate from a stronger position. Such networks should be able to negotiate better prices for equipment and connectivity, as well as create a more viable market for online educational content. Moreover, this comprehensive net of regional and national networks has offered educators a higher level of support in their efforts to integrate ICT into their work, as well as a sense of community and a place where they can share and learn from each other.

A lot more needs to be done, however, to level the digital gap among the various EU countries, let alone some of the much poorer Eastern European countries. The introduction of modern ICTs in education demands a dramatic shift in the way we have traditionally thought of education and the approaches used. It requires a change in curriculum and teaching methodologies, which in turn requires extensive and long-term teacher training. Education is a long-term process, and the effective integration of ICT in education requires a long-term strategy and commitment.

CASE STUDY: SCHOOLS ONLINE

The projects of Schools Online are examples of smaller-scale public-private partnerships. Driven by Silicon Valley funding sources, Schools Online embarked on an ambitious endeavour of "connecting the world, one school at a time." It worked in partnership with other international organisations, such as World Links for Development, iEARN, SchoolNet Africa and Ritsec, as well as local NGOs, education authorities and Internet service providers (ISPs). Schools Online worked around the world, but in Europe it focused on Bulgaria, Macedonia, Russia and Spain. In Macedonia Schools Online partnered with several local NGOs – Svest, a young Macedonian organisation and IMOR, the local iEARN network.

From the very beginning the project gained the interest of the Macedonian president and the Macedonian Telecommunications Company, the main ISP in the country. The Internet business unit of the Macedonian Telecommunications Company, MtNet, was interested in establishing a large-scale, long-term collaboration with the Ministry of Education for the purpose of connecting Macedonian schools to the Internet. The Ministry of Education leadership, however, did not show much interest, and the following administration was openly hostile to the idea. As a result, the Schools Online project was mostly designed and implemented independent of the Ministry of Education, in direct dealings with participating schools. Thus, the Education Ministry missed an opportunity to establish the beginnings of a national schoolnet and take advantage of the interest of an initial outside funder and a major ISP.

Nevertheless, Schools Online and its partners managed to create a small network of schools (seven elementary and four high schools), and provide equipment, connectivity and initial professional development for teachers. Significant changes could be observed in teachers within a year of their participation. Some who started from no or very basic ICT skills at the beginning of the school year were conducting basic lessons using ICT as a tool by spring. A Yahoo Groups site is currently being used as the network's "portal," and the project has made considerable progress, but its full utilisation as a learning community still has a long way to go.

Small efforts were made to begin creating online content for teachers in Macedonia, where there is almost nothing aimed at developing tools. Considering that Macedonian is a very "small" language with a limited geographic footprint, and that the standard of living in the country is relatively low, it is often not commercially viable to provide locally specific content unless big players such as government or international organisations subsidise these kinds of products.

Hit by the fall of the American stock market, Schools Online has since pulled out of Macedonia. However, the local NGO Svest was able to obtain a grant from the Balkan Youth Foundation and continue efforts in other elementary schools in the country. The Ministry of Education (under a different administration) has been supportive of the project, acting as a full partner and providing the equipment (in fact, another donation from a Western European government) for nine new elementary schools. Macedonian Telecommunications is the other partner, providing free Internet connection through ISDN lines. The role of Svest is to provide programme management, professional development and support for the teachers and students in the network. Efforts are being made to encourage teacher participation in the Web group created for the purpose, as well as to offer related educational resources on the Svest Web site.

Incremental efforts such as this one have certainly made a difference in the education technology landscape of Eastern European and CIS countries. However, they tend to be short-lived due to a number of factors:

- Donors do not plan for the long-term; projects are usually limited to a small number of schools, often deepening the digital gap within the country in question.

- Technology connectivity is still relatively expensive in less-developed countries and schools cannot afford to sustain these efforts on their own after donors leave.

- Not enough attention is given to educating educators about the benefits of technology and the methods of its integration into the teaching process.

- Very little education content in the native languages is available online and small projects cannot stimulate a real market for content providers.

- School administrators and other education leaders have a low level of education technology awareness and, as a result, they do not consider this issue a priority in their planning and budgeting.

Without a comprehensive national strategy and commitment to the issue on all levels, efforts are bound to remain erratic and unsustainable.

CONCLUSION

In the last few years, most educators have faced the question of how to effectively use ICTs for learning. Developed countries have been able to address the issue and have gone farther in integrating ICT in their education systems and processes. Developing countries still struggle, limited by lack of resources, underdeveloped telecommunication infrastructure and, potentially, some educational and cultural factors.

Since primary and secondary education in most Eastern European and CIS countries is still largely state-funded and managed, it will take government awareness and commitment of the kind seen in some EU countries for more schools to gain access to the Internet and, furthermore, for Internet technologies to become fully integrated in school life as effective educational tools.

In some Eastern European countries, education reform processes are moving some of the control over schools from centralised authorities into the hands of local governments, which may change the dynamics and allow progressive municipalities to have a positive influence over the development of ICT resources in schools. This may, however, deepen the digital gap between schools, as municipality administrations are bound to command different levels of resources, entrepreneurship and commitment to advancing education in their communities.

Public and private partnerships on the international, regional, national and local level will be crucial for the development of more sophisticated structures and processes which would address current education technology needs across the region. Schools from developing countries should be offered the opportunity to join existing EU structures and resources, so that they can take advantage of what is already available, and to build their local networks on existing best practices models. Only through well-developed strategic partnerships among governments and industries will the educational technology "map" be more evenly developed, preparing European youth for the global information society before us.

CHAPTER 5

THE MIDDLE EAST

Sherif Kamel

INTRODUCTION: INFORMATION TECHNOLOGY IN THE MIDDLE EAST

The Internet as an innovation has emerged as one of the most profound social, technical and business phenomena in the history of humankind. It has changed how people work, study and communicate with each other. Electronic learning, as a new way of delivering education and knowledge, is a growing trend which is leading to improved ways of investing in larger numbers of people and of leveraging their capacities with fewer resources while maintaining a high level of good quality deliverables and promising diversified venues for knowledge dissemination. The impact of this trend will be felt by all and will be reflected in individuals and organisations throughout society, from schools to industries to professions.

The diffusion of information and communications technology (ICT) in the Middle East has increased remarkably over the last two decades, although there is a wide gap from both Europe and the United States which contributes to an ever-increasing digital divide. It is estimated that the Middle East is three to four years behind the United States in terms of ICT deployment and about two years behind Europe (American Chamber of Commerce in Egypt 2002).

The use of the Internet throughout the region has been increasing, but not enough to create a major impact. According to a survey conducted in 2001, there were 3.54 million users in the Middle East, and that number was expected to grow to an estimated 10 million by the end of 2002 (see *www.ajeeb.com*). The number of Internet account holders in the Middle East reached over one million in 2001 based on the assumption that 2.5 users is the rate per subscriber across the region (except in some countries such as Egypt which ranges between four and eight users per subscriber account). However, such numbers constitute only 0.7 per cent of the population of the Middle East which stands at 280 million (American Chamber of Commerce in Egypt 2002). Table 5.1 ranks the countries in the Middle East in terms of Internet subscribers.

During the past few years, countries in the Middle East have made significant progress in expanding access to and improving the quality and equitable distribution of education

Table 5.1: *Internet penetration in the Middle East*

Rank	Country	Number of subscribers	Number of users per account	Number of users	Per cent of population (%)
3	Egypt	70,000*	8	560,000	0.82
5	Lebanon	75,000	3.5	262,500	6.56
7	Jordan	35,000	6	210,000	4.57

*Reflects the number of individual subscribers excluding businesses. In 2003, the Minister of Communications and Information Technology noted that the number of Internet users in May reached 2.1 million.

Source: www.ajeeb.com

resources. Diversified efforts have been exerted to integrate nations in the Middle East with the newly developing global knowledge society. It is now widely held that a country's investments in human capital are at least as important as its stock of physical capital and its natural resource endowments, although the links between education, technology and other education inputs to a country's competitiveness ranking have yet to be fully understood. In that respect, nations that will not take the necessary actions to improve the efficiency and quality of the education offered in their K–12 institutions, and to better align the knowledge and skill outputs of their education systems with the changing and evolving needs of the global economy, will not become or remain competitive players in the developing global marketplace. The United Nations Arab Human Development Report 2002 concludes that a mismatch between educational output, on the one hand, and labour-market and development needs, on the other, could lead nations in the Middle East to isolation from global knowledge, information and technology at a time when accelerated acquisition of knowledge and formation of human skills are becoming prerequisites for progress (UN 2002a).

THE REGION: AN OVERVIEW

The 22 countries that constitute the Arab region account for 5 per cent of the world population totalling 280 million (UN 2002b). Population varies dramatically among different countries. Egypt has the largest population with over 71 million, followed by Sudan, Algeria and Qatar (see Table 5.2).

The age structure of the population is significantly younger than the global average, reflecting the large proportion of children aged 0 to 14 (38 per cent) and of those aged 60 or older (6 per cent). The population growth ranges widely among different countries in the region, from as low as 1.1 per cent in Tunisia to as high as 4.1 per cent in Yemen. By 2020, the population of the Arab region is expected to reach 459 million.

This demographic represents a set of challenges and opportunities for the Arab region. The population growth could represent an engine of material development and human welfare when other vital factors conducive of economic growth, including high levels of investment and appropriate types of technological know-how, are present (UN 2000b).

Language and culture also play a part. Arabic is one of the top 10 languages spoken in the world, yet the Arab-speaking region is one of the least connected to the Internet, with only around 1 per cent online. Those who are connected are mostly young, well paid, highly educated and English-speaking. Therefore, if the region is to get more people

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Table 5.2: *Population of the Arab world*

Country	Total (thousands)	Age group 15–59 (% year 2000)
Algeria	31,800	58.8
Bahrain	724	66.3
Comoros	768	52.9
Djibouti	703	51.9
Egypt	71,931	56.9
Iraq	25,175	53.4
Jordan	5473	56.5
Kuwait	2521	70.9
Lebanon	3653	60.7
Libya	5551	61.4
Mauritania	2893	51.4
Morocco	30,566	60.5
Oman	2851	59.1
Palestine	3557	48.7
Qatar	610	70.3
Saudi Arabia	24,217	56.2
Somalia	9890	48.3
Sudan	33,611	54.4
Syria	17,800	55.6
Tunisia	9832	61.4
United Arab Emirates	2995	71.0
Yemen	20,010	47.2

Source: United Nations Population Division

online, it must attract them to the Internet through awareness, skills development and content creation, and that should start from the school level (Internet for the Arab World 2000).

THE EDUCATION SECTOR

Achievements in the education sector are modest when compared to other regions, even in the developing world. This is especially true among adults, where the overall educational achievements remain low on average. However, the collective effort of the Arab region is considered tangible and headed in the right direction as it moves forward in the quest to improve literacy rates. In fact, illiteracy has effectively dropped from 60 per cent in 1980 to 43 per cent in the mid-1990s (UNESCO 1998). However, illiteracy in the Arab region is still higher than the international average as well as being higher than the average in other developing regions. One man in three and one woman in two in the Arab countries is illiterate (UNESCO 2002). Table 5.3 shows the statistics on illiteracy rates in the Arab region.

Over the last few decades, the number of children who were enrolled in preschool education specifically during the period 1980–1995 doubled. The data on enrolment in the three levels of formal education showed a steady quantitative increase moving from 31 million in 1980 to 56 million in 1995. Moreover, education expenditure on education

Table 5.3: *Illiteracy rate relative to population*

Country	Illiteracy rate (%)	Illiterate population (000)	Total population (000)
Algeria	11.5	758	6585
Bahrain	1.6	2	100
Djibouti	16.0	20	123
Egypt	30.3	4178	13,799
Iraq	55.4	2554	4610
Jordan	0.8	8	1032
Kuwait	7.6	34	445
Lebanon	4.8	32	654
Libya	3.5	44	1252
Mauritania	51.1	268	524
Morocco	32.7	2015	6158
Oman	2.1	10	491
Qatar	5.2	4	71
Saudi Arabia	7.3	287	3925
Sudan	22.8	1400	6138
Syria	12.8	461	3591
Tunisia	6.7	133	1994
United Arab Emirates	9.4	37	400
Yemen	35.0	1165	3332

Notes: No information was available for Palestine, Comoros and Somalia.

Source: UNESCO Institute of Statistics

has risen substantially since 1985. Education spending increased from USD18 billion in 1980 to USD28 billion in 1995 (UN 2002b). However, during the same period, per capita expenditure on education in the Arab countries dropped from 20 per cent of that in industrialised countries in 1980 to 10 per cent in the mid-1990s.

Education and human resources development in the information age and within the knowledge-based societies are becoming invaluable. It is essential for economies to develop and grow to create synergies between education and the socio-economic system. In that respect, the main challenge facing the Arab countries is the formulation of a model that will help enable quality education at the right cost. During the school year 1999–2000, over 2.4 million children were enrolled in the region in preschool education (UNESCO 2002). This represents about 16 per cent of all children of preschool age. In that domain, private schools play a fundamental role in pre-primary education with over 79 per cent of those enrolled attending private schools (with wide variations among different countries).

Primary education is important with an official age of entry being six and with a duration of six years (with a few variations). In 1999–2000, over five million children entered primary school for the first time (UNESCO 2002). Two indicators are used to measure the extent of participation in primary education: the gross enrolment ratio, or GER, which is the number of children enrolled as a percentage of the total population of primary school age; and the net enrolment ratio, or NER, which is the percentage of the official primary school age group that attends primary school. In 1999–2000, over 35 million pupils were enrolled in primary education in the Arab region; of these 94 per cent were enrolled in public schools (with some exceptions such as Lebanon, the United Arab Emirates and Jordan where 66 per cent, 45 per cent and 30 per cent respectively of all pupils were enrolled in the well-established private primary education) (UNESCO 2002).

In 1999–2000, over 22.5 million pupils of all ages were enrolled in secondary education (UNESCO 2002). This number represented 60 per cent of the population of the official age for this group. Of all these pupils, 93 per cent were enrolled in public schools.

THE ROLE OF ICT IN THE LEARNING PROCESS

Students are heavy users of the Internet compared to the general population of the Arab Region, in part because they have grown up with computers, according to findings from the Pew Research Center for the People and the Press (see *http://people-press.org*). However, that degree of usage differs from one community to another based on connectivity and accessibility to infrastructure platforms. The Internet has become so integrated into students' lives that it has become a technology as ordinary as the telephone or television, and students more than anyone else look like a generation comfortable with online research and online learning.

Statistics show that in the United States, 20 per cent of today's students begin using computers between the ages of five and eight, and by the time they are 18, computers and the Internet are commonplace in their world. However, it is important to study how such percentages differ in the context of developing nations and how wide the gap is in the context of electronic readiness of students at schools. The same report also indicated that 85 per cent of students own a personal computer and 66 per cent use e-mail, but these percentages are far lower in developing nations based on a per capita scale.

The introduction of ICT in the education sector in the Arab nation, as elsewhere in the world, will help improve the quality of education through the use of interactive computer-based systems and enable the possibility of individualising the educational process to accommodate the needs, interests, knowledge and learning styles of students (Kehoe and Mixon 1997). Increasingly, the Internet will play an important role in improving and developing a country's educational system (Bernt and Bugbee 1993). Recently, researchers have begun to focus on the potential of information technology to support certain fundamental changes to the traditional approaches to the educational process (Ehrmann 1995). Information technology is serving as a powerful tool for teachers to monitor and assess students' progress and maintain portfolios of student work. It can help prepare coursework, communicate with students, parents and administrators, exchange ideas and experiences, access remote databases, acquire educational software and expand knowledge and professional capabilities (Williams 1999; Bunderson and Inouye 1987). At school, while the role of the teacher is likely to change within a technology-rich classroom, it is perceived that the potential benefits will decline as class size increases (Porter 1997). Teachers will be required to play an important role in helping students to assimilate abstract concepts and develop higher-order thinking skills. Therefore, school

administrators need to invest not only in hardware, but also in adequate professional development plans for teachers (Threlkeld and Brzoska 1994).

CASE STUDY: EGYPT

Egypt is the cradle of an ancient civilisation dating back to 3000 BC. It has a population of more than 68 million with an average growth rate of 1.9 per cent. Over 16 million Egyptians, 65 per cent of whom are under the age of 25, are in different education stages (IFC 2001). About 49 per cent are at school level. In 2002, 1.1 million university students graduated; 1.2 million students were enrolled at the university level with 225,000 students at the post-graduate level (Kamel 2002).

Public expenditure on education represents 4.1 per cent of GDP (UNESCO 2002). Egypt has the second largest economy in the Middle East and has successfully implemented its economic reform programme, which has enabled its current annual economic growth rate to stand at 3.1 per cent and its inflation rate at 3.6 per cent (as of March 2003; see *www.economic.idsc.gov.eg*).

Like many other developing countries, Egypt is trying to modernise technologically, and one of the main sectors the government is focusing on is education (Kamel 2002). The ratio of personal computers per capita is low at 1.12 per 100 inhabitants (American Chamber of Commerce in Egypt 2002). While this low ratio makes the diffusion of the Internet relatively difficult, the situation is likely to change in the near future as such a large percentage of the population is made of young people who are exposed to media and technology (see Table 5.4).

Table 5.4: *Population demographics in Egypt*

Age	Population	Cumulative population	Per cent of population (%)
Under 5 years	7,505,200	7,505,200	11.6
5–10 years	8,346,300	15,851,500	12.9
10–15 years	8,605,100	24,456,600	13.3
15–20 years	7,505,200	31,961,800	11.6

Source: CAPMAS 2001

Recent studies by UNICEF show that 47 per cent of the population of Egypt is illiterate, and this percentage is increasing due to a high birth rate, a deteriorating school sector and poor literacy retention (see *www.unicef.org/infobycountry/egypt.html*). The Egyptian government recognises that to move the country forward and build an information-based society that can compete on a global scale, it needs to mobilise and co-ordinate its leadership, government and people and develop "learning bridges," which are the mechanisms that can help diffuse learning and education in society. It is the platform through which knowledge will be acquired from different sources and channels and dissemination across the different levels and areas in the society.

Egypt has acknowledged the importance of ICT for growth since the mid-1980s, and it has launched several initiatives aimed at establishing a national ICT industry through capacity-building such as setting up government information and training centres and

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introducing ICT in schools and establishing ICT faculties at universities (ESCWA 2003). Other projects have included establishing the Pyramids Smart Village, ICT incubators, ICT community telecentres and, more importantly, increasing allocation of funds for research and development.

In 1985 the Cabinet of Egypt Information and Decision Support Center (IDSC) was established (see *www.idsc.gov.eg*) along with its various related programmes and projects. A large number of achievements and objectives have been realised since then, but it was only in 1999 that the Egyptian government announced that development of the ICT industry was a national priority (American Chamber of Commerce in Egypt 2002). This was followed by the creation of the Ministry of Communications and Information Technology, which showed that the government acknowledged that the ICT sector could contribute to high and sustainable economic growth for the Egyptian economy (see *www.mcit.gov.eg*). The ministry developed a national plan focusing on infrastructure development, training, education and human resource development such as upgrading the ICT infrastructure, investment in training, developing a new generation of graduates capable of dealing with ICT, establishing technology clubs and establishing technology awareness centres.

Education is the mainstay of progress and development. It is an integral part for societal development, especially in a world led by information and knowledge-based societies. In Egypt, the extent and quality of its workforce, human and intellectual capital will determine its social and economic future development (Kamel 2000). Therefore, investment in human resources is a prerequisite for preparing for the new century. Also required is an investment in the diffusion of information technology in various sectors of the economy with a vision of building an information society that can compete in the global marketplace. An integral part of such a society is an educated labour force with learning facilities and resources available that allow them to master the use of ICT. According to the World Bank's world development indicators, the percentages of gross (i.e., those who are enrolled) and net (i.e., those who complete or graduate) primary school enrolment ratios in Egypt in 1998 were 100 per cent and 92 per cent respectively.

Thus, the challenge in the current educational system in Egypt is to prepare students more effectively through the use of state-of-the-art ICT. The institutionalisation of computer-based education programmes in the different phases of the learning process is essential in order to meet the continuous innovations of the 21st century. It has become increasingly important to dramatically transform the way that the learning process is being designed, developed and delivered.

Therefore, Egypt has formulated a massive plan to revolutionise the educational system using ICT through a number of large projects. Examples of these projects are described below:

- **Educational Software for Children** targets computer literacy among children. The objective is to prepare new generations to be leaders in the information age, to learn and think using interactive learning media, to enhance their skills at young age and to evaluate their learning ability using systematic computing methods. The project is to be implemented in 200 schools with an estimated cost based on 15 packages per year of USD1.8 million (Kamel 2000).

- The **Educational Software for Students** project includes the development of courseware covering topics such as science and technology, languages, history and geography for students currently enrolled in schools (Kamel 2001). The objectives include enhancing the effectiveness of students' basic skills, encouraging them to learn about different subjects by introducing computer-based competitions,

motivating them to search and acquire information and encouraging them to communicate through electronic media. The project is based on the collaboration of various educational institutions including private sector software firms to develop the educational packages. The project is expected to produce 30 packages per year with an estimated cost of USD4.5 million.

- The initiative **Investing in Egypt's Future** is meant to prepare the kids of the nation for the new millennium. The initiative was developed primarily to help kids talk about tomorrow's language, communicate with their peer group in different parts of the world and allow them to compete and work in a global environment regardless of time and distance barriers. This initiative mainly targets disadvantaged children and includes a number of activities among which is the establishment of The **21st Century Kids Clubs,** the development of a Web site and supporting the development of a software industry for kids in Arabic. The objectives are creating a better learning environment for kids with state-of-the-art practices, exposing kids to new ways of thinking to be able to compete globally, promoting collaboration among kids worldwide, and improving the quality and methodology used in the learning process (VITA 1995). The 21st Century Kids Clubs project was first launched in Cairo in June 1997 with 26 personal computers, 300 software packages and full Internet connectivity. The clubs allow kids to learn about computers and the importance of information technology and the Internet, as well as to use the facility for both training and enjoyment. The success of the pilot of the Cairo Kids Club encouraged the project team to establish 12 additional clubs throughout Egypt in those remote areas considered the least privileged. The technology investment was an attempt to minimise the gap between the "haves" and the "have-nots." By December 1998, there was at least one club in every one of Egypt's 26 provinces. More clubs are expected to be established in the years to come. The growth rate in the establishment of the clubs was mainly due to a collaborative effort by the private sector, the government and non-governmental organisations (NGOs). The clubs have proven to be appealing not only to the kids, who represent 33 per cent of the population, but also to youths and families (American Chamber of Commerce in Egypt 2002).

- The **Technology Access Community Center Project** (TACC) project demonstrates the potential waste of children in low-income communities being denied access to ICTs (see *www.undp.org/info21/pilot/pi-egprog.html*). The project aims at promoting the theme "Internet is for everyone." However, realising that this theme will not occur until the Internet is available in every home, business and school, TACC offers a unique platform for providing community access to the Internet and disseminating electronic information and knowledge using ICT. In 1998, a pilot project was initiated to establish three TACCs in the province of Sharkeya (70 kilometres northeast of Cairo). The province comprises 15 cities, 82 villages and 4492 sub-villages and has a population of some 4.2 million. The project was funded by the United Nations Development Programme (UNDP) through Information Technology for Development in co-operation with the United Nations Volunteers programme (UNV). The Egyptian partners were the province of Sharkeya, Sharkeya Chamber of Commerce, the Cabinet of Egypt Information and Decision Support Center and the Investors Association of the 10th of Ramadan City (located in the province of Sharkeya). In 1999, the Chamber of Commerce of Sharkeya and the trade point division of the Ministry of Trade joined the project (see *www.undp.org*). The diversity of the project partnership scheme reflects the interest of the Egyptian government, private sector and NGOs in the TACC concept (Hashem 1999). The number of TACC users is continuously increasing; after just one year of operation, TACCs had attracted some 3000 people to receive information technology training

with a view to supporting development activities in the community. These users have developed and posted over 1000 Web pages, most of them in Arabic, offering applications in health, agriculture and e-commerce, and they have also generated Web sites that carry information ranging from culture and history to the promotion of local innovations and expertise. The government, in collaboration with the private sector, is currently formulating a plan to diffuse the TACCs concept in Egypt's 26 provinces to replicate the successful experience.

- In June 2003, the United States and Egypt launched a major computer education initiative, **IT in Schools,** worth USD10 million that will reach 23,000 students in a pilot programme in an attempt to bring information technology to schools in Egypt using modern instructional methods. The project will work directly with 14 schools in seven governorates over the coming three years, installing 7700 computers and power supplies as well as connecting them with local networks and the Internet. At the same time, the project will create a model that can be replicated in many more schools throughout Egypt in the future, including an online version of the Egyptian national curriculum. The project beneficiaries will be the 23,000 students in kindergarten through grade 12 and their 2100 educators and administrators. The United States, through its Agency for International Development, will provide equipment and technical assistance to the project. The Minister of Education, Dr Hussein Kamel Bahaa El Din, announced the public launch of the project during the ceremony held in Cairo on June 25, 2003, marking the completion of training for a group of school administrators. It is important to note that the United States has invested USD65 million in improving education and training opportunities in Egypt since 1975 (see *www.usaid-eg.org*).

- In an effort to accelerate the adoption of the Internet as well as raise technology awareness among private and public school students, the Ministry of Communications and Information Technology is implementing the **Smart Schools Network Project**, a three-year project that started in 2000 with a number of key objectives, including raising student awareness of modern technological tools and resources, introducing a three- to five-hour per week ICT syllabus into the education system with an emphasis in the primary stages of education and introducing computer-aided education to the school system. The project is to be implemented in a number of private and public schools with the Ministry of Communications and Information Technology supplying the schools with a sufficient number of computers and accessories to allow a one-to-one student-computer ratio; providing the required software tools as well as the education solutions necessary for the project; establishing a network to interconnect schools, teachers, parents and students; and developing, evaluating, and following up on training programmes for teachers in technology and computer-aided education (American Chamber of Commerce in Egypt 2002).

- There are 10 **Internet learning centres** (ILCs) that have been established in public schools in five different regions of Egypt (see Table 5.5) as part of the Schools Online project. A number of partners are working together to ensure the success of the project: the Ministry of Communications and Information Technology is providing leased lines, the Ministry of Education is providing the basic training for the teachers, Hewlett-Packard is donating equipment and the Regional Information Technology and Software Engineering Centre is handling the management of the operational plan. ILCs are open after school hours to the community to maximise the resources, which contribute to the ICT literacy of the whole community.

- Other initiatives have been developed by a collaborative effort between the government, NGOs, the private sector and individuals: **Little Horus**

(*www.horus.ics.org.eg*) and **Aftal.org** (*www.atfal.org*) are multilingual knowledge repositories addressing issues of concern to children; First Lady Mrs Susan Mubarak runs an annual contest that encourages students of all ages to innovate, develop and design local content and ideas which are backed up, supported and sponsored by different companies in the ICT sector, mainly software companies. Running parallel to this contest are other competitions arranged by the Ministry of Education in collaboration with organisations such as ThinkQuest and ThinkQuest Africa.) In 2003, the Government of Egypt, in collaboration with the private sector, launched a project to introduce computers to every household. The programme is led by the Ministry of Communications and Information Technology.

Table 5.5: *Schools Online in Egypt*

City/Town	School
Cairo	Hafez Ibrahem Experimental School
Cairo	Tarek Ibn Ziad Experimental School
Cairo	El Geel Al Gadeed Experimental School
Giza	Gamal Abdel Naser Experimental School
Giza	Abu Bakr El Sedeek Experimental School
Alexandria	Talat Harb Experimental School
Alexandria	Samy El baroudy Experimental School
Gharbia	El Hadisa School
Hurgada	El Shahed Waleed El Ghafari Schools
Sharm El Sheick	El Fayrouz Experimental School

Source: www.schoolsonline.org

CASE STUDY: LEBANON

Lebanon has a population of about 3.5 million with a 2.7 per cent growth rate (UNESCO 2002). The nation covers 10,400 square kilometres.

The education system in Lebanon is one of the most advanced of the Arab nations in terms of quality and deliverables. Expenditure on education as a percentage of GDP is 2 per cent and as a percentage of total government percentage is 9.2 per cent (UNESCO 2002). The illiteracy rate is the lowest in the region, and enrolment is rising in different educational levels due to a successful partnership between the public and private sectors. However, there are still some problems that relate to low compatibility with the requirements of the labour markets.

Due to the high level of private universities and schools in Lebanon, ICT capacity-building is gaining ground in the education sector; however, more is needed to realise an impact that can help transform positively the society from an ICT perspective (ESCWA 2003). One of the important initiatives is the establishment of BERYTECH, which is a private "technology park" focusing on activities related to information technology and multimedia training among other things (see *www.escwa.org.lb/ntpi/members/*

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lebanon.html). A study that was conducted in 2001 on 206 of the 411 private schools located in the greater Beirut area, which represents 50 per cent of the schools showed some important aspects such as the need of funding for hardware purchases, lack of enough qualified teachers, consensus that computers have positive implications on student motivation, importance of the role of the school principal as a decision-maker and as a champion in introducing schools to computers (Kibbi 2001).

Lebanon is gradually giving more attention to ICT. A national ICT strategy has been drafted and awaits adoption by the Council of Ministries. Currently, the country exhibits an average penetration of personal computers compared to regional levels (5.6 per cent). Further, except for the Gulf Cooperation Council, Lebanon has the highest Internet penetration rate in the Arab world (8.6 per cent). However, broadband per account is low (0.4 kbps), and this affects speed of access. Usage is expected to grow, as the country boasts a relatively well-educated population with an inclination to adopt technologies rapidly. According to the World Bank's world development indicators, the percentage of gross and net primary school enrolment ratios in Lebanon in 1998 was 110 per cent and 78 per cent respectively.

In 1998, the National Authority for Public Schools was established with the objective of developing state-of-the-art schools that would match innovative tools and applications related to knowledge dissemination and management. One of the main outcomes of this effort was the registration at the World Bank of Lebanon's request to introduce the Internet to all private and public schools to support the development of the education sector.

The efforts of the Government of Lebanon date back to the early 1990s when they first thought of introducing information technology into the education sector with its different phases. Since 1991, the Ministry of Education, in collaboration with the UNESCO regional office (Arab countries), started to put together the framework to improve the information technology infrastructure related to the education sector. Additionally, in 1997 the Ministry of Education started a comprehensive project that included an effort to establish an information system for the education sector as well as a plan to train 600 instructors on the use of computers in education. The programme had as its objectives automating units and upgrading the information units in the public schools that could lead to better accumulation of information and standardisation of procedures and policies related to school administration. The programme also promoted collaboration between different schools to promote the exchange of experiences and knowledge. Moreover, the accumulation and proper recording of information could lead to a more comprehensive understanding of the sector at large and, therefore, more analysis of the information that could help in future directions and improvement of the services offered.

The programme will also help the diffusion of the information technology culture among all public school students in Lebanon and help develop a new generation that is technology literate and that can compete globally. Technology is therefore being integrated as a means to an end and as an integral element in organisational development and societal growth rather than an end in itself. However, this trend is sometimes hampered by the lack of resources required to establish information units in public schools and the unavailability of the authority ready to introduce and implement training on computer usage. The literacy programme will energise and activate the role of public schools as the focal organisation for reducing computing illiteracy. There is remarkable potential impact for the society at large in terms of development and knowledge dissemination where the schools can work as the bridge between the society and information for all sectors.

A number of other government initiatives are either under study or already being implemented:

- Of the 8,000 schools in Lebanon, 12 are participating in the **Schools Online** programme (see Table 5.6), for which the Ministry of Telecommunication will ensure Internet connectivity.

- The **Internet learning centres** (ILCs) opened in October 2001 to create a network linking the selected schools in different regions of Lebanon. Teachers and students from the 12 participating schools and five other local schools learn how to take advantage of the Internet to engage in learning programmes with peers around the world. Optimising the use of resources is crucial, and each ILC opens its doors after school hours to surrounding schools and the community at large. This effort is implemented with full collaboration and support from the Ministry of Education.

- The **Technology Literacy Program**, a project sponsored by the World Bank, the National Authority for Schools and Al-Hariri Foundation has led to upgrading of the technological infrastructure in 456 schools spread across Lebanon's six provinces (see Table 5.7). The project's objective is to leverage the computing and technology capacities of Lebanese younger generations. A total of 1224 schools have been upgraded and work is still underway to leverage their capacities to more advanced levels (El-Hariri Foundation 2000).

Table 5.6: *Schools Online in Lebanon*

City/Town	School
Beirut	Gameel Rawasy
Beirut	El Ghebairy
Mount Lebanon	Bekfayya
Mount Lebanon	Jbeil
Halba	Halba
Zogharta	Zogharta
Bekaa	El Manara
Bekaa	Hermel
Saida	Saida
Abbasiyye	Abbasiyye
Nabatiyah	Hasan Kamel El Sabah
Nabatiyah	Mariayoun

Source: www.schoolsonline.org

CASE STUDY: JORDAN

Jordan has a population of 5.2 million (Jordan Department of Statistics 2002) with an annual growth rate of 4.4 per cent and a land area of 89,210 square kilometres (UNESCO 2002). Public expenditure on education is 5 per cent of GDP. The total number of schools in Jordan is 6500. In 1999/2000, there were 80,257 children enrolled in pre-primary education, 723,508 in primary education and 583,535 in secondary education (UNESCO 2000). According to the World Bank's world development indicators, the percentage of

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Table 5.7: Upgraded schools

Province	Number of schools
Beirut	61
South	153
Nabatiyah	128
Bekaa	260
Jabal Lebanon	193
North	429

Source: El-Hariri Foundation 2000

gross and net primary school enrolment ratios in Jordan in 1998 were 69 per cent and 64 per cent respectively.

Jordan recognised some time ago the role ICT capacity-building can play in developing a wealthy socio-economic environment and, accordingly, it has have embarked on a number of initiatives including the development of a national strategy where six ministries have been selected in an ICT fast-track programme. Within the education sector, a nationwide integrated distributed database management system aims at connecting 28 Ministry of Education directorates to the ministry headquarters. Moreover, ICT community centres have been established in rural areas to provide access and training to local communities. Further, there are plans to establish CyberCity, an information technology park, in the north of the capital Amman (ESCWA 2003).

Jordan has a strong ICT agenda that focuses on human resources development. However, the cost of access remains relatively high in comparison to annual per capita income. Personal computer prices remain unaffordable for most of the population, but the proliferation of Internet cafés has helped improve Jordan's ICT readiness. Amman (the capital) remains the regional hub in portals development (e.g., Maktoob, Arabia Online and Al Bawaba).

Generally, Internet penetration is gradually increasing, and was 4 per cent in 2001 (see *www.ajeeb.com*), due to the various initiatives taken by the government:

- The **Schools Online** initiative started in October 2001 and includes 10 schools, each having an Internet learning centre (ILC) (see Table 5.8). Global Telecommunications Engineering (GTE), the national managing partner of schools online, managing the programme in Jordan, and the National Science Institute and Fast Link Company provides the Internet connectivity. This connectivity allows students to work and get information from the Internet as well as engage in online collaborative projects. Each school opens its ILC after school hours and during the holidays to allow the students to maximise its use.

- The **Electronic Learning Initiative** is a national plan instigated by a royal decree. The initiative constitutes a support element for the king's declared objective of transforming Jordan into the region's centre for information technology. However, there are a number of challenges that exist, the biggest being the preparation of the required human resources necessary to achieve this ambitious goal. Jordan's 1.5 million school students, which represent around 33 per cent of the population, are vital to this aspiration. Therefore, the government has formulated a gateway for

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electronic learning to serve as a consulting and training body to all of Jordanian society. The common roles played by schoolnets include networking the schools, providing training and purchasing hardware. The Ministry of Education, playing the pivotal role in the initiative, is working on fundamentally changing some policies to avoid centralisation of the decision-making process in order to ease the swift introduction of ICT into the system and into management. The objective is for all of Jordan's schools to have access to the Internet. Moreover, a national information centre for education technology will be established, coupled with a programme to leverage the knowledge of teachers and their ability to employ technology in education reflecting training the teachers. For this purpose 30 learning resource centres will be established to educate the public at large, but more importantly to train the teachers specifically on the uses and application of technology in education. The ministry is to build the Jordan Learning Network as an initial technological infrastructure to pave the way for further networking and sharing of information between schools with a goal of creating valuable content accessible to the society. Moreover, the Ministry of Education will establish the National Information Center for Education Technology with an objective of constantly developing and advance the use of ICT in education.

Table 5.8: *Schools Online in Jordan*

City/Town	School
Irbid	Al Hussein
Irbid	Aisha Bent Abu Baker
Amman	Al Qusour
Karak	King Abdullah II
Tafilah	Al Ein Al Baida'a
Madaba	Madaba
Amman	Al Ashrafiah
Zarqa	King Abdulallah II for Excellence
Amman	Kamal Borhan Al deen
Zarqa	Rukhaiah Bint Rasoul

Source: www.schoolsonline.org

CONCLUSION

The Internet can play a major role in education reform with students taking more responsibility for their own learning. However, teachers need to adapt themselves to a changing technological society to prepare productive citizens adapted to ICT. Traditional methods of teaching will no longer be valid, and there will be a major transformation in the role of teachers, becoming facilitators and co-learners and providing richer learning environments, experiences and activities, and creating opportunities for students to collaborate to solve problems and share knowledge and responsibility. Students will switch from passive to active learners, becoming more of explorers of the universe of learning. Such exploration will provide students with opportunities to make decisions, while figuring out the attributes of events, objects, people and concepts. Both teachers and students will excel in their learning of using the Internet in a variety of ways to enhance their teaching and learning experiences.

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The Internet has the potential to drastically change the way students learn by controlling their learning process. As the global society enters the 21st century, innovative ICTs will create many great challenges and opportunities for growth and the development of smarter communities, smarter societies and a smarter world. The community and the education sector should be prepared to adapt to such change and transform it to handle all the needs and requirements that will come along with it. This will include changes in the design, development, implementation and institutionalisation of many aspects that relate to the education sector at large and its different building blocks.

The challenges of preparing education systems and institutions in the Arab region will become increasingly important. Some of these challenges will include declining financial resources, increasing population growth and the complexity of the reforms required. There are so many efforts already underway in many countries of the region (Cassidy 2003). However, addressing these challenges fully will take time because experience and research documented in the literature demonstrates that changing people's behaviour is a slow process requiring sustained effort and much support. One of the vital steps is establishing significant, substantive and ongoing professional development activities for educators working at different levels of the educational system.

The importance of securing an adequate education for children worldwide has acquired a sense of urgency over the past 15 years, with the increase in the diversity of information dissemination channels (Bossert 1999). Moreover, the expanded global competition and corporate restructuring have drawn attention to the importance of preparing the next generation of children to add value within an increasingly integrated world economy. However, the challenges and the requirements to meet the growing needs of education are diverse. While a number of different approaches have been suggested for improving K–12 education in various countries, one common element has been the more extensive and effective use of ICTs through partnerships involving governments, local communities, schools and the private sector (Moore et al. 1990).

Education must be the key driving force in the development and growth of the strategy of the countries in the Arab region. Failure to improve and expand the impact and effectiveness of education will have serious negative consequences on the development of the nations in the region. Reforming curricula and systems will be the critical success factor in rendering the future generations of the region more competitive in the global marketplace.

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CHAPTER 6

THE PACIFIC REGION: AUSTRALIA, NEW ZEALAND AND THE PACIFIC ISLANDS

Derek Wenmoth

REGIONAL OVERVIEW

The Pacific Region comprises Australia, New Zealand and the group of countries and states known as the Pacific Islands. While all these countries are surrounded by the Pacific Ocean, they each have unique characteristics, both geographic and political, which provide different challenges when it comes to meeting the communication and education needs of the dispersed populations.

Australia is characterised by a number of large urban centres located along its coastline, with the rest of the population dispersed thinly across a large expanse of inland area, much of it desert. Australia's school system is administered differently in each of the eight states and territories, with limited direction or intervention from the federal government (although the federal government has provided substantial amounts of funding to seed initiatives in distance education and the use of telecommunications technologies in recent years).

In New Zealand, a third of the population lives in its largest city, Auckland, while another third are spread among a handful of smaller centres located on both the North and South Islands. The remaining third live in rural towns and isolated settlements scattered up and down the two main islands and a number of smaller, off-shore islands. Schools in New Zealand follow a national curriculum framework, and since the education reforms of 1989, they have been responsible for their own governance and management. The Ministry of Education maintains a central role for policy and resourcing.

Both Australia and New Zealand have a long history of attending to the educational needs of students in rural and remote parts of their respective countries. The New Zealand Correspondence School has been providing correspondence education to students for over 80 years, and in Australia, the Schools of the Air programme has been running since 1951 in conjunction with the Flying Doctor service. The number of Schools of the Air has steadily grown, although there is currently a move towards replacing the use of radio technologies with terrestrial broadband and satellite communications.

The 22 Pacific Island countries and territories support a combined population of around 2.3 million, varying from 50 in Pitcairn to 775,000 in Fiji. Many of these countries and territories comprise a collection of small islands and atolls, with populations concentrated on one island or state. The population densities range from as low as eight people per square kilometre in Vanuatu to 430 people per square kilometre in Nauru.

The development of countries in this region has traditionally been hampered by their dispersed populations, small size and the vast ocean distances separating them. These circumstances impose large costs on service provision, including education. While the University of the South Pacific has provided a tertiary-level education at a distance for residents of many of the islands, educational opportunities for primary and secondary school students are often developed through intergovernmental aid programmes, mostly with Australia and New Zealand.

ICT USE AND ACCESS

The level of use and access to information and communications technology (ICT) varies considerably among these countries. Both use and access have grown dramatically in both New Zealand and Australia over the past decade, but has remained low in the Pacific Islands.

Australia

Australians have been quick to embrace new technologies. Statistics for November 2000 show that 37.1 per cent of Australian households were online and 50 per cent of Australian adults accessed the Internet (from any site) in the previous 12 months. Internet connectivity and use in Australian schools is also very high, with each state and territory implementing a variety of strategies to increase access. Much of the funding and policy direction for these initiatives originates at the Commonwealth (national) level with the implementation plans developed locally.

New Zealand

New Zealand has the world's highest access to telecommunications per capita, with the cost of accessing the Internet being almost as low as it is in the United States. Research shows that New Zealanders are usually quick to embrace new technology. They have been buying computers, signing up to Internet service providers (ISPs), and going online at an internationally impressive rate. By March 2001, 46.6 per cent of New Zealand households had a computer, and in the final quarter of 2001, 72 per cent of New Zealanders were able to access the Internet from any location.

Figure 6.1 below shows the growth in Internet access in New Zealand schools from 1993 to 2001.

Pacific Islands

Internet access — or lack of it — is a key issue for the Pacific Islands, where it is estimated that less than 25 per cent of the population have access. It is not financially viable on some of the islands to develop a basic telecommunications infrastructure, and telecommunications and power provision are generally limited to urban areas in most countries, and concentrated on few of the islands in those countries consisting of many islands.

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Figure 6.1: *Internet access in New Zealand schools*
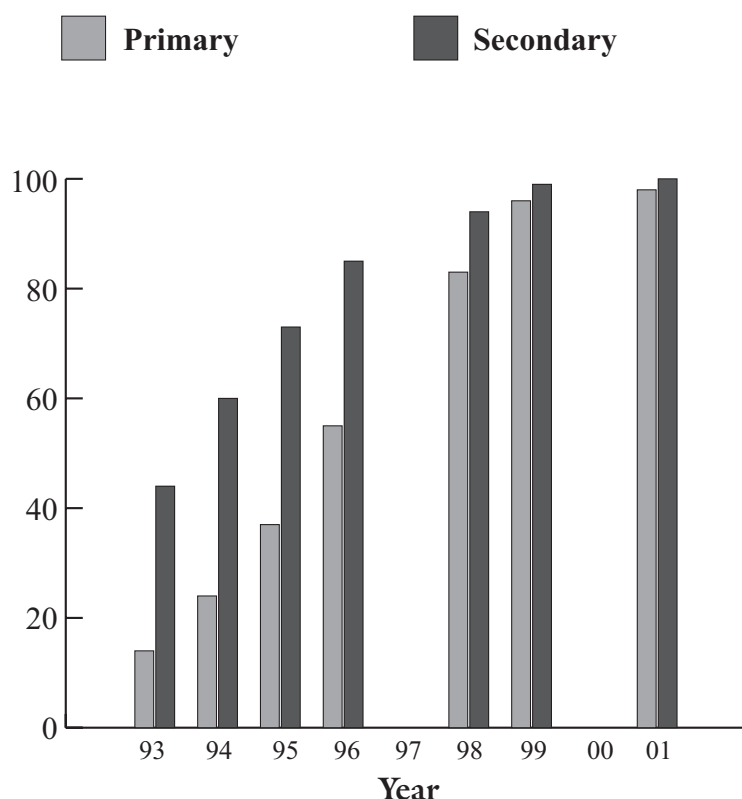
Note: No figures are available for 1997 and 2000.

According to the ITU basic indicators and the ITU Internet indicators (ITU 2001), the rate of Internet connectivity and personal computer (PC) ownership in the Pacific Islands is less than 20 per cent of the world average. This fact is particularly problematic given the distances between different islands in the same country, and the remoteness of the islands relative to the rest of the world. Underlying this problem are even more basic issues relating to telecommunications infrastructure, quality of service and costs. While all countries in the region now have some form of Internet access, the price inhibits growth. A recent UNESCO survey revealed that prices vary from USD9 to USD50 for 10 hours of Internet connectivity, compared with USD4.30 in New Zealand (UNESCO 2002).

DRIVERS FOR SCHOOL NETWORKING

In each of the three regions, Australia, New Zealand and the Pacific Islands, the drivers for school networking are similar, although the methods of achieving the goals differ. The drivers are reflected in strategic, national-level goals, as well as those identified at the local level.

In a recent OECD report, the ICT drivers were identified as economic, social and pedagogic (OECD 2001). An emphasis on citizens of these countries being able to take their place in a knowledge-based economy is a feature of planning in each country, with many commentators noting the likelihood of two classes of economy emerging in the next five years: the information-rich and the information-poor. Each of these countries

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proposes the development of network infrastructures as a means of ensuring they are included in the information-rich category.

It is clear that in each of these regions the drivers for school networking are closely related to the drivers for ICT networking of government and business at a national level. To achieve school networking, the governments of the region have recognised that national-level infrastructures are required, which in turn require strategic decision-making and resourcing at a national level.

In Australia and New Zealand, there has been a significant investment in ICT in schools over the past decade, and now, as schools seek to fully realise the potential of the Internet to provide access to resources and opportunities for learning, the barriers of limited bandwidth and Internet services is inhibiting this development. Therefore, the provision of broadband access is a high priority in both countries, and government-level strategic policies support such initiatives.

An Australian report published by the Education Network of Australia (Moran et al. 1999) described setting out a vision for the future and a roadmap for change, and identified three priorities: bandwidth, professional development and online content. Each state in Australia is currently supporting initiatives to address these priorities.

In New Zealand, the ICT strategy for schools 2002–2004 (Ministry of Education 2002) identifies seven priority areas, five of which address the needs of particular stakeholders (students, parents, community, etc.) The other two areas are curriculum and learning resources and infrastructure, reflecting closely the goals in the Australian document.

In both New Zealand and Australia there are growing concerns about the inability of the existing school structures to provide the rich and rounded educational experiences that students entering the knowledge economy may need. An expanding curriculum, issues of teacher supply and small schools in remote locations, combined with a change in pedagogical focus from the "delivery of courses" to "making learning happen" with an emphasis on promoting learner choice and autonomy, are all factors that are driving change. In both countries, the networking of schools is seen as a means of addressing many of these issues.

Similar issues are driving the development of school networks in the Pacific Islands, although the widely dispersed populations and the associated costs of providing educational services mean that the rate of progress is likely to be slower and will require a greater extent of international co-operation to achieve the desired outcomes.

The Pacific Islands have embarked on an ambitious plan to provide "information and communications technologies for every Pacific Islander" (Draft Pacific Islands Regional Information and Communications Technologies Policy 2001). The focus of this policy and the subsequent strategic plan are to implement ICT solutions that will help to overcome barriers of distance, as well as contribute to the social and economic development of the region. Education is one of the major focus areas in this region, with a particular emphasis on secondary school level.

ORGANISATIONAL ENTITIES

Australia

Because of its size, history and structure of both federal and state governments, Australia has a number of organisational entities that contribute to the development of school

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networks. Besides the very strong directives from the central government, and the well-researched and implemented plans at the state level, there are a number of national-level organisations that have emerged to address the particular needs of schools. The Education Network of Australia (EdNA) provides an important role in co-ordinating many of the national-level initiatives, providing a point of reference and information about them. The EdNA Web site (*www.edna.edu.au*) is an extremely valuable resource in this regard.

New Zealand

Following the education reforms of 1989, schools in New Zealand have been self-managing, and the central Ministry of Education has adopted more of a policy and curriculum support role. This has led to a number of corporate entities taking responsibility for the development of ICT initiatives. Most noticeable of these has been NZ Telecom, which introduced its Telecom Education Foundation in the early 1990s. Projects initiated and supported by Telecom to benefit New Zealand schools have included the provision of a dedicated telephone to all schools for the use as a telecommunications link at no charge, a series of teacher professional development programmes across the country and the establishment of the NZ Telelearning Network, which existed in the first half of the 1990s as means of linking together schools and organisations that were using online technologies.

More recently, it has been recognised that there needed to be more strategic direction and support provided from central government, and in 1998 the first ICT Strategy for Schools was launched, followed by an updated version in 2002 called Digital Horizons. The first strategy focused primarily on ICT competence and establishing ICT infrastructure, while the second built on this theme with a focus on teaching and learning. One of the important developments from the first strategy was the formation of a national online resource centre for teachers, Te Kete Ipurangi (TKI). The bilingual TKI site provides an ever-increasing range of support material for teachers, including curriculum support, professional development opportunities and ICT resources.

A significant development with the second strategy has been the co-operation between the Ministry of Education and the Ministry of Economic Development to support a project that will see broadband technologies rolled out to every school in New Zealand. The Provincial Broadband Extension (PROBE) will be achieved through partnerships between various telecommunications providers, local governments and regional councils.

Pacific Islands

In the Pacific Islands, leadership from governments and partnerships with businesses, non-government organisations (NGOs), religious groups and the community at large is required to facilitate participation in the knowledge society. In his environmental scan of five of the Pacific Islands States, Brandjes (2002) observed there to be no formal Ministry or Department of Education policy for the use of ICTs at the administration, teacher training or school level, although he acknowledged a number of "local champions" in schools and government who are working to make things happen. This includes a variety of government, mission and private schools in each country, mostly at the secondary school level, who have introduced ICTs on their own initiative.

A workshop sponsored by the governments of Australia, France and New Zealand and jointly organised by the South Pacific Applied Geoscience Commission (SOPAC), the Forum Secretariat and the Secretariat for the Pacific Community (SPC) in August 2001, brought together representatives from Pacific Island countries and territories to

complete a draft regional ICT policy, which included a set of guiding principles for the development of future policy and for the co-operation by the Pacific Islands Countries and Territories (PICTS)

CASE STUDIES

Each of the case studies below describes an approach used to address the needs of senior secondary school students whose choice of subject or ability to participate in learning may be restricted because of their isolation. In each case the Internet is used as the network backbone, involving the establishment of a co-ordinated infrastructure for the services provided. The differentiating factor for each case study is the level at which the solution has been developed. In Australia there is a strong emphasis on the role of the central government to provide a co-ordinated "top-down" approach, while in New Zealand the initiatives have been started at the local school level and grown from the "bottom up." In the Pacific Islands there is a strong dependence on international aid projects to assist with the building of the core infrastructure to support these initiatives.

Virtual Schooling Services Pilot: Queensland, Australia

Australia has been a pioneer in the use of telecommunications technologies to link schools together, and for more than 10 years there have been a number of networking initiatives across all states of the country. Currently, most states have programmes in place to connect schools. These include projects such as the Learning and Teaching in Schools (LATIS) project of the Northern Territories Department of Education which aims to roll out education services to remote schools using satellite technologies, and Connecting Tasmanian Schools, a joint Commonwealth, Telstra and Tasmanian Government project to provide local and wide area networks to link Tasmanian schools.

In Queensland, there have been significant efforts to establish ICT-enabled networks among schools. Through its Connect-ED and School LANs projects, Education Queensland has made significant progress towards providing a state Wide Area Network (WAN) necessary to underpin the connectivity needed by students, school and state in the future.

In 1999, the Director-General of Education commissioned an innovative pilot project — the Virtual Schooling Service — to determine the viability of synchronous and asynchronous online delivery of senior school subjects to small numbers of students at schools where teaching expertise in certain subject areas was not available. The needs of remote or external students were traditionally met by distance education lessons, which were delivered using a combination of print and high-frequency radio. The Virtual Schooling Service sought to expand the range of communications channels by which students receive educational services remotely.

The Virtual Schooling Service chose to use a combination of the following communications modes:

- Audiographic conferencing lessons delivered twice per week to small groups of students
- E-mail and telephone contact between individual students and the teacher
- E-mail discussion lists for ongoing multipoint interaction between students and teacher

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- Chat or conference tutorials
- Curriculum materials provided via a Web site and on CD-ROM

The pilot study two-year review (Prendergast et al. 2002) concludes that the Virtual Schooling Service should be an ongoing feature of Queensland's education service provision because of its potential to provide a significantly enhanced pedagogical model of distance education.

New Zealand Cluster School Networks

Of the 350 secondary schools in New Zealand, 110 of them have rolls of less than 120 students in the senior three years of study. This demographic poses particular problems with respect to curriculum provision and the supply of specialist teachers. In response, over the past decade there has been a development of clusters among these smaller, rural secondary schools, using various forms of telecommunications technologies to enable teachers and students to interact for both professional development and the provision of senior secondary curriculum.

One of the earliest of these clusters formed in 1994 and involved seven area schools (years 7 to 13) in the central part of the South Island. The CANTAtech project drew on the similar experiences in South Australia, using audiographics technologies to enable specialist staff in one school to teach a "class" comprising students at one or more of the other schools in the cluster. Students who may otherwise have had to move to a major centre to be able to study the subjects they chose now had the opportunity to remain in their local school and complete their studies. This project required careful planning and co-operation among the cluster of schools to co-ordinate timetables, assessment practices and staff workloads.

The success of the CANTAtech project and the valuable experiences that have been gained and documented have led to the development of other clusters. In 2001 a cluster of nine rural secondary schools in the lower part of the South Island, with support from the Ministry of Education and Telecom NZ, collaborated to establish a virtual private network over which they could share lessons by videoconference, supported by online resources and discussion forums. The New Zealand Correspondence School was included in this cluster, providing courses in subjects where no local teacher was available.

Today, over a quarter of all the secondary schools in New Zealand are connected in some way to a cluster, with the NZ Correspondence School providing a support role, providing subjects where required, and brokering the opportunities for schools from one cluster to interact with a teacher from another cluster in some cases. In addition, correspondence schools provide some of the professional development required for teachers from the cluster schools.

It is anticipated that participation in such clusters will continue to grow over the next few years to the point where all schools will have the opportunity to have their educational experiences enriched and expanded through these networks. The Ministry of Education has announced its intention to provide support to clusters of schools that present a suitable business case, and Telecom NZ is well advanced in its plans to introduce a service to schools that will provide a secure virtual private network within which the bridging of videoconferences can be scheduled and conducted, Web resources can be accessed and online forums and discussions conducted.

Pacific Islands Network (PIN)

The Pacific Islands Network (PIN) is an initiative of the UNA-USA Hawaii Division and is currently the leading initiative to promote school networking in the region. Although a small initiative, it is currently the most active project to develop schoolnets in the region. Together with Schools Online (*www.schoolsonline.org*), a California-based non-profit organisation, PIN has equipped Samoa College with computers and, more importantly, has started to encourage the use of ICTs across the curriculum through collaborative online projects.

The PIN programme helps to establish online links between schools within the region and Hawaii to allow teachers and students to interact and learn about each other's culture, history, geography and environment. The programme is modeled after Internet links developed between Hawaii schools and other countries, and was started in July 2000 by Dr James McDivitt, an advisor to the United Nations Association. Dr McDivitt is working with other NGOs and related programmes — such as PREL (Pacific Resources for Education and Learning), PEACESAT, UNESCO and the Peace Corps to name a few — to provide free computers to schools in the Pacific. In a region where it is a goal to have a computer in every school, let alone one in every classroom, providing more computers will be an important step towards enabling networks such as this to succeed.

TEACHER TRAINING OPPORTUNITIES

The requirement for appropriate professional development to enable teachers to work effectively in these new environments is widely recognised and reflected in the strategic plans for each region. As noted by Queensland's New Technologies Project steering group:

The implementation of ICT in schools results in changes to the duties of teachers, teacher-librarians and administration staff. Ongoing professional development and training programmes are required to enable all staff to identify, integrate and manage relevant applications of ICT (Education Queensland 1999a).

Both Australia and New Zealand have identified professional development as priorities in their latest strategy documents. The Pacific Islands, too, have identified "human resources development for ICT professionals" as one of their four priority areas, however this applies across the board for everyone working with ICT and telelearning, including health professionals and other government and business agencies, and the emphasis tends to be on developing technological capability more than with the practice of teaching and learning with and through ICT.

Much of the teacher development in Australia has been developed and co-ordinated centrally, while in New Zealand the emphasis is on local schools and clusters of schools defining and developing their own approaches to professional development. Both of these two approaches have their advantages and disadvantages. In Australia there is a clear, research-based approach that is systematically made available to all teachers. The advantage is consistency of approach and message, while the possible disadvantage is a lack of ownership by teachers who feel that something is "being done to them."

The emphasis on people is clearly seen in the Queensland approach where they have established a Centre for Teaching Excellence and a Centre for Leadership Excellence, set minimum standards for teachers for learning technology and ensured that more than 20 per cent of the learning technology funding is dedicated to professional development and

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training. In addition, Education Queensland has appointed 28 district education advisors (learning technology) and 50 district systems technicians.

The New Zealand approach focuses on local schools and clusters taking responsibility for initiating their own professional development. Clusters of schools are able to apply to a contestable fund for a grant over three years to help them achieve the professional development goals that address the national strategy. Each cluster is then able to appoint their own advisors, co-ordinators and systems technicians as required to achieve what they have determined in their business case.

The strong emphasis in New Zealand on teachers taking greater responsibility for their own professional learning is supported by a number of national-level projects. These include the provision of various online professional learning forums for teachers such as Think.Com and Te Kete Ipurangi, a special online professional development programme for principals called LeadSpace, and a subsidy scheme to enable principals and teachers to purchase their own laptop computers, which in turn gives them better opportunities to log on to such programmes.

Both Australia and New Zealand highlight the tensions that exist between focusing on the technological skills development and on changes to pedagogical approaches that are required to make best use of these technologies. The VSS Pilot in Queensland highlights the need to develop different pedagogical approaches that reduce or eliminate the emphasis on didactic, transmission modes of delivery (Prendergast et al. 2002).

These concerns are described in the EdNA report from Australia regarding what is happening in pre-service teacher education:

> …Australia's pre-service teacher education programmes are still locked into older paradigms of teaching and learning which do not adequately prepare students to make effective use of technology when they go into the schools (Moran et al. 1999).

Similar concerns are expressed in New Zealand and the Pacific Islands. In all of these countries, while many of the pre-service teacher education programmes include and/or require units on learning about technologies, few have yet adapted their curriculum to integrate ICTs into both content and learning processes.

The EdNA report recommends national collaboration to establish a comprehensive professional development plan that would include a major expansion of existing professional development programmes that move from basic skills to the integration of technology into classroom practice, and the development of an online professional development network that includes access to resources and discussion forums (Moran et al. 1999).

INTERNET-BASED CONTENT

Australia and New Zealand

As school-level access to online technologies develops, the imperative to provide quality online resources for teachers and students is being recognised through a number of initiatives, some local, some national and some international. In both Australia and New Zealand there are organisations that have provided resources for schools and teachers over many years.

The Education Network of Australia (EdNA), Curriculum Corporation and the National Materials Development Network (NMDN) are three examples of national organisations in Australia that have provided high-quality learning materials in traditional print and audiovisual media for a number of years. As the use of online technologies grows, each of these organisations is moving towards providing at least some level of service via the Internet. For example, EdNA has developed EdNA Online (*www.edna.edu.au*), a service that aims to support and promote the benefits of the Internet for learning, education and training. It is organised around the Australian curriculum, its tools are free to Australian educators and it is funded by the bodies responsible for education provision in Australia (i.e., all Australian governments).

As an information service, EdNA Online provides two key functions:

- A directory about education and training in Australia
- A database of Web-based resources useful for teaching and learning

As a communications service, EdNA Online aims to promote collaboration and co-operation throughout the Australian education and training sectors and to facilitate the growth of networks of common interest and practice.

A key component of the New Zealand ICT Strategy (Ministry of Education 1998) was the development of an education portal site as a major policy infrastructure initiative. Te Kete Ipurangi — the Online Learning Centre (*www.tki.org.nz*) is New Zealand's education portal and is an initiative of the Ministry of Education.

The Te Kete Ipurangi vision is to provide New Zealand schools with a cost-effective electronic platform to communicate curriculum and administrative materials, enhance teaching and learning, raise student achievement and advance professional development for school management and teaching staff.

Te Kete Ipurangi, as a bilingual education portal, is intended to:

- Provide easy access to useful and relevant information on the Internet for New Zealand school communities and whanau
- Help New Zealand educators find reliable and relevant information on the Web quickly and easily by delivering a clear path to quality online information, services and resources to meet a diverse range of school needs
- Provide access to quality information and resources provided by the Ministry of Education in New Zealand
- Provide a gateway to useful and relevant education-related content available in the wider world of the Web
- Establish a community of learners, who are sharing information
- Develop and shape the site by using the user feedback constructively
- Provide fair opportunities for commercial providers to promote and house resources, products and services to the Te Kete Ipurangi audience

These initiatives have tended to apply similar understandings about what constitutes a resource, matters of instructional design and quality assurance to online content as to that which appears in print or other media. As the use of the online environment is changing the way teaching and learning occur in some situations, so too is the understanding of what constitutes an online learning resource. An international trend towards breaking traditional resources into smaller, reusable components is emerging, taking advantage of the ability afforded by the technology to handle digital content in such a flexible way.

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These smaller resources, known as "learning objects," are the focus of a joint Australia-New Zealand initiative called The Le@rning Federation. Over the period 2001–2006, the Initiative aims to develop online interactive curriculum content specifically for Australian and New Zealand schools. The governments of both countries, along with each state and territory, are contributing a substantial amount of money over a five-year period to support the development of high-quality online curriculum resources, services and applications available to Australian and New Zealand school systems. This infusion of funding is expected to stimulate a competitive, domestic online content market through the release of successive tenders for the provision of these "learning objects."

The project is developing systems which will allow the input and delivery of high-quality curriculum online by a range of approved content developers to an agreed set of specifications. The systems will also facilitate the breakdown of content into discrete "objects" and the reassembly and repurposing of these to suit the particular needs of teachers and students.

Commonwealth funding is being used primarily to support development and distributed access to schools systems across Australia. The final delivery to schools is a matter for individual jurisdictions. The Le@rning Federation online system (The Exchange) provides the central content management facility within which curriculum content can be submitted, stored, managed and distributed.

Pacific Islands

Schools of the Pacific Islands region have traditionally accessed resources from a variety of sources, many of these through aid projects from countries such as Australia, New Zealand and the United States. Within the Pacific Islands community, the University of the South Pacific based in Fiji has also played a prominent role in producing and distributing locally developed resources.

The ubiquity of the Internet means that these countries may soon have access to an unlimited quantity of online resources, including collections such as those being developed by The Le@rning Federation. The need for resources to reflect local culture and values is not always addressed in this way, however, and organisations such as Pacific Resources for Education and Learning (PREL) are providing some answers. PREL is an independent, nonprofit corporation that serves schools across the United States and its affiliates from Rhode Island to Palau. PREL's main office is located in Honolulu, Hawaii, with service centres in American Samoa, the Commonwealth of the Northern Mariana Islands, the Federated States of Micronesia (Chuuk, Kosrae, Pohnpei, and Yap), Guam, the Republic of the Marshall Islands, and the Republic of Palau (see *www.prel.org*).

PREL's mission is "to strengthen culture, increase literacy, and improve quality of life locally, nationally and globally." The organisation is guided by the belief that learning and sharing throughout the Pacific educational community are essential in achieving their vision for the Pacific child. PREL's programmes provide resources and products developed to promote educational excellence for children, youth and adults, particularly in multicultural and multilingual environments.

CONCLUSION

The development of school networks in the Pacific Region is being driven in part by the need to address issues of teacher supply and curriculum availability, and also as a

response to the opportunities provided by access to online technologies. Factors such as isolation, technical capability and costs are resulting in different solutions being developed, but in all areas the desire to provide high-quality learning experiences for students remains an underpinning motivation for developing these networks.

Across all of the initiatives the heavy reliance on technology is noticeable, and it is not surprising that the development of broadband, secure and reliable infrastructures is a high priority for governments and other agencies in each region. As noted in the Queensland Virtual Schooling Services Pilot research:

> …the reliability of technology (incorporating hardware, software, bandwidth, Polycom devices, etc.) for virtual schooling is — at this time — the most significant factor detracting from the success of the pilot project. It is also the reason some of the schools have withdrawn from the Virtual Schooling Service pilot (Prendergast et al. 2002).

While the provision of technology infrastructure and services is essential to the development of school networks and may be seen in some cases as driving them, the real benefits lie in the expansion of educational opportunities for everyone. These include greater curriculum choice for students, professional development for teachers and the learning that comes from exposure to and interactions with people in other cultures or with different perspectives in direct and authentic ways, rather than vicariously means through textbooks or other media.

There is clearly a lot of work to be done in each of these regions to establish the balance required between the extent of centralised provision and co-ordination, and the development that needs to take place locally.

On the one hand, central intervention appears essential to ensure the development of robust infrastructures, policies and co-ordination of teacher training and resource distribution. On the other, local involvement ensures that there will be a higher level of "ownership" and sustainability, and that the programmes and products that these networks are established to facilitate are appropriate to the local context.

As the countries in the region progress plans to support and develop school networks, this balancing act will become increasingly important.

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Web sites

- CANTAtech (Canterbury Area Schools Technology project): www.cantatech.school.nz
- TKI (Te Kete Ipurangi): www.tki.org.nz
- LATIS (Learning and Teaching In Schools): http://latis.net.au
- The Learning Federation: www.thelearningfederation.edu.au/tlf
- SOPAC (South Pacific Applied Geoscience Consortium: www.sopac.org.fj
- SPC (Secretariat of the Pacific Community): www.spc.org.nz
- VSS (Virtual Schooling Services pilot)

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CHAPTER 7

SOUTH ASIA

Sanjaya Mishra

INTRODUCTION

The use of information and communication technology (ICT) at the school level is more important today than even before. In addition to the traditional knowledge transfer, ICT enables the creation of "new learners," empowered with tools to be independent and lifelong learners. The use of computers and the Internet provides better opportunities for learners to enrich their knowledge with the latest information, in less time and in better ways. At the same time, "the digital environment has created new challenges — learners who can potentially learn from vastly greater access to resources, but who can also be sidetracked, slowed down, overwhelmed, or tempted to simply copy and paste information without thinking" (Ba et al. 2002). Therefore, it is important to plan and integrate ICT in the school curriculum systematically through teacher training and the deployment of relevant infrastructure. "If technology is to achieve genuinely transforming improvements in schooling for all students, it must be at the centre of school reforms and improvement efforts" (U.S. Dept. of Education 2000).

Today, the emphasis is no longer on learning ICT; rather it is on using ICT for learning. However, although the world is changing very fast in all spheres due to advances in technology, the world of schools is not changing at the same speed, particularly in South Asia, where efforts to bring ICT to the classroom are sporadic. This chapter reviews and documents the school networking initiatives that are in use in South Asia.

REGIONAL OVERVIEW

South Asia, often called the Indian subcontinent, comprises seven countries: India, Pakistan, Bangladesh, Nepal, Bhutan, and the island states of Sri Lanka and Maldives. About one-fifth of the world's population live in this region, which is defined geographically by the Himalayan Mountains in the north, the Karakoram and Hindu Kush Mountains in the northwest, deserts in the west, and dense forest and hills along the Myanmar boarder in the east. The region is also witness to some of the world's most bitter ethnic and regional conflicts. Though culturally akin to each other, historically, each of the seven countries in the region has its own set of problems and uniqueness, often overshadowed by the large landmass of India.

At the one extreme, Maldives boasts almost 100 per cent adult literacy, while other countries, such as Bangladesh, Bhutan, Nepal and Pakistan, have yet to reach 50 per cent. Economically South Asia is a host to some of the world's poorest countries such as Nepal (GDP per capita USD1310), Bangladesh (GDP per capita USD1610), Bhutan (GDP per capita USD1833) and Pakistan (GDP per capita USD1890). On the 2003 UNDP Human Development Index (2003), only two are within the 100 top countries: Maldives (86) and Sri Lanka (99). Table 7.1 provides an overview of some of the basic facts about these countries.

In general South Asian countries have similar problems: low literacy, poor economic conditions, high population density and poor health conditions. Though all the countries are committed to Education for All by 2015, in reality they may not achieve it (with the exception of Maldives and Sri Lanka which already have a high rate of literacy). Because of poor economic conditions, most of the time the final outlay for education in these countries is far below expectations, but there also remains unspent balances at the end of the financial year. In order to provide impetus to development, from time to time the use of "ICT at low cost" or "low cost ICT" has been considered as one of the strategies for collaboration and resource-sharing.

COMMUNICATION INFRASTRUCTURE

It has now been realised that the strength of communication infrastructure of a nation drives the knowledge economy. Thus, South Asian countries are trying to develop

Table 7.1: *Basic data on South Asian countries*

Country	Population								Human Development Index	
	Total in millions in 2001	Annual growth rate in % (1975–2001)	GDP per capita USD (2001)	Gross enrolment ratio (%) 2000–2001	Net primary enrolment ratio (%) 1999–2001	Children reaching grade 5 (%) 1999–2000	Youth literacy % of 15–24 (2001)	Adult literacy of above (2001)	Rank	Value
Bangladesh	140.9	2.4	1610	54	89	n.a.	49.1	40.6	139	0.502
Bhutan	2.1	2.3	1833	33	n.a.	90	n.a.	47.0	136	0.511
India	1033.4	2.0	2840	56	n.a.	68	73.3	58.0	127	0.590
Maldives	0.3	3.0	4798	79	99	31	99.1	97.0	86	0.751
Nepal	24.1	2.3	1310	64	72	n.a.	61.6	42.9	143	0.499
Pakistan	146.3	2.8	1890	36	66	n.a.	57.8	44.0	144	0.499
Sri Lanka	18.8	1.3	3180	63	97	n.a.	96.9	91.9	99	0.729

Source: UNDP. 2003. *Human Development Report 2003*

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appropriate policy frameworks and an institutional climate to guide the growth of ICT in their respective countries, and all seven countries today have ICT policies in place (see Table 7.2).

In general, the teledensity (fixed line) is extremely poor. The total telephone subscribers per 100 inhabitants in South Asia (2002) is 4.5 up from 0.6 in 1992 (ITU 2003). However, with the emergence of the mobile telephone, it is expected that the situation will improve substantially, as "one in five people around the world now has a mobile phone, up from one in 337 in 1991" (ITU 2003).

The reality of the digital divide is clear from the fact that computer and Internet access in these countries is very low. Though India had more than 16.5 million Internet users in 2003, that number is low in relation to the population. However, as Table 7.2 shows, India holds 45th place on the Network Readiness Index, far ahead of all the other countries in South Asia.

The extent of ICT infrastructure access for the public in general has to be kept in mind while analysing school networking in South Asia.

Table 7.2: *Communications facilities in South Asian countries*

Country	ICT policy	Computers per 100 inhabitants	Fixed line telephone per 1000 inhabitants	Mobile telephones per 1000 inhabitants	Internet users per 1000 inhabitants	Latest data on Internet users (2003)[*]	Network Readiness Index rank[**]
Bangladesh	Yes	0.2	4	4	1.4	204,000	93
Bhutan	Yes	1.0	26	-	7.4	10,000	-
India	Yes	0.6	38	6	6.8	16,580,000	45
Maldives	Yes	2.2	99[†]	69	36.5	15,000	-
Nepal	Yes	0.4	13	1	2.6	60,000	-
Pakistan	Yes	0.4	23	6	3.4	500,000	76
Sri Lanka	Yes	0.9	44	36	8	200,000	66

Sources: UNDP. 2003. *Human Development Report 2003*
 [*] www.internetworldstats.com/stats.htm
 [**] WEF. *The Global Information Technology Report 2003-2004*

 [†]108.5 as on June 2003, Reported in the *Asian Forum on ICT Policies and strategies, 2003 October 2003*, Kula Lumpur, UNDP-APDIP

SCHOOL NETWORKING

There has been a paradigm shift in the teaching-learning scenario from the industrial age to the knowledge age. The traditional learning environment has changed dramatically (see Table 7.3), forcing all the stakeholders in the school education to change and adapt to the new environment.

Many of these changes can be fostered through the application of ICT which has always attracted the attention of educational planners and policy-makers. Perraton and Creed (2001) in a thematic study of ICT application in basic education, outline the rationale (including four given by Commonwealth Secretariat, 1991) for the use of computers in schools. These are:

- **Rationale 1**: To build a resource of people who are highly skilled in the use of information technology, where governments see information technology as a means of strengthening the economy and want to develop a workforce with vocational skills

Table 7.3: *Paradigm shift in learning environments*

Traditional learning environment	New learning environment
Teacher-centred instruction	Student-centred learning
Teacher as director	Teacher as facilitator, guide, consultant
Teacher as knowledge source	Teacher as co-learner
Classroom focused	Community focused
Single-sense stimulation	Multisensory stimulation
Single-path progression	Multiple-path progression
Single media, static presentation	Multimedia, dynamic interaction
Drill and practice	Discovery and innovation
Isolated work, competitive	Collaborative work
Information delivery	Information exchange
Passive learning	Active/explanatory/inquiry-based learning
Factual, knowledge-based learning	Critical thinking and informed decision-making
Reactive response	Proactive/planned action
Isolated, artificial context	Authentic, real-world context
Classroom-bound communication	Worldwide unbound communication
Computer as a subject of study	Computer as tool for all learning
Conform to norm	Creative diversity
Test assessed by norms	Performance assessed by experts, mentors, peers and self

Source: Based on Trilling and Hood (1999) and Olliges and Mahfood (2003)

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for computer-related activities, and computer education programmes have been set up to develop a cadre of people with specialist skills.

- **Rationale 2**: To equip all students for a future in which technological awareness and basic computer skills will increasingly be important for greater numbers of citizens. Countries have adopted this approach as they see that, whether or not the country is likely to be a producer of computer hardware or software, its citizens need to be in a strong position to take advantage of technological developments as they arise.

- **Rationale 3:** To use the technology to enhance the existing curriculum and to improve the way in which it is developed. Computer-assisted learning programmes, in which the computer takes over some of the activity of the teacher, fall within this rationale.

- **Rationale 4**: To promote change in education by moving towards a more relevant curriculum and a new definition of the teacher's role. Some computer projects have been designed to shift the curriculum in the direction of practical learning of information-handling and communication skills rather than concentration on memory.

- **Rationale 5:** To allow learners to seek information from a database, especially through the Internet, and use computer technology to communicate with other schools, colleges and learning communities. This rationale opens up new learner-initiated opportunities.

In a recent review of research on ICT in elementary and secondary schools, Ungerleider and Burn (2002) concluded:

- Student attitudes towards computers and computer-related technologies improve as a consequence of exposure to them.

- The use of ICTs for group work can be beneficial if teachers are able to take into account the complex interplay of the age of the students, the kind of task, and the amount of interdependence allowed.

- The use of ICTs for mathematics instruction has a significantly positive effect on teaching high level concepts to students in grade 8 or above.

These conclusions put the role of teachers and integration of ICT in the curriculum as important issues. In fact, "the effective integration of ICTs into the educational system is a complex, multifaceted process that involves not just technology — indeed, given enough initial capital, getting the technology is the easiest part! — but also curriculum and pedagogy, institutional readiness, teacher competencies, and long-term financing among others" (Tinio 2003).
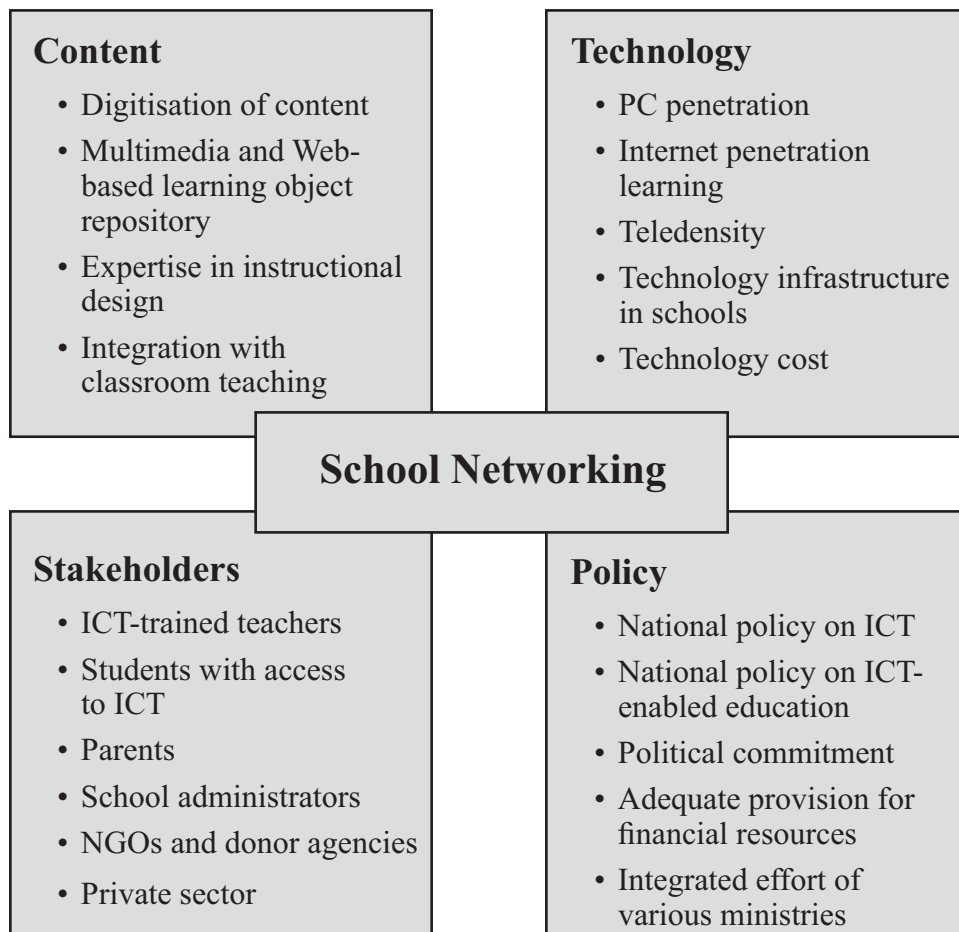
In recent years, the unprecedented growth and development of the Internet and the World Wide Web (WWW) have had a tremendous impact on the thinking of school networking. The Web-based technology provides increased opportunities for learning, including:

- Integration of multiple media into a single application

- Ability to control, manipulate and contribute to the learning environment through interaction

- Location and time independent delivery of course materials

- Capability to serve a large number of learners at a potentially low cost

- A simple standard interface (Goldberg et al., 1996; Blurton 1999)

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In order to analyse the school networking efforts in South Asia, a framework for the factors affecting school networking and the driving forces behind their emergence, growth and development has been developed (see Figure 7.1). The four driving forces are content, technology, stakeholders and policy, and each has its own set of factors influencing the process.

- **Technology**: In order to have successful school networking at national, regional and local levels, it is important to have access to technology, especially computers, networks and the Internet. The access should be affordable for schools.

- **Policy**: It is established that having a national policy for a specific sector propels the development, and therefore ICT policy and political commitment to take ICT to schools are important factors for ensuring adequate resources and co-ordination among various players.

- **Content**: Any network becomes successful through the repository of content it has developed through a centralised or distributed co-operative effort. Availability of digital information for school education developed according to the principle of instructional design will go a long way to sustaining school networking efforts.

- **Stakeholders**: They should be the major driving force behind school networks, especially ICT-trained teachers, who can play the role of change agents in inculcating

Figure 7.1: *Drivers of school networking*

Content
- Digitisation of content
- Multimedia and Web-based learning object repository
- Expertise in instructional design
- Integration with classroom teaching

Technology
- PC penetration
- Internet penetration learning
- Teledensity
- Technology infrastructure in schools
- Technology cost

School Networking

Stakeholders
- ICT-trained teachers
- Students with access to ICT
- Parents
- School administrators
- NGOs and donor agencies
- Private sector

Policy
- National policy on ICT
- National policy on ICT-enabled education
- Political commitment
- Adequate provision for financial resources
- Integrated effort of various ministries

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digital literacy among pupils and parents. Non-governmental organisations (NGOs) and the private sector can also propel the growth of school networking initiative through fundraising as well as supplying technology-mediated content.

COUNTRY SPECIFIC ANALYSES

Bangladesh

Bangladesh is cradled by India on three sides and opens to the Bay of Bengal on the fourth side.

Mainframe computer technology and multiuser terminals have been in use in Bangladesh since 1964, while PCs were introduced in 1983. The ICT Policy (2002) outlines plans to build an ICT-driven nation comprised of a knowledge-based society (see *www.unescobkk.org/education/ict*). The policy emphasises the key issue of human resource development in the area of ICT, and recommends:

- Building facilities for ICT education and computer-aided education at all levels of education
- Using the potential of ICT for delivery of distance education
- Providing the Internet to the educational institutions and library

However, the National Education Policy of Bangladesh does not include ICT education in its plan for 2010, though a small number of city-based schools do have limited computer access. Computer science education was launched as an optional subject for the secondary level students in 1994, and more than 150 schools are now teaching the subject. A systematic effort to network schools has yet to emerge, but the Bangladesh Computer Council is currently implementing a project to introduce ICT education in more than 1000 secondary schools (Chowdhary 2002).

Wireless goes to school in Bangladesh

The Bangladesh Rural Advancement Committee (BRAC), a non-governmental organisation in Bangladesh, is trying to put computers in 650 rural schools under its management. Since the beginning of the project in 1999, it has so far managed to install computers in 60 schools. Normally a computer is placed in the school library under the supervision of the librarian, who works as an intermediary to help children learn how to use it. Through this project, primary school children are introduced to computers using multimedia CDs. In one of the schools managed by BRAC, at Roverpally, 41 kilometres north of the capital Dhaka, five students share a computer for 45 minutes a week. The computer is connected to the Internet through a wireless link to the BRAC headquarters in Dhaka, which is cheaper and more reliable than using the existing telephone network. One of the girl students, Shahsena (11 years) says, "I can learn mathematics with the computer. If I have a problem with my English, the computer can solve it. The computer can do lots of things." Though the students are yet to make full use of the Internet, this facility gives the local community access as they can send e-mails to their relatives abroad.

Source: Hermida, A. "Wireless Web Reaches Village Pupils." BBC Online News, http://news.bbc.co.uk/hi/technology/2261492.stm.

Bhutan

Sandwiched between two Asian powers — China and India, Bhutan is a relatively small country in the Himalayas. For centuries it has been isolated from the world, and it was only in June 1999 that the Internet and television were introduced in the country.

With a small but well-educated population, a static political climate, all digital telephone network and local call access to Internet from anywhere in the country, Bhutan has decided to leapfrog into the mainstream of ICT development and applications in different walks of public services, including education. *Bhutan 2020* envisions that ICT should make it possible "to access the information super highway that will provide us with the same information and data as those residing in the technologically most advanced nation" (Bhutan Planning Commission 1999). In March 2001, Bhutan adopted the IT master plan prepared by the Division of Information Technology (DIT), which envisages:

- Using information technology as an integral tool to enhance good governance
- Developing ICT and ICT-enabled industries to generate employment and income
- Applying ICT to improve the livelihood of all Bhutanese (Bhutan 2001).

In addition to the DIT master plan, the Ministry of Education has formulated its own plan for computerising all schools in the next 10 years (UNDP 2002).

There are 361 educational institutions in Bhutan, most of them community and primary schools. Computer education is prominent only in the private schools. Interestingly, an independent sector study reveals that 82 per cent of Internet usage is e-mail correspondence in the education sector alone (Pradhan 2003).

The National Institute of Education (NIE) in Samte is responsible for training teachers in the country. UNICEF has recently provided hardware equipment to install a network at NIE. With the successful implementation of the network, the focus now is on developing software for an education management system.

India

India has the largest landmass in the region and overshadows her neighbours in South Asia in all respects — size, economy, population, ICT growth, illiteracy, etc.

The Computer Literacy and Studies in School (CLASS) project, which started in 1984, was the first systematic attempt to use computers in school education, and by 1989, about 2,000 schools had computers (Agrawal 1996). However, this project failed miserably due to problems of maintenance, electricity and lack of useful content.

Since the CLASS project, computer science as a subject has been introduced in many secondary schools, but the use of computers as a learning tool is far from satisfactory. The situation in private schools and in and around cities is quite different, as most use computers and the Internet.

In recent years, there has been tremendous change in the availability and access of computers in schools due to the landmark policy of the National Task Force on Information Technology and Software Development (popularly known as the IT Task Force) in 1998. As a follow-up, the National Council of Educational Research and Training (NCERT), responsible for secondary school education, released the National Curriculum Framework for School Education in 2002. It emphasises the role of ICT in schools:

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The revolution in new technology ushers in a fundamental challenge, converting the information society into a knowledge society…the new technology has a tremendous potential to revolutionise education and transform schools dramatically…ICT is bound to influence and transform the existing curricula, bringing in a new generation of learning material and encouraging the networking of schools (NCERT 2000).

There have been number of efforts towards networking schools either by physical deployment of computers or by providing training for teachers and students. Many of these efforts have been made by NGOs and philanthropic organisations, in collaboration with state governments.

Table 7.4 shows some statistics on availability of computers in Indian states. Three states, Goa, Karnataka and Madhya Pradesh, have taken special steps to bring ICT into the schools; their projects are discussed below.

Goa Schools Computers Project

The Goa Schools Computer Project (GSCP – see *www.gscp.org*) is a community-based project that is attempting to improve the levels of computer literacy and access to computers in the schools of Goa. In collaboration with the Department of Education, the Knowledge Initiative Trust manages the project which envisages helping all secondary schools in setting up a computer laboratory with at least eight Internet-ready computers. The GSCP uses the Linux operating system and works on the concept of "thick server-thin client" (a robust network server with dump terminals) to provide low-cost computer access. Started in 1995, this path-breaking initiative has proved to be highly successful in making available at least one computer to all the schools of Goa.

Computer Assisted Learning Centre (CALC)

The Computer Assisted Learning Centre (CALC – see *www.azimpremjifoundation.org*) was started as a pilot project in 34 schools in Bangalore (the Silicon Valley of India) and adjoining rural areas by the Azim Premji Foundation in collaboration with the Government of Karnataka in 2001. It has so far covered 90 schools in 14 districts, and there were plans to cover 135 more schools by 2003. Each school is provided with six to eight computers, and children from standard 3 to 8 have designated periods in their timetable to attend the CALC. The emphasis is not to learn computers, but to learn curriculum-related topics through interactive multimedia.

Table 7.4: *Distribution of computers in schools in some Indian states*

States	Approximate no. of schools	No. of schools with computers	Percentage
Andhra Pradesh	8897	1000	11.23
Goa	430	430	100.00
Karnataka	9713	600	6.17
Kerla	2585	600	23.2
Maharashtra	13,906	-	< 5.0
Tamilnadu	7357	6001	8.15

Source: Computers for India*, www.digitalequalizer.org*

Headstart

The Rajiv Gandhi Shiksha Mission (Rajiv Gandhi Literacy Mission) of the Government of Madhya Pradesh has initiated a computer-enabled education programme called Headstart (see *www.bhojvirtualuniversity.com/abt_headstart.htm*). Under Headstart, a unit of three computers is provided in the nodal school of a school cluster called Jan Shiksha Kendra (JSK). More than 16 CD-based lessons on mathematics, environmental studies, Hindi and English have already been developed as a culturally familiar interactive learning tool. So far 648 JSKs have been covered under the scheme, and more than 4000 teachers have been trained by the M.P. Bhoj (Open) University. The plan is to cover all the 6500 JSKs by the end of 2004 (Sharma et al. 2001).

Schoolnet India

Schoolnet India Limited, a wholly-owned subsidiary of Infrastructure Leasing and Financial Services Limited (IL&FS), has developed a framework for technology-enabled learning, called Networked Learning that is delivered through the Web and serves as an aid to teachers in their pedagogic delivery (see *www.schoolnetindia.com*). Through networked learning, Schoolnet India provides the teacher with a powerful teaching resource, and the student with an interesting and motivating learning medium.

The Schoolnet India portal is a one-point access to networked learning that has links to educational sites, access to lesson plans, teaching materials mapped and broken down into modules and lessons each with their own learning outcomes, assessment strategy, resources and activities.

Schoolnet India provides necessary training to teachers so they can adapt to a new way of teaching. The teacher development programme is divided into three phases:

- The foundation course introduces teachers to technology.
- The intermediate courses expose teachers to advanced technologies and their application in specific subject areas.

EDUSAT: India's dedicated educational satellite

"Educational broadcasting suffers when there is a demand of other sectors like entertainment."

Dr K. Kasturirangan, Chairman,
Indian Space Research Organisation (ISRO), 23 July 2003

The Government of India has planned for a dedicated satellite for all sectors of education system in the year ahead. It is planned to be launched by the end of 2004 with the support of the indigenous Geo Synchronous Launch Vehicle (GSLV) – GSAT3. With capability to provide six Ku-band transponders for regional transmission, six transponders in the C-Band, and one Ku-band national beam, the satellite will have capabilities of television and radio broadcasting, videoconferencing, audio and video return links, and computer-based data transfer. It will have 72 channels to meet the demands of "educating the nation" through area specific channels in formal educational and lifelong learning.

Source: Report of the National Consultation on EDUSAT. 2003. New Delhi: NIEPA.

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- The advanced course take teachers through a project work, in which they become content creators.

The networked learning concept is being implemented through the K–10 programme in 770 schools, including 330 government schools covering 300,000 students.

Maldives

In the southwest of the Indian subcontinent is Maldives, an island nation with 1192 islands scattered across the Indian Ocean. Only 200 of the islands are inhabited, while 87 others are developed exclusively as tourist resorts. About one-quarter of the country's population lives in the capital city of Maldives.

The Government of Maldives gives high importance to information technology and has incorporated it in the educational curriculum. The training programmes in the schools are mainly run in collaboration with the local information training industry. Special rates for Internet access are also provided to the education sector (Maldives 2002).

Currently, only 75 schools out of 281 have computers. The Ministry of Education has started a Basic Compute Literacy Project aimed at providing computer literacy for all students who complete primary education, envisaging one multimedia computer for every 60 students (Shareef and Kinshuk 2003). As primary school education is compulsory in Maldives, this project aims at universal computer literacy.

Multipurpose Community Telecentres

Recognising the geographical size and distribution of the islands with displacement of population, the Government of Maldives has initiated a plan to create Multipurpose Community Telecentres (MCT) at island locations where a variety of ICT services such as telephones, fax, voice mail, Internet, TV and radio can be made available for information and recreation to people at affordable costs. It is expected that the MCTs will be the answer to the diseconomies of scale and other logistical constraints (see *www.apdip.net/asain-forum*).

Nepal

Nepal is a landlocked and mountainous country that lies between China and India in the Himalayas. The Information Technology Policy (2000) of Nepal has a vision to put "Nepal on the global map" by 2005 (see *www.saarcnet.org/newsaarcnet/govtpolicies/ nepal/ITPOLICY.html*). Its objectives are to make information technology accessible to the general public, build a knowledge-based society and establish knowledge-based industries. In order to achieve these objectives and implement the policy, the action plan includes human resource development strategies as follows:

- Computer education for all by 2010
- Computer education provided at school level
- Internet facility made available free of cost to universities and public schools for four hours a day
- Computer education provided for in-service teacher education programmes

Immediately after formulating this policy, the Department of Education provided computer training to teachers of 19 selected public secondary schools in the country (Dhakal 2001).

Computer penetration in the education system in general is low in the country. In 2000, the ITU Survey of Nepal's Internet users estimated that international organisations based in Nepal are one of the major consumers of Internet services (20 per cent). Home users account for 20 per cent, NGOs 15 per cent, educational institutions 10 per cent, government 5 per cent and business organisations 30 per cent (ITU 2000). In the secondary school level, computer is taught as an optional subject, available in most of the private schools in the Kathmandu valley (Silwal 2002). Though the Government of Nepal has started providing free e-mail facilities to public schools, most of them are not yet equipped with ICT facilities.

Shrestha and Pandey (2003) have identified the major factors hindering access to ICT services in Nepal as inadequate rural telecommunication facilities and electricity infrastructure; a large percentage of the population below the poverty line (38 per cent); widespread illiteracy; and the cost of computers, software and Internet service providers (ISP) subscriptions. Currently there are 12 ISPs operational in the country.

Pakistan

Pakistan has India, Afghanistan, Iran and China for neighbours. It is nearly four times the size of the UK and it is the second largest economy in the South Asia.

Pakistan adopted a national information technology policy in August 2003, which envisions "to harness the potential of information technology as a key contributor to development of Pakistan, and the broad-based involvement of the key stakeholders is a must for its sustainable development" (see *www.unescobkk.org/education/ict/v2/info.asp?id=11113*). Its goals include:

- Extensive use of information technology applications in education and other sectors with widespread use of Internet
- Development of an extensive pool of trained information technology manpower
- Establishment of efficient, cost-effective and equitable access to national and international networks

The policy promotes the use of computer-assisted learning as one of major strategies in developing human resources. There are 80 private sector ISPs in Pakistan in addition to the public sector operators for data communication. Internet access is available in all major cities (Masood 2003).

The federal and provincial governments of Pakistan have been involved in computer literacy projects since 1993. During 1993–1995, more than 150 schools were covered under a computer literacy project. In 2002, the federal government declared plans to provide at least one qualified computer teacher to every public secondary higher secondary schools (see *www.dawn.com/cgi-bin/dina.pl?file=top9.htm&data=20020428*). Under this massive project, the government will distribute 200,000 computers to secondary schools.

There are also few non-governmental initiatives bringing the benefits of computers to schools in Pakistan.

Pakistan Association for Computer Education in Schools (PACES)

PACES (see *www.dawn.com/events/it-supplement/itsup5.htm*) is the leading promoter of computer use in the school curriculum in Pakistan. It all started in 1985 as a small project

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to train 37 teachers from 16 schools of Karachi. Similar training events continued in 1986 and 1987 to cover teachers from Lahore, Islamabad and Rawalpindi. Since then PACES, through its computer literacy project, has donated computers to 50 schools.

School Links

The British Council (BC), Pakistan, has initiated a project to link schools in Pakistan and the UK (see *www.britishcouncil.org.pk/education/paksclnk.htm*). Under this project, the BC provides Pentium 4 computers to schools in Pakistan to help students and teachers share information, ideas and experiences with their counterparts in the UK. It is also envisaged that these computers will contribute towards capacity-building of schools in Pakistan through quick and cheaper information flow, inculcation of information technology skills and development of Web sites of schools.

Sri Lanka

Sri Lanka, a small island nation in the Indian Ocean, was the first country in South Asia to liberalise its economy in 1977. Facing formidable challenges in the last two decades related to peace and development, Sri Lanka has done tremendously well as far as its education and health sectors are concerned. In 2003 it had a Human Development Index value of 0.729 and ranked 99 among the countries in the world, and second in South Asia.

Although Internet and e-mail facilities have been available in a few selected academic institutions since 1984, Internet access only became available on a commercial basis in 1995 when Lanka Internet Service started its operation (Gunawardene and Waltgama 2003). However, computer education at the school level started in 1983. With the assistance of the Asian Development Bank (ADB), Computer Resource Centres (CRCs) were established to provide computer literacy and vacation courses to students. Today, there are 73 such CRCs spread across the country.

In February 2001, the Ministry of Education prepared the National Policy on IT in School Education (NAPITSE), which was approved by the Sri Lankan cabinet in October 2001 (see *www.unescobkk.org/education/ict/v2/info.asp?id=11117*). The NAPITSE has a three-phase strategic plan to implement the policy from 2002–2007. It focuses on using information technology in teaching and learning, as well as in the management of the education system. The goals are to create lifelong learners who are information literate.

Secondary Education Modernisation Project

The Ministry of Education is the central co-ordinating agency for computer education in schools. It is currently implementing the ADB-founded Secondary Education Modernisation Project (SEMP – see *www.adb.org/documents/news/2000/nr2000091.asp*).

SEMP focuses on improving quality, access, efficiency and management of 2300 secondary schools in the country. The project comprises three components:

- The modernisation of secondary schools through modern teaching methods and evaluation to improve quality, and the development of computer literacy to narrow the digital divide
- The expansion of educational opportunities for poor students by increasing the number of full-time schools in the rural areas

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- The improvement of the delivery of educational services including modernising the national examination system and training of relevant agencies

It is expected that there will be improvements in academic subjects and skills including language, mathematics, science and computer literacy and that the project will provide relevant training to 40,000 teachers and 6000 administrators at the central and local level.

TEACHER TRAINING OPPORTUNITIES

Preparing teachers for tomorrow is a challenging task that many South Asian countries recognise. In answer to that challenge, many have included strategies to train school teachers in the use of ICT for teaching. This requires teachers to be digitally literate, which means:

- Using troubleshooting strategies for computers

- Understanding the different usages of computers

- Knowing how to use common tools like word processors, e-mail and Web searching

- Being able to use instant messaging and other communication tools to communicate with peers and others

- Using the Web to find, evaluate and use relevant information, and creating such Web-based information

Teacher training programmes on ICT are available in Bhutan, Sri Lanka and India, and are mostly embedded within computer deployment projects.

- In Bhutan, the United Nations Development Programme (UNDP) is paving the way towards digital literacy by conducting orientation training for high school students, unemployed youths and school teachers through cyber cafés (Pek 2001).

- The Sri Lankan Ministry of Education with the support of UNESCO is currently implementing a project to train teachers in information technology to meet the emerging needs of the new learning environment. This project has rightly identified that having information technology skills is different from having skills to use information technology to teach various disciplines/subjects. At the end of the project in 2004, it is expected to cover 2428 schools in 25 districts of Sri Lanka (see *www.unesco.org/bangkok/education/ict/unesco-projects/JFIT/srilanka.htm*).

- The Intel Teach the Future Programme currently being implemented in India helps classroom teachers learn how to best use technology to improve teaching and learning. This worldwide programme was launched in February 2002 in India and covers 35 cities. So far it has trained 253,502 teachers (see *www.educationinindia.net*).

- World Links (see *www.world-links.org*), a global learning network that links thousands of students and teachers worldwide, started its India Programme in January 2002 as a professional development initiative for preparing teachers who would use computers in classrooms. In Phase I, it covered 32 rural and underserved schools in Delhi and Karnataka. In conjunction with its local partner, Schoolnet India, it plans to reach 125 more schools in Delhi, Karnataka, Kerala, Andhra Pradesh, Punjab, Gujarat and Tamil Nadu in the second phase. In 2002, World Links covered 200 teachers and had plans to provide training to 1500 teachers in 2003. It has developed five 6-day training programmes of 40 hours each to train teachers. The five programmes are Introduction to the Internet for Teaching and Learning; Introduction to Tele-collaborative Projects; Curriculum and Technology Integration; The Diffusion of ICT Innovation; and Planning for School-based Telecentres.

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- Jiva Institute, a NGO initiative in India offers a complete training package and certification programme — Jiva Education Technology Specialist (JETS) to improve the competence of teachers to integrate computers, multimedia and Internet in school curriculum (see *www.jiva.org/education/index.asp*). The programme includes three textbooks, three workbooks and a CD-ROM as a self-learning package. The courses in Level 1 (Foundation) are Computer Basics for Teachers, Multimedia and Internet for Teachers and Teaching with computers. Level 2 (Integration) courses are Technology and Curriculum Integration, Multimedia and Curriculum Integration and Internet and Curriculum Integration.

Apart from these training opportunities, many other curriculum frameworks exist. One such curriculum framework on Web-skills training for primary school teachers was presented in the International Workshop on ICT for Professional Development of Primary Education Personnel organised by the Distance Education Programme — District Primary Education Programme (DEP-DPEP) of the Indira Gandhi National Open University (IGNOU) (Mishra 2001). IGNOU has also developed many other computer literacy training packages, which are available in print medium with audio and video support.

CONCLUSION

The school networking initiatives in the South Asia generally follow the five approaches identified by Perraton and Creed (2001) for computers in schools:

1. Direct provision of computer hardware and software to existing schools (e.g., in GCSP, India; in Nepal; and in SEMP, Sri Lanka)
2. Building new customised schools or computer suite annexes (e.g., in CALC, India, and in Pakistan)
3. Bringing resources to schools via mobile units (yet to come up in South Asia)
4. Providing access for children via a variety of community-based resource centres such as libraries, technology access community centres and non-profit organisations (e.g., in BRAC, Bangladesh; in Headstart, India; and in Maldives)
5. Mediated access, where someone with access to a computer and Internet helps children who do not have access (e.g., in Bhutan through cyber cafés)

Though there is national information technology policy in all the countries of South Asia, to date no national programmes are in place to link the schools. However, it must be noted that it would be a gigantic task for a country like India to link all the schools through any physical network. Therefore, the Web-based approach taken by the privately managed Schoolnet India is an example to follow, developing content in a "learning object" framework that can be used by any school, teacher and student, leaving access to computers and Internet.

Providing access to computers and the Internet should be a major priority for governments of the South Asian countries in the next couple of years. In fact, smaller countries like Bhutan and Nepal already have facilities for subsidised access to the Internet for schools.

From the perspective of drivers of school networking framework described earlier, the school networking initiatives in South Asia face problems in the areas of technology and content. Goa Schools Computers Project can be replicated to have cost-effective technology access through the use of open source software and refurbished computers.

But governments have to initiate integrated mechanisms to develop digital multimedia contents for the school level. The available content in the private sector is too costly for schools. On the other hand, the cost of content will also come down because of economies of scale, as the access to technology in school increases. School networking projects in South Asia, by and large, are driven by the Ministries of Education, NGOs, international donor agencies and private sectors. However, it is significant to note that teacher training has been embedded in many of the projects.

In spite of the common cultural linkages, because of poor educational facilities of the South Asian countries, there has been no special effort at the regional level to collaborate and develop school networks. It would be in the interest the region to develop a common resource pool through Web technologies to share, save foreign exchanges and increase the quality of education at the school level.

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CHAPTER 8

SOUTHEAST ASIA

Carmelita Villanueva

OVERVIEW

The Southeast Asia region consists of a diverse group of 11 countries, namely, Brunei, Cambodia, East Timor, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam. This region of extremes ranges in population from a high of 213.6 million in Indonesia down to a low of 0.34 million in Brunei. In the middle are Vietnam, the Philippines and Thailand with populations of 79 million, 77 million and 61.2 million respectively, and the smaller countries with populations of 12.3 million in Cambodia, 5.4 million in Laos and 4.1 million in Singapore.

The gross national income (GNI) among the countries is also diverse: Singapore has the highest per capita at USD24,740, followed far behind by Malaysia at USD3,640. Thailand and the Philippines follow one after the other at USD1,970 and USD1,050 respectively and then Indonesia at USD680. Countries with lower GNI include Vietnam, Laos and Cambodia, which range from USD410 down to USD270 (World Bank 2003)

In terms of technology penetration, be it telephone and computer ownership or Internet access, available data follow the same trends. Singapore tops the list far ahead of the other countries, followed always by Malaysia or Brunei as the case may be. In the middle range are Thailand, the Philippines and Indonesia while the lower end of the spectrum includes Vietnam, Cambodia, Laos and Myanmar.

For example, data on telephone subscribers per 100 inhabitants reveal the existence of a digital divide in the region. Statistics from 2000 show that Singapore has the most number, with 120 over 100 subscribers, followed far behind by Brunei at 52, Malaysia at 41, Thailand at 13 and the Philippines 12. Those below 1 per 100 include Indonesia at 0.9; Vietnam at 0.8; Cambodia, Laos and Myanmar (ITU 2002a).

The disparity of computer ownership is also great. In Malaysia, the number of computers per 100 inhabitants is 12.61 and in Brunei it is 7.46 (2001 numbers). At the low end is Myanmar with 0.11 Cambodia with 0.15 and Laos with 0.28. In the middle are Thailand with 2.67, the Philippines with 2.20, Indonesia with 1.07 and Vietnam with 0.99 (ITU 2002a).

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Internet penetration (i.e., Internet users as a percentage of population) in ASEAN countries is tremendously varied. The highest, as to be expected, is Singapore with 29.9, followed by Malaysia at 15.9, and then far behind are Thailand at 3.8 and the Philippines at 2.6. At the bottom are Indonesia at 0.9, Vietnam at 0.25, Laos at 0.1 and Cambodia at 0.05 (ITU 2002a).

Statistics show that there is an association between Internet and wealth but not necessarily with education. Countries with GNI per capita lower than USD3000 (Cambodia, Laos and Vietnam) have lower Internet penetration ranging from 0.01 to 0.25, while countries whose GNI per capita range from USD5000 to USD10,000 (Indonesia, the Philippines, Thailand and Malaysia) have better than average Internet penetration ranging from 0.09 (Indonesia) to 15.9 (Malaysia). Singapore stands out, as usual, with the highest GNI per capita and an Internet penetration of 29.9 (Gray 2001).

But literacy rates and education enrolment rates do not correlate with Internet penetration. For example, while Vietnam has an adult literacy rate of 93.1 per cent, higher than Malaysia's at 87 per cent, Internet penetration is much lower (0.25 compared to 15.9). The same is true for the Philippines and Thailand with higher literacy rates than Malaysia, but lower Internet penetration.

LEVEL OF ICT USE AND ACCESS

General

Within the education system, enormous differences in the availability and use of computers as well as access and use of Internet characterise the region.

At one end of the spectrum is Singapore where computers are found in all primary and secondary schools and junior colleges at a student-to-computer ratio of 2:1 to 5:1, and a teacher-to-computer ratio of 2:1. All schools are connected to broadband and linked to a wide area network, and all teachers and students from primary 4 and above are provided with e-mail accounts (Cher Ping 2003).

In the middle of the spectrum are Malaysia, Thailand and the Philippines. Under the Ministry of Education's Smart Schools programme, Malaysia has equipped 87 pilot schools with computers, not only in the laboratories but also in classrooms at various levels depending on the categories of technology model the schools are in. They also have Internet connection through leased lines. Thailand has equipped all secondary schools with computers at a ratio of 1 to 54 students, and 71 per cent have an Internet connection, although this is not the case at the primary level (Waitayangoon 2003). The same is true with the Philippines, where 56.4 per cent of public secondary schools have at least one computer as a result of a massive computerisation programme of the Department of Education (Tinio 2003).

Indonesia and Vietnam claim to have one computer per secondary school, while in Cambodia, Myanmar and Laos no more than 10 schools have been equipped with computers and linked to the Internet as pilot projects of donor agencies. It should be noted that all these countries except Singapore have paid more attention to equipping and connecting their secondary schools before their primary schools.

Singapore

Singapore achieved its national standards for ICT infrastructure build-up by 2002. A recent study pointed out that one computer is now available for use by two to five students depending on the school policy (Cher Ping 2003). Computers are now provided in all classrooms and other learning areas such as libraries and special rooms, besides computer laboratories, which means teachers and students have access to them at all times and can use them in the curriculum in an integrated way. Further, for every two teachers in every school, one notebook has been provided to help teachers to work around the constraints of space in staff rooms or to work at home whenever needed. The Ministry of Education also provides grants for teachers to purchase their own computers.

Every school runs a whole-school networking. All schools are linked through a wide area network (WAN), which is eventually connected to the high-speed backbone of Singapore ONE. All teachers and students from primary 4 and above are provided with e-mail accounts, and students are given a financial subsidy of SGD10 under FastTrack@School to subscribe to broadband services in their homes.

Thailand

As of August 2003, it was reported that 70 per cent of primary schools had no telephone lines, 4 per cent no electricity, and 79 per cent no computers for teaching and learning. At the secondary level, all schools had computers for student use at the ratio of 1 computer to 54 students, 71 per cent had an Internet connection and 17 per cent still had no telephone lines. Further, the provisions for hardware or software and staff development were unsystematically added onto the total school plan on a year-to-year basis. The student numbers from these schools range from a low of 300 to 500, to more than 3000 (Waitayangoon 2003).

Various levels of schooling are connected through different networking projects. The SchoolNet connects around 5000 secondary schools which have been equipped with telephone lines and the Internet. With the help of the Telephone Authority of Thailand and the Communications Authority of Thailand, online connection can be made at the cost of a local call, instead of long distance, throughout the country. The MOENet also offers Internet access to some schools but gives priority to connecting various educational organisations within the ministry. UniNet provides Internet services for higher education institutions focusing on distance learning and e-library. Usually, small schools with limited infrastructure use a dial-up connection with two to three Internet accounts, while medium schools have both dial-up and leased-line access depending on available infrastructure and satellite link. Small and medium schools located outside the Internet service area use satellite link.

The Philippines

A 2001 survey of public and private primary and secondary schools concluded that only 14 per cent had computers. For the past seven years, the Department of Education (DepEd) has been conducting a massive computerisation programme for secondary schools. To date, 56.4 per cent of public secondary schools have at least one computer, and it is estimated that by end of 2005, 75 per cent of public secondary schools will have computers (Tinio 2003). Once this target has been reached, the computerisation

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programme will focus on public primary schools. DepEd has also deployed hardware, printers, office software and educational CD-ROMs and has conducted teacher training on basic computer literacy for 986 of the over 4500 public secondary schools.

Because of limited availability of fixed-line telephone service, the widespread use of the Internet in the basic education system has been constrained. Only 13 per cent of primary and secondary schools have landlines, and these are mostly in urban and peri-urban areas. And because most Internet service providers (ISPs) are located in urban areas, rural schools are charged long distance telephone rates when dialing up. A wireless solution, using VSAT technology for instance, is still an expensive proposition as it involves installation costs of at least USD600 and monthly charges of between USD300 to USD2000.

To encourage private companies, corporate foundations and non-governmental organisations (NGOs) to contribute hardware, software and computer literacy training, the Adopt-a-School Act of 1998 was enacted. It provides tax incentives to private organisations that donate ICT facilities to public schools. These include, among others, Intel Philippines, Citibank, the Coca-Cola Export Corporation, Philips Electronics and Lighting and the Japanese government. As a result, additional computer laboratories and learning centres have been built in more schools, and more in secondary than primary schools. This has also resulted in the proliferation of more hardware (PCs, networking equipment) over educational software.

Malaysia

All 87 pilot schools under the Ministry of Education's Smart Schools programme are well equipped with computers and Internet connection through leased lines. The 87 pilot schools, representing urban, rural and semi-urban areas, were chosen from 15 states in the country, with two or more from each state, depending on student population. However, various types of schools are equipped differently. Three models of technology infrastructure have been introduced in the pilot schools. Under these models, schools are grouped into three clusters:

- Level B provides for the 37 computers (21 of which are placed in a computer lab, and the others in the resource centre and the administrative office) as well as two notebooks and three servers. These are connected to the Internet by Fast Ethernet backbone with 128/64 kbps leased line.

- Level B+ not only provides more computers to the laboratory (81 computers, two notebooks and three servers), but six computers are placed in each of 15 classrooms and science labs, and the others are in the resource centre and the administrative office supported by 128/64 kbps leased line.

- Level A provides 520 computers, five notebooks and six servers with 512/256 kbps leased line. Of the 520 computers, 35 are placed in each of the four computer labs, seven in each of the 40 classrooms, seven in each science lab, and the rest in the resource centre, the teachers' room and the administrative office.

Each pilot school was provided its own LAN and every computer in the Smart School System is Internet-enabled and connected to the ministry's Virtual Private Network.

There is also a schoolnet project being implemented which provides Internet broadband facilities to all 10,000 primary and secondary schools in the country. At present, the first phase of the project involves connecting 110 schools in Sabah and another 110 in

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Sarawak. Steps are underway to hand over the pilot schools to the Ministry of Education and to merge these 220 schools into the broader SchoolNet Project (Chan 2003).

Indonesia

The first attempt to wire schools for the Internet in Indonesia was undertaken by the Indonesian Internet Service Providers Association (APJII) with its Schools 2000 Project which was aimed at connecting 2000 secondary schools by 2000. Together with other organisations like ISP and telecom operators, and private sponsors such as CISCO and ORACLE, APJII worked with the Ministry of National Education to develop a portal. By the end of 2000, the project had connected 1180 schools, which translates into half a million new Internet users from high schools (ITU 2002c).

A report by the Center for Information and Communication Technology for Education (Pustekkom) points out that there are no data available on the number of schools connected to the Internet and no accurate data on the ratio of computers to teachers or computers to students. However, most of the schools in the cities have been connected to the Internet, usually through dial-up access. In the urban areas, most of the schools have 40 to 50 PCs, one server, one modem, one LCD projector and four printers. About 40 computers are used and placed in a computer laboratory, and the others are used for administrative purposes. There usually are only two computers that have a direct connection to the Internet. Under a ministerial decree issued by the Minister of Communication and Information, it is hoped that every school will have a computer laboratory facility through its One School One Computer Laboratory (OSOL) Programme.

ITU also reports that distance education has also been flourishing. The Universitas Terbuka (see *www.ut.ac.id*) established in 1984 has evolved into one of the largest open universities in the world with over 350,000 students. It had traditionally used TV, radio, and videocassettes to reach its students, but now collaborates with the Indonesian Internet Kiosk Association to use their facilities for providing Internet-delivered education applications.

The University of Indonesia estimates that by 2005, around 30 per cent of its 38,000 students will be involved in some form of distance learning. Plans call for a distance learning centre to be created at the university campus in Jakarta as well as sub-centres at two regional universities. The main centre will feature two classrooms containing 30 computers each linked to the Internet via VSAT.

Cambodia

Cambodia is known for having the lowest Internet penetration and the highest prices in Southeast Asia. This has made it difficult to use Internet in schools, especially as very few fixed lines (4000 lines for a population of some 9.3 million) are available. This condition has instead contributed to the growth of cellular phone services (ITU 2002b).

The Ministry of Education, Youth and Sports has no large-scale plan to place computers or telephones in schools because the majority do not have the money needed to support them. There was a plan by the ministry to connect three secondary schools under a World Bank–funded initiative, but due to delays in administration, the project has been postponed. One example of a high-profile NGO-funded e-school is found in the remote village of Robib, in the northern province of Preah Vihear. It makes use of solar-powered panels to run computers, but this project has met with much difficulty and criticism.

Of the tertiary institutions, four of the nine have Internet in at least one department. However, they continue to have problems even if they have computer and Internet connection.

UNESCO has arranged for several hundreds of donated computers from the Republic of Korea's Ministry of Education and the Hong Kong University to be sent to Cambodia for use at the teachers' training colleges.

Laos

Currently in Laos, ICT is not a part of the curriculum, and if students want to learn how to use computers or the Internet, they have to go outside the schools. The Ministry of Education plans to supply two secondary schools in each province with a computer and Internet access by 2005 which will be primarily provided to the administrative staff (ITU 2002d). There are also plans to teach basic computer courses at the secondary level and some teachers will be trained in Malaysia and Singapore. However, four Internet Learning Centres (ILCs) have been established in secondary schools in four provinces through the Jhai Foundation and SchoolsOnline. Each of the ILCs are equipped with 10 Intel based PCs, Windows 98/2000/XP, Hub/LAN, a digital camera, a printer, a scanner, 10 ethernet cards and Internet connectivity (dial-up to Laotel.com). The basic commercial software is installed in the computers, but no educational software has been made available. The goal of the ILCs is to link the upper secondary school's students to the world. More specifically, the ILCs provide Internet access/facility and technology for students, teachers, staffs, parents and local people in the surrounding areas and help schools gain effective access to the communication and information resources of the Internet.

Apart from the ILCs, two Smart Schools are also being introduced by the Malaysian government as part of their international programme to extend the lessons learned from their own national Smart Schools programme.

At the higher education level, the Japanese government has funded a computer laboratory at the National University of Laos which has 1740 students and 1486 staff, 790 of which are teaching staff. The computer lab has around 20 PCs connected to a LAN and access to the Internet.

Myanmar

With the co-operation of Malaysia, the Smart School pilot project was introduced at three primary schools in Yangon. The content development according to the curriculum is underway. The connectivity for these three schools was provided by Bagan Cybertech (BCT), which will also sponsor the connectivity of an additional 100 schools with multimedia classrooms to create a schoolnet in Myamar. At the tertiary level, there are two universities of computer studies and 22 computer colleges under the Ministry of Science and Technology which are equipped and will see ICT professionals graduating annually starting in 2003 (UNDP 2003).

Vietnam

In Vietnam, 80 per cent of the secondary schools have computers (Quach Tuan Ngoc 2003). ICT has become a compulsory subject in specialised upper secondary high

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schools (grades 10, 11 and 12), and at the university level; all university students receive compulsory courses in basic ICT use. In fact, there are some 50,000 information technology specialists in universities and training colleges and around 5000 computer graduates each year.

However, although the Internet is considered very important for teaching and learning in Vietnam, the actual level of Internet use in primary and high schools is low. About three to four per cent of the total number of 120,000 Internet accounts in Vietnam are used by the academic sector (ITU 2002e). Because connections are slow, typically just a 64 kbit/s dial-up line using the Internet is often frustrating. The Internet is still not widely used even at university due to the very high cost of access.

DRIVERS FOR SCHOOL NETWORKING

In Southeast Asia, schoolnets arose from different organisations. They were either established from the ICT sector, as in the case of Thailand; or from the Ministry of Education, as in the case of Singapore, Malaysia and Indonesia; or from an organisation outside the government, as in the case of the Philippines. Consequently, there were varied drivers of the schoolnet creation: a need to demonstrate the power of ICTs; the drive to put into action ministerial policy and master plan to connect schools and share resources; the desire to connect technical and vocational schools as part of an information technology course; and the need to experiment as a pilot project venture. The drive to set up a schoolnet to respond to the needs of teachers and students to access information resources was considered implicit, informally observed by the organisers. No needs assessment was undertaken before the establishment of any schoolnet.

Singapore

In Singapore, the school networking programme called edu.MALL was developed under the Masterplan for ICT in Education (MP1) and launched in July 1998. The SchoolNet edu.MALL was clearly an integral part and a support to the ICT for Education programme of the country. It was not only meant for the teachers and students but for parents as well.

The programme provides a one-stop Web-based access to educational resources and online information services for teaching and learning using the mall concept (Cher Ping 2003). Shopping has been a way of life in Singapore (being known as a shopper's paradise), and thus calling the schoolnet a "mall" appeals to the users and does not make them feel threatened with new interface or new means of navigation. The creation of the edu.MALL was in response to teachers' needs to have access to information and share their ideas, experiences and setbacks. It was also set up to reach out to students and parents to promote creative thinking and lifelong learning in a fun manner.

Malaysia

In Malaysia, the driver of the schoolnet was the Ministry of Education and was an integral part of the Smart School Pilot Project which set up 87 schools for pilot testing the use of ICTs in classroom teaching. The requirement for integrated telecommunications and computing infrastructure was written into the Smart School Pilot Project Agreement and was to be provided and established by a consortium of companies. A list of objectives of the school networking shows that it was set up to support a centralised and distributed

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data repository; to allow school heads, teachers, students and parents to access school servers from their home computers via the Internet; to allow each pilot school to access online information in other pilot schools and for transferring files between them; and to communicate with each other through e-mail.

The Philippines

The driver of the schoolnet in the Philippines was an NGO called FIT-ED (Foundation for Information Technology in Education). The Pilipinas SchoolNet is part of the ed.venture project run by FIT-ED which covers 15 public schools under the Ministry of Education. Though the Pilipinas SchoolNet is not an integral part of the Department of Education (DepEd) ICT programme, it responds to and is being implemented in close collaboration with the ICT policy of the DepEd. A recent report points out that:

> …since DepEd has no budgetary allocation for ICTs in education programmes apart from the annual national appropriation for the purchase of computers for schools, what ed.venture is doing is what DepEd has been wanting to do but for which it unfortunately does not the have sufficient financial and technical resources. Indeed, DepEd has often looked to the private sector and civil society groups to drive experimentation and innovation in the public school system. Thus, FIT-ED did not encounter any strong resistance at either the national, sub-national or school levels of DepEd at any stage of the implementation of the pilot (Tinio 2003).

The pilot project is indeed supported by the DepEd from the national, sub-national and school levels which provides financial and personnel support from the provision of a room that houses the ed.venture Centre, to covering the recurring costs of operation to salaries of technical support staff.

Thailand

In Thailand, schoolnet was born more out of a need to show that technology can create equal opportunity in education than the desire to start from what specific teaching/ learning needs were. The driver of schoolnet in Thailand came initially from the information and technology sector, led by National Electronic and Computer Technology (NECTEC) with the collaboration of Telephone Organisation of Thailand, and the Communications Authority of Thailand. The vision of this undertaking was in the right direction — that is, to create equal opportunity in education and thus lead to the improvement of educational standards in the country. However, the focus concentrated mostly in equipping schools with computers, network and central computer systems, telephone lines and Internet (dial-up mode), etc., which by itself was necessary as it offered the enabling environment, but which moved so fast that the other more substantive components, such as content development and integration into classroom teaching and curriculum, were left behind.

After the schoolnet's establishment in 1995, the Ministry of Education, the Ministry of Science, Technology and Environment, and the Ministry of Transport and Communications were brought on board in 1998. It was a little too late in the game as their involvement became at most ceremonial. With the educational reform and the realisation that the schoolnet was weak in educational content and that integration into the educational curriculum and classroom teaching was not taking place, it became necessary to move it to the Ministry of Education. The official transfer took place in September 2003.

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Indonesia

In Indonesia, the schoolnet called WAN Kota sprung from the need for the vocational secondary schools to develop a communication forum, called School Information Networks, for each region in order to build a critical mass of users of ICTs (Iskander 2003). The forum enabled teachers, administrators and students to use the Internet, exchange e-mails and information and subscribe to a mailing list. The school networking in this instance is more of a vehicle for communicating and discussing rather than for providing content for teaching/learning. As well, WAN Kota is also based in only one city.

Recently, the Ministry of Education, through its Center for Information and Communication Technology for Education, has launched the Edukasi-net, which will provide content through its repository of lessons and learning materials for use in all schools in the country. In the future, this will be the vehicle for the national schoolnet.

ORGANISING, OPERATING, MANAGING AND SUSTAINING SCHOOL NETWORKING

Organisational structure, management and services

The operation and management of Southeast Asian schoolnets has been demonstrated through a variety of models and approaches, each of which has their own strengths and weaknesses. Consider the following wide range of modalities of running a schoolnet: the government (Ministry of Education) manages it as in the case of Malaysia; a city government runs it as in the case of Indonesia; an information technology government organisation manages it as in Thailand or through equal partnership between the Ministry of Education and the information technology business sector as in the case of Singapore; and an NGO manages it, as in the Philippines. Indeed such variety of school networking approaches in this sub-region has generated a wealth of lessons learned, encompassing both strong and weak practices.

Standing out from these experiences is the fact that starting and managing a school networking from the telecommunications and technology sector side carries enormous advantages as far as start-up requirements are concerned. But there are a number of disadvantages as well. Just focusing on the education aspect and neglecting the technology component brings debilitating inadequacies.

The cases of Thailand and Malaysia are useful illustrations of this point. SchoolNet arose from the desire to try out computer and Internet technologies to connect schools and share resources to bridge the digital divide. While it had very good support from the telecommunications sectors like Telephone Organisation of Thailand and the Communications Authority of Thailand, it did not get the same level of support from the Ministry of Education. The recent transfer of Thailand SchoolNet to the Ministry of Education will hopefully correct this weakness.

Malaysia went in the other direction. It built its school networking component gradually from the Smart School project which ensured the integration of the use of ICT in the policy and curriculum of the Ministry of Education as well as in classroom teaching/learning. This primarily education orientation downplayed a number of infrastructure and technology issues required in operating a schoolnet. To correct this deficiency, the

Ministry of Education will join hands with the Ministry of Energy, Communications and Multimedia to provide Internet access to all 10,000 schools in the country. The two ministries have started discussing how best to integrate the Smart School Network with the Universal Service Provision Project of the Ministry of Energy, Communications and Multimedia to come up with wider Malaysian SchoolNet in the next phase.

While the education and government information technology sector figure prominently in the schoolnets of Malaysia and Thailand, it is the business sector which mainly supports Singapore's operations. The model adopted by Singapore, the edu.MALL, is run as a business enterprise to provide one-stop access to educational resources and online information services for teaching and learning. Though edu.MALL is an integral part of the ICT Master Plan and co-ordinated by the Educational Technology Division of Ministry of Education, Singapore has capitalised on the expertise, infrastructure and services of the business sector to deliver all aspects of creating and operating it. The responsibility of operating the edu.MALL has been given to a commercial company called CHAPTER-E.com, the venture company of National Computer Systems (NCS) and Panpac Media.com. Armed with the ICT infrastructure and capability of NCS, and the content and pedagogical expertise of Panpac Media.com, CHAPTER-E.com is able to continually push the possibilities of acquiring and constructing knowledge in creative ways through interactive activities in a learning community. In effect, the management is being handled by a virtual community organiser which assumed the role of the schoolnet operator and brought with it other business partners to expand schoolnet to other markets in the country. This has the potential of making the existing virtual community in schoolnet more compelling and more economically viable in the long run.

The Philippines offers an entirely different model that brings together the government and NGOs working hand in hand. The Pilipinas SchoolNet is run and managed by an NGO called FIT-ED. But the Department of Education (DepEd) recognises the project as an extension of their ICT strategy and a support to the department's policy and programme on ICT. The department could have done the same thing, but due to insufficient funding, FIT-ED has taken over. Both work systematically and smoothly hand in hand, with the DepEd providing various specific supports. The pilot schools used are the public schools run by the DepEd, which shoulders the salaries of pilot teachers and running costs like electricity and classroom facilities.

In Indonesia, the WAN Kota Project is an educational network launched by the City Government of Malang, not by the central Ministry of Education or by the Department of the Vocational Secondary Schools (VSS). With varying degrees across cities, steering committees have been set up to oversee the WAN Kota, comprised of local government as an advisor, heads of school principal associations of vocational secondary schools, general secondary schools and junior secondary schools as chairman, secretary, and treasurer respectively. The steering committee appoints one full-time manager, three technicians and three programmers, mostly VSS teachers and students and SIN active members, to run the project daily. The management raised funds from clients (participating schools) and built WAN infrastructure on their own. In fact, WAN Kota is entirely run from revenues from various sources (e.g., participating schools, advertisements, students and other users). The number of clients in every city ranges from 10 to 40 schools and is growing. In addition to a school system within the city, teacher training centres, universities and local government offices have also joined the network.

The co-ordination and collaboration aspect also paints a variety of pictures. In Thailand, for example, because of the top-down approach in policy formulation and programme implementation, the schoolnet initiatives have not been fully successful in soliciting the

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support and collaboration of the various ministry departments both at the central and local levels. NECTEC was almost solely running the entire operations, and the rest of the stakeholders did not fully collaborate as there was lack of sense of ownership right from the start. Malaysia, on the other hand, provides a good example of distributed leadership in running the Smart Schools where the various departments within the Ministry of Education are mobilised to co-operate through a Smart School Project Team of ministry officers with different expertise and responsibilities from various departments. In the Philippines, though the FIT-ED is an outside agency, it has a close working relationship with the Department of Education and its sub-national and local departments and schools. Finally, Singapore is almost running on virtual collaboration and co-ordination that assumes automatic networking.

Services offered

The services delivered by schoolnets also vary from country to country. Singapore has the most holistic approach to services including provision of high-quality teaching and learning resources through its eduLibrary; professional development offering an updated list of ICT-related courses for teachers, heads of departments and principals; infrastructure and support which provides information about ICT support and services for schools; showcasing of innovative projects and good practices (success stories and setbacks) through its eduGallery and research and development through eduQuest; a consultancy centre which provides advice and guidelines and addresses enquiries for implementing ICT in schools; a forum which provides a platform for educators to engage in discussions on the use of ICT in education; and a news brief which includes regular e-mail updates on ICT in education and information and classroom resources.

Thailand SchoolNet provides for Thai open source software called Linux which serves as a platform for the contents on the Web site. To promote the use of information on the site, local content development is promoted through its Digital Library Project. The project creates national Web sites in the Thai language for secondary school students in seven major academic subjects. The software used, the Digital Library Tool Kit, offers easy-to-use functions that allows teachers and especially those with no knowledge of HTML to develop Net-based lessons for students. It offers opportunities to participate in international collaborative projects through the Global Learning and Observations to Benefit the Environment (GLOBE) programme and the ThinkQuest Project. Apart from providing content and information resources on the Web site, it also offers Internet and Web page development training courses, seminars and activities to teachers and students of participating schools.

The Malaysian BESTARInet portal was meant to serve as the hub for all the pilot schools with the Data Centre and the Smart School Pilot Project Team at the Ministry of Education's Educational Technology Division in Kuala Lumpur. The portal was also meant to allow parents to access their children's records online through the Smart School Management System of their children's schools. In addition, an online forum, e-mail, search engines and other online services were made available on the portal. Teaching-learning materials in the form of courseware and printed materials for Bahasa Melayu, English Language, Science and Mathematics are also available.

The Pilipinas SchoolNet provides the latest news on the school networking activities; a directory of participating schools; a database of telecollaborative projects; a repository of lessons and materials in Math, Science, English, Filipino, Makabayan and multidisciplinary subjects; and links. The various sub-sites are for the large part still empty. Teacher training is also provided.

Indonesia's WAN Kota offers e-mail, mailing lists, newsgroups, ftp, WWW, technical support and help desks, a virtual library, school magazines, modular (interactive self-instructional) learning packages, multimedia learning activities, information technology training packages, and an education information centre. Some WAN Kota offer VoIP and videoconferencing services.

Support from various sectors

All schoolnet projects enjoy support and collaboration from various sectors including the telecommunications sector, the information technology industry and businesses, private and voluntary groups and civil society, academic training institutions and universities and local community groups. The kinds of support vary from one-shot deals such as donated equipment to project-based contributions such as pilot testing of materials. In the end, this varied support leaves schoolnet programmes struggling for survival and sustainability.

Support by local telecommunication companies

To promote affordable connectivity, the Internet connection for almost all the countries was supported and enhanced by the local telephone companies. In Thailand and Malaysia, the respective telephone companies offered a specific telephone access number for schoolnet members to connect to the Internet at local telephone rates instead of long distance rates. Telekom Malaysia, the country's main telecommunications company, has proposed a special education rate for telecommunications services to the schools and the Ministry of Education. Maxis, another telecommunications company, is co-operating with Telekom Malaysia to provide Internet access and telephones to 220 remote schools and their surrounding communities in Sabah and Sarawak. In Thailand, through the joint support by the Telephone Organisation of Thailand and the Communications Authority of Thailand, Internet dial-up access can be accessed anywhere in the country for the cost of a local telephone call.

The Philippines has done better by obtaining free telephone time and Internet access for one year to schools and extending a 50 per cent discount for succeeding years. FIT-ED joined forces with DepED and other NGOs to broker a deal with the leading telecommunications companies, namely Globe Telecom/Isla Communications (Globe-Isla) and the Philippine Long Distance Telephone Company (PLDT), the two biggest telecom companies in the country, which are also the ed.venture connectivity partners. One school has been provided a DSL connection by PLDT. The three schools not covered by the e-rate have been provided with dial-up connections that were paid for during the first year by ed.venture.

In Indonesia, Indosat built an intercity backbone connection using fibre optics and satellite facilities to connect the schools in the city of Malang through a wireless WAN. However, the costs for maintaining the facilities are being shouldered by the schools and the students.

Public-private partnerships

Experiences of all countries have shown various initiatives in mobilising different private companies so that schools are able to obtain a reduction in costs for computer equipment and software and applications. In Malaysia, the consortium that developed the Smart School Integrated Solution for the Ministry of Education is helping the ministry tap into

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the resources of local and international hardware, software and applications companies in order to promote volume reductions for the schools. Microsoft has a special education pricing for schools and other educational institutions as well.

In Thailand, the information technology sector, namely Compaq, Intel and Powell Computer, have contributed as well. Powell Computer donated Pentium computers to 32 schools in rural areas, and Microsoft donated 50 sets of Windows 95 and utilities to speed up the schools' activities on the Net.

To reach the Singapore society in the low-income bracket, six hardware and software providers and one ISP donated computers and other software. The recipient households were provided with used PCs bundled with free Internet access and basic training. The Philippines reports of a long list of private companies (e.g., Coca Cola, Intel, Microsoft) which have supported the school networking

INFRASTRUCTURE AND CONNECTIVITY

Type of connections

A good physical and technological infrastructure and affordable connectivity are necessary pre-conditions for the operation of a schoolnet. Various countries are at different stages of development as far as ICT infrastructure and connectivity for schoolnet is concerned. At one end of the spectrum is Singapore, which has not only achieved 100 per cent connectivity to all schools through a WAN but is offering broadband connection as well. Indonesia has managed to connect its schools in a city-wide wireless WAN by an intercity backbone connection using fibre optic and satellite connection. Malaysia, under its Smart Schools Project has connected 87 schools using both broadband and ISDN and is about to launch its expansion phase. It is only Thailand and the Philippines which are generally using dial-up access. Thailand has connected 5000 schools out of approximately 34,000 nationwide to its schoolnet with free Internet dial-up access. In the same way, the Philippines has established a schoolnet to connect 15 pilot schools under dial-up Internet access in a decentralised way.

Reaching the marginalised areas

A few cases respond to the issue of providing alternative provision for connectivity (like satellite) to reach remote areas or economically disadvantaged groups. In Malaysia, some of the pilot schools were given satellite and wireless connection to the Smart School Network because of problems with the land lines in their areas. Indonesia automatically solves this problem through its wireless and satellite connection. Singapore has been committed to bridging the gap by committing SGD25 million to promote PC and Internet awareness and use through collaboration with community groups and voluntary welfare organisations. Households with a monthly income of not more than SGD2000 have been provided with used PCs bundled with free Internet access.

Problems in connectivity

Problems remain for all countries. In Thailand, many schools in the remote area that cannot afford the cost of utilities (electricity, water supply, and phone bill) are still unable to access the Internet. With the transfer of SchoolNet to the Ministry of Education and

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the merging of the SchoolNet to EdNet, the new programme is expected to eliminate or reduce the cost for Internet access for schools which do not have sufficient funding. Through the co-operation between the Telephone Organisation of Thailand and the ministry, the monthly fee charged is a negotiated "educational price," including the leased line and telephone lines. For the schools that have the budget, the cost of Internet access can be shared between the schools themselves and the ministry.

In Malaysia, the budget was a constraint in determining the design of the network, especially in terms of the server capacity at the schools and data centre, and the bandwidth to be provided. Lack of access to computers was a common complaint by teachers and students in the Level B and B+ schools. The costs of the use of videoconferencing for Level A pilot schools were prohibitive and the Internet connections costs are yet to be offered at an "educational price."

In the Philippines, there is a need to provide funding for Internet connections after the free service offered by the telecommunications sector has expired, to promote more participation in the school networking activities, and to connect the schoolnet schools using an appropriate networking connection as well as expanding the pilot phase to cover more schools.

Singapore is confronted with the issue of the digital divide in a different way. Its preoccupation is to equip households with incomes below SGD2000 with computers as a result of a survey which showed that the personal computer ownership and Internet penetration were higher in private housing units than in public housing units.

Sustainability and incentives

Sustainability of operations confronts schoolnets built both outside the Ministry of Education and those run by the ministry on a pilot basis. Thailand and the Philippines are two examples of schoolnets run by an information technology organisation and an NGO respectively. Because they were run outside of the ministry, minimal support and involvement was given by the government and activities were often isolated from the mainstream programmes.

As for schoolnets launched as pilot projects, the key question mainly deals with the ability of the Ministry of Education to financially support widening the geographical area to cover more schools using the most effective technology model tested. At the operational and practical level, sustainability also becomes an issue when teachers and students are not motivated enough to participate actively in the schoolnet.

Solutions to these problems were identified by Thailand when it transferred its SchoolNet to the Ministry of Education in 2003 after seven years of operation. The Philippines has yet to do this, but there it is still early to make a transfer for several reasons: the SchoolNet has yet to place all its mechanisms at a fully operational level, the Department of Education is not ready to take over, and the Foundation for Information Technology in Education is considered by the Department of Education as their arm in sustaining its implementation.

To make it easier for schools to join the a schoolnet, the problem of connectivity should be tackled first. There are a number of solutions that could be considered. These include providing free hosting facilities and domain, providing free Internet connection for the first year, and paying the monthly fee at a negotiated "educational price" including the leased line and telephone. For schools that can afford it, the cost of Internet access could be shared with the ministry.

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Sustaining interest must also be addressed. The following incentives are proposed by many of the country case studies:

- Organising competitions for both teachers and students to develop the best school Web site, best educational software or lessons, best teaching materials, etc.

- Sponsoring collaborative projects with some seed money or rewarding the best collaborative projects if not in cash, in kind

- Providing free hours for teachers to practise what they have learned from the training and to contribute to the schoolnet Web site activities

- Organising activities that will ensure the use of the lessons and teaching materials on the site in the actual classroom teaching

- Connecting more computers to the Internet and allowing their use beyond school hours

- Preparing and disseminating guidelines for the optimal use of the schoolnet Web site resources

- Building a reward system for teachers who demonstrate innovation in their use of ICTs

- Providing follow-up training on a continual basis

- Conducting seminars and discussion groups among students and teachers on the topic of ICTs

TRAINING TEACHERS AND STAFF

The optimum utilisation of the resources and facilities offered in school networking depends on the readiness and skills of the teachers. Three of the four countries included in the analysis have provided training to ensure that the teachers know how to participate and operate the systems and facilities offered. The various training given varies in terms of where it started, the type of school personnel covered and the contents and skills provided.

Teacher training on school networking could emanate from the schoolnet project itself which is outside of the ministry programme (as in the case of Thailand and the Philippines), or it could be an integral part of the ministry ICT training programme (as in the case of Malaysia). Some programmes have targeted teachers only, while others have included the training of the school administrators and technology or technical personnel themselves, as in the case of the Philippines. It is only Singapore that has not separated training for school networking and use of the edu.MALL because the various training programmes given under the Master Plan were intensive and complete enough to enable teachers to automatically go on board in the posting, sharing and accessing of information under the schoolnet.

The expected knowledge and skills to be learned after the training also vary from country to country: Thailand focuses only on the use of Internet and Web page development; Malaysia focuses largely on the creation of knowledge and skills in basic computer literacy, and the Philippines has gone further by going into ICT integration in curriculum and telecollaboration. It is Singapore which has developed the knowledge and skills of the teachers in authentic integration of the use of ICT in subject teaching such as Mathematics, Science, English and Humanities, and the use of ICT-based pedagogical principles and skills.

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Singapore

Teacher training in Singapore is intensive, continuous, both general and needs-based, online and asynchronous, and undertaken by various institutions from government to private companies (Cher Ping 2003). The general training given to all the teachers based on the Master Plan followed a four-tier fan model. First, the senior ICT instructors were given training to serve as master trainers. The senior ICT instructors then trained the heads of departments and selected teachers in schools in Phase 1, who in turn co-trained the teachers of three to four schools each, together with the senior ICT instructors, in Phase 2 of implementation. The fan approach generated a multiplier effect, enabling the sharing of expertise and experiences between schools. The senior ICT instructors played the roles of the key trainers, mentors and co-ordinators for all schools during the planned implementation.

Teachers in Singapore have various opportunities to constantly refresh their skills and knowledge to keep up with the latest developments in education, both pedagogies and technologies. Teachers are entitled to 100 hours of in-service professional development each year. Teachers are also fully sponsored or highly subsidised for courses, conducted by private training agencies that enhance their professional competence. For pre-service programmes, the following content focus of teacher training is given: basic ICT skills, integrating ICT into schools, and ICT-based pedagogical principles and skill sets such as "Constructivist Learning with the Internet" and "Instructional Multimedia Design." Besides these courses, there is also an ICT component integrated into all subject areas such as Mathematics, Science, English and Humanities. In the foundation courses, the tutors employ a fully dynamic online learning environment to complement onsite activities for this module. In 2002, there were four major components in the module: anywhere/anytime lecture, onsite laboratory tutorial, online independent hands-on session and online asynchronous discussion.

Thailand

In Thailand, the training courses basically focus on the Internet and Web page development. An evaluation of the Thailand SchoolNet project has shown that the training has been inadequate in empowering teachers to use ICT in an integrated way in their classroom teaching.

Malaysia

In Malaysia, both the school administrators and the teachers are trained in basic computer literacy. While the training covers more topics than those given to the Thai teachers, the focus is still on basic computer literacy and hardware. Basic ICT integration is also a part of the pre-service and in-service training, but these skills are not linked to effective participation in the Smart School Network programme. A gap is seen between teachers trained and actual participation in the schoolnet. Learning from this experience, a recent study recommends that future training for school heads and teachers should focus more on how to integrate the school network activities into school management and classroom activities (Chan 2003).

The Philippines

In the Philippines, the training given for both the teachers and the school administrators is much more holistic and comprehensive and linked to the operations of the school

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networking. The three types of training include instructional use, technical support and ICT management. The instructional use training includes basic computer and Internet skills, information literacy and telecollaborative learning, and ICTs and curriculum integration. The second module on technical support training aims to build the school's capacity for "autonomous maintenance" (i.e., the local staff provides first-line troubleshooting and maintenance and arrangements with external service providers are optimised). The following areas are covered: PC troubleshooting (hardware and software), network administration, software installation and configuration, and network security. The third module dealing with educational technology management training for school administrators focused on curriculum integration planning, business modelling, and community mobilisation and partnership building.

An assessment of the training programmes undertaken by the three countries shows a common trend: the lack of use of knowledge and skills gained from the training in actual classroom teaching and school networking activities. The solutions proposed are similar: provide incentives and a reward system to the teachers for hard work and innovations, focus training on the development of knowledge and skills that are directly linked to the school networking programme activities and ICT integration into the curriculum; undertake follow-up and continuous professional development, provide an enabling environment after training (i.e., easy access to computers or to procure computers and Internet connection for teachers use), motivate teachers to develop Web content instead of using their skills for troubleshooting or school management, train all personnel in the schools and not only teachers and, most important, provide some free time for the teachers to practise and use computers.

CONTENT DEVELOPMENT AND USING SCHOOLNET EDUCATIONAL RESOURCES

Content development for use in school networking has followed different approaches depending on the policy mandate and organisational location of the different countries. In Malaysia, Singapore and the Philippines, the content and teaching/learning materials followed the national curriculum in order to ensure integration into classroom teaching and learning. In Thailand, the lessons and teaching/learning materials were contributed by teachers and students directly from various school members, which may or may not have direct bearing with the national curriculum.

The originators of Internet-based lessons and teaching materials also differed from country to country. In Thailand, the major contributors were from the field (i.e., teachers, students and school heads of the school network). But an evaluation found this inadequate and suggested that the content development should also involve experts and subject specialists in other departments and sectors in the Ministry of Education as well as students. It pointed out that very often teachers are very busy and do not have the time to prepare lessons and are not skilled in developing ICT-based lessons.

It was the other way around for Malaysia where the content was basically initiated and updated by the Smart School development team rather than the teachers and students. The team members comprise ICT-competent educators who manage both the technical and the pedagogical aspects of the portal, and so the content was developed mainly by subject specialists. It was, therefore, proposed that more involvement from teachers and students should be solicited to reflect various users' needs (Chan 2003).

The Philippines realised the importance of letting students help drive the programme by actively involving them in designing curriculum integration activities and developing

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materials to support the teachers who were mainly responsible in developing the content.

It was only Singapore that enjoyed the multi-sectoral involvement in content development. In addition to the materials developed by teachers and students, the content was also generated by technical experts and commercial companies as well as links to existing sites.

The language of the content was another consideration. In Thailand in the early years, content was mostly in English derived from its international links to Global Learning Observations to Benefit the Environment (GLOBE) Program and the ThinkQuest Project. Because of this, the Internet-based English materials posted on the Thai Schoolnet Web site were not used by non-English speaking Thai teachers and students. To encourage more usage by teachers who did not use English, the SchoolNet Content Development project, called Digital Library, was started in 1998. It was commissioned to Kasertsart University in conjunction with the Institute for the Promotion of Teaching Science and Technology (IPST). The Digital Library became a repository of Thai-based teaching/ learning lessons contributed by a university and science centre–based team and later on by teachers and students.

On the other hand, Malaysia found the need to have more content in English. After the pilot project, some of the browser-based courseware was converted to Web-based materials and placed on BESTARInet. It was recommended that more content in English be placed on the portal now that Science and Mathematics are being taught in English.

The Philippines and Singapore have materials both in English and their national languages. Most lessons and materials developed have a sound pedagogical basis. In the Philippines, the content is rich in interactive lessons and classroom activities. One activity, dealing with an online treasure hunt, is inquiry-based with the students being given questions, the answers to which can be found in a series of Web sites pre-selected by the teacher. Similarly, Webquests, which are also inquiry-based and make use of online resources, target the development of a student's higher-order thinking skills (e.g., analysis, application, synthesis).

In Singapore, the main repository of content for schoolnet use is the edu.MALL Web site which provide access to a wealth of information resources in multimedia formats (e.g., CD-ROMs, Web sites, videos and lesson plans). ICT-based tools are available on the site to allow teachers to collaborate in building lesson plans and explore the best ways to integrate ICT into their lessons. The site is multimedia endowed and uses interactive, enquiry and constructivist-based materials.

Not all countries documented the use of the Web-based contents in a specific classroom setting. In Thailand, it was found that there was limited use of schoolnet content in actual teaching, and this was considered a weak point of the school networking which otherwise was quite effective. The materials developed in the Philippines were used in the ed.venture pilot schools as they were integrated into the national curriculum for Science, Mathematics, English, Filipino (the national language), and Social Studies. Singapore seemed to project actual use of the Web-based resources in teaching/learning, while Malaysia was not clear on this issue in their reports.

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CONCLUSIONS: MAKING SCHOOLNETS VIABLE FOR ENRICHING TEACHING AND LEARNING

Value added

The cornucopia of experiences and lessons learned from school networking in Southeast Asia has added to the growing body of global knowledge in the area of ICT use in education. The mass of information can be translated into a handy and practical set of do's and don'ts useful to those about to embark on a similar initiative or in the process of upgrading their existing schoolnets. The UNESCO Asia and Pacific Regional Bureau for Education and the Commonwealth of Learning have seized this opportunity of making all of these experiences and lessons learned do-able and practicable by coming out with guidebooks or toolkits for establishing viable schoolnets.

Needless to say, the experiences described above have shown successes as well as failures. Despite the gaps and inadequacies of schoolnet ventures in the region, school networking has offered tremendous value to the use of ICTs in the education systems.

First, school networking has accelerated technology-based modernisation of the education systems and schools through the rapid increase in number of computers, installation of Internet, setting up of local area and wide area networking, training of school heads and teachers in the use of computers, and local content development through the expansion of Web-based educational resources.

It has helped address the digital gap by mobilising the telecommunication and information technology sector to reduce telecommunications costs and offer free Internet connections through various arrangements, thus expanding the number of schools which can make telephone calls and connect to Internet. It has also helped to lower student-computer and teacher-computer ratios and enhanced accessibility of teachers and students to computers due to more open access areas and local area and wide area networking,

It has attracted and mobilised public-private partnerships and leveraged more support through consortiums of telecommunication companies, ICT vendors, business enterprises, educational content developers, and training and academic institutions that contribute to the various operations of schoolnets through a range of hardware, software and applications support, apart from cash, discounts, subsidies, technical assistance and organisational backing and the like.

It has networked educators and communities who otherwise have neither the tools nor the time and money to get together to connect for dynamic partnerships and strengthened skills in collaboration and working in teams through its various telecollaboration activities and projects both at the national and global levels. As part of networking, schoolnets have provided a useful forum for Internet communication and activities, enabling teachers and students to set up a network of contacts and initiate discussions with other teachers and students within the school and between schools in the country and all over the world.

It has provided a one-stop Web-based access to educational resources and online information services for teaching and learning and has served as a platform for virtual library, news and events, a showcase of collaborative and research projects on the use of ICT in education and good practices and, most importantly, promoted access to improved pedagogy-based educational resources. Similarly, it has stimulated rapid development of content through lessons, teaching/learning support and multimedia materials contributed

by teachers and students made easily accessible online. Schoolnets have served as an experimental laboratory for the creation of educational software and multimedia technologies, and the testing and evaluation of open source platform and software, inspiring creativity and productivity.

School networking has also stimulated the development of knowledge and skills of school heads and teachers to participate and contribute to the programme through both one-shot and continuing training courses, some of which are offered on the schoolnet portal. Apart from announcing scheduled training courses for school staff, online ICT courses are also linked to enable teachers to learn anytime and anywhere.

Lastly, many schools in rural areas have suffered from lack of technical help when troubleshooting is required for damaged ICT hardware and systems. One of the most important components of a schoolnet is a built-in help desk which provides instant maintenance advice online.

Future needs and challenges

The list of value-added items by schoolnets above might underemphasise the many gaps and problems that beset operations in Southeast Asia. Based on the trends and developments examined in this document, some urgent issues, needs and challenges have emerged which have to be addressed if schoolnets are to become viable vehicles for ICT-based education programmes. These include the need to:

- Institutionalise schoolnets into the Ministry of Education and more specifically into its ICT master plan, as well as further integrate its operations into the various departments of the Ministry of Education, in order to promote sustainability and a more systematic integration into the national education curriculum and systems

- Establish a team approach in management by creating an interdepartmental advisory and co-ordinating committee or unit to oversee and orchestrate the functions and activities of schoolnets to ensure more efficient management, co-ordinated action and wider support from the entire education system

- Promote nationwide upscaling of the pilot phases as adequate experiences and lessons learned have been accumulated to serve as basis for further expansion

- Address the need to explore connectivity options in order to reach the marginalised or disadvantaged schools as in the case of Thailand, Malaysia. the Philippines and Indonesia

- Ensure sustainability in technology infrastructure support and maintenance and Internet connectivity by negotiating mutually beneficial arrangements with telecommunications sector, ICT vendors and service providers

- Promote effective partnerships by identifying what value each partner adds to the programme and the terms of the partnership as well as by keeping them regularly informed on the benefits and impact that their contributions are bringing to the programme

- Incorporate or join other initiatives that focus on the development of ICT resources, infrastructure and connectivity, and support and professional development of educators by other sectors. Schoolnet's potential will not be optimised if it does not support or is not supported by other initiatives

- Develop a realistic technology plan as a precondition to a successful implementation of schoolnet and, based on this, build a viable school networking infrastructure and

connectivity with long-term support from all sectors guided by strong leadership from the Ministry of Education

- Create more innovative strategies to motivate schools, teachers and students in participating more actively and contributing consistently to the schoolnet programme activities and portals as well as promoting greater collaboration among schools in order to strengthen their sense of ownership and confidence on the quality of content and activities

- Ensure the participation of all sectors in content development from subject specialists and content experts to teachers, students and parents and commercial and educational industry players to reflect the various needs of the users as well as enhance the breadth and depth and robustness of the schoolnet educational resources in support of the national curriculum

- Ensure that the teaching and learning materials posted in the schoolnet portals are integrated into the national curriculum, and built-in mechanisms for the integrated use of schoolnet content and educational resources are instituted into classroom teaching and learning

- Adopt a more holistic approach towards the operation of the schoolnet to cover ICT resources, professional development, infrastructure and support, dialogues on practices (success stories and setbacks), showcase of innovative projects, and research and development

- Place greater attention on the training of school heads and teachers in integrating the activities into school management and classroom teaching and activities to accelerate intensive use of schoolnet

- Devise ongoing professional development of teachers and school administrators in various aspects of school networking in order to continually upgrade their knowledge and skills to adapt to rapidly changing technology requirements

- Establish technical support and a help desk which are not only provided online but established within the schools as technical problems have been found to be the best way of dampening enthusiasm and interest in schoolnet participation

- Formulate a set of operating guidelines for the schools to enable them to operate and participate in the schoolnets effectively

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CONCLUSION

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ACHIEVEMENTS

The last few decades have been characterised not only by the rapid development of technology but also by its integration into all aspects of society – educational, cultural, social and entertainment. The impact is especially visible in the developing world.

Today, information and communications technology (ICT) plays a major role in the socio-economic development of a country through the provision of timely, accurate information. Almost all nations around the world, both developed and developing, are focusing their ICT infrastructure and human resources on children and young adults to prepare them for today's world with all its challenges and opportunities. Through a skilled and educated generation, well-equipped with both knowledge and ICT tools, a country can play a dynamic role in the global economy and support the building of its information society. Today ICT is changing the way people think, learn and act, just as the tractor dramatically changed farming when it was first introduced. Computers are the means by which students orchestrate the use of ICT to share knowledge and communicate with each other, thereby shaping the future of nations.

The new ICT is considered a "tipping point" in the development of nations. The new communication tool, the Internet, has become a vital source of information dissemination. It has changed all aspects of life: technologically, the Internet empowers people with tools for a more efficient means of living; culturally, the Internet creates opportunities and means to share and exchange ideas across the geographical boundaries; and economically, the Internet helps emerging economies based on innovation. It is the fastest, easiest and richest tool not only as an information provider and knowledge disseminator, but also as a network connector around the world regardless of time, space and difference. The power of the Internet has helped the world to become smaller and to realise the concept of a true "global village," through eliminating the geographical boundaries between countries. As Kofi Annan, Secretary-General of the United Nations has said, "Information technology is not a magic formula or panacea. But it is a powerful force that can and must be harnessed to our mission of peace and development."

Realising the importance of the role of ICT, the need for knowledge acquisition and quality education, countries have strived to build their knowledge-based societies. Nations have invested in developing new education policies to ensure the foundation of the knowledge society through having knowledge organisations, knowledge communities and knowledge schools.

To address the challenges of realising these new policies, it became clear that there was a need for the emergence of a new movement — one that would both support the government in achieving its socio-economic and development policies and ensure the fulfilment of Education for All by 2015. To this end civil society has had a great impact in formalising new strategies and initiating new programmes to integrate ICT in education, whether in developed or developing nations. The so-called schoolnet formations have played an instrumental role in shaping the world of education, introducing new directions for the use of technology as a main tool to empower young learners to be critical thinkers. School networking organisations are being looked at as the creators and innovators of ideas and information, and governments have welcomed the active role of NGOs in this arena of education and often empowered them and partnered with them, giving their work more credibility and public acceptance.

School networking organisations have been instrumental in identifying and laying the foundation of the main pillars of integrating ICT in education. This has been done through various initiatives such as training teachers to use ICT in the classroom and for management, online course and content development to ensure the integration of ICT in course delivery, providing an ICT-appropriate environment, adopting and engaging in online collaborative programmes, and basic technology trouble-shooting which will lead to providing a new holistic approach for ICT. Through the role of schoolnets, integral programmes have been formulated which have enabled the institutionalising of ICT in education and encouraged innovative approaches to learning and teaching. This study reflects on the schoolnet developments in various regions of the world and their impact on the education system. For example:

- The emergence of SchoolNet Africa (SNA) in the late 1990s had a significant impact on a number of national policies in education. As a knowledge organisation, SNA has left its fingerprints in shaping ICT in education policy in a number of African countries. This formation led African students to play a role globally in the cyber world and to contribute with their educators in building the African Knowledge Warehouse (SNA's educational portal).

- In Singapore, the work of integrating ICT in education is a true model of partnership efforts, where government, the private sector and NGOs have been instrumental in driving education initiatives. It is obvious that the school networking organisation, in collaboration with the government, has made great strides in using ICT in education and learning. Through their efforts, they have managed to ensure an increase of 30 per cent in the use of ICT in learning due to the high ratio of computers to students. (Based on the latest statistics published on the Ministry of Education Web site, of 302,501 primary students, the ratio of computer to students is 1:6, while of 194,002 secondary students, the ratio is 1:5.) Additionally, computers are now available in the classrooms, libraries and community centres. Thus, access is no longer a challenge, but an empowerment tool for educators and learners, representing creativity, innovation and the best utilisation of ICT in education.

- The efforts of SchoolNet Canada have focused on capacity-building to enable and empower youth to play a role in the global economy and help in growing the Canadian information society. The role of SchoolNet was derived from the country's education priority, and it now helps to foster the socio-economic growth of the country.

- In the Middle East, through a public-private partnership, developing countries managed to leapfrog into the field of integrating ICT in education. In Jordan, the innovative Jordan Education Initiative (JEI) is transforming the public education for

effective and advanced learning deployment. JEI's goal is to accelerate the socio-economic development through application of distance learning, provision of an ICT-appropriate environment, content and curriculum development and capacity-building. The Jordanian government has made great strides in ensuring education is part of and a key factor to accelerating socio-economic development.

One of the outstanding achievements of school networking organisations has been to move the education system towards a student-centred approach, where learners are the focus of the whole system. Empowering them and creating programmes to build their critical learning and thinking abilities have become the main concern of governments. This was very clear with the ThinkQuest Africa programme, which offered a new style of learning to empower young Africans to collaborate on and develop educational Web sites through the use of the new technology. ThinkQuest Africa goes beyond developing content by African students for Africa however; it prepares the learners to be the workforce innovators and active contributors in the knowledge era.

School networking has evolved from different organisations, and as this report makes clear, they vary in nature and types: in Thailand school networking is driven by the ICT industry; in Singapore, Nigeria, Canada, and Europe, it is an integral part of ministries of education; and in parts of Africa and the Middle East, it is part of the civil society. But whatever the organisational differences, school networks have managed to partner and seek support from all key stakeholders in the sphere of ICT and education, from industry and business to government and international organisations. And as a result, a number of organisations and business have been established and formalised, thus contributing not only to the enhancement of education and empowerment of the learners but also to the creation of new jobs, employability and economic development. In fact, it is foreseen that school networking organisations will play a crucial role in the socio-economic development of a country.

How does this evolution take place? Through an educated nation, economies can transform and the different sectors of society can progress. Thus, a new generation, capable of competing globally will transpire, driving nations to a new realm of independence. Achieving this will happen through mobilisation and collaboration of both the public and private sectors. This partnership, with school networking organisations representing the grassroots movements and being a major stakeholder, is one of the key success factors.

CHALLENGES AND THE WAY FORWARD

School networking has been significant in not only introducing ICT into education, but by bringing new ways of thinking, creating a space for public-private collaboration, enhancing skills and supporting employability. Additionally, the efforts of school networking have led to strong alignment and co-operation between the ICT and education sectors and collaboration at both public and private sector levels. This alignment of plans has been clearly reflected in this report in a number of countries in Africa, the Middle East and Asia. This success of school networking lends itself to a clear vision of champion and partnership in development.

However, despite success, questions still exist:
- How will these organisations sustain their operations, especially if they are NGOs or have been established through the support of intergovernmental organisations or programmes?

- How will school networking continue to drive the process, especially after it is integrated in the ICT and education policies of the governments?

These questions of sustainability present a major challenge to school networking organisations.

Sustainability should be looked at from three different perspectives: social, political and economic. From a social perspective, schoolnets have to continue to play a leading role in developing new initiatives and measuring the impact of programmes. The adoption of new programmes and the evolution of existing ones will continue to position schoolnets in the leading role. Schoolnets should ensure that there is a viable plan to address the challenges of enabling infrastructure, capacity-building, teacher development, curricula and content development, technical support and help desks, and management and sustainability. Schoolnets must continuously be learning organisations and institutionalise new ideas to maintain their role of champion in the industry.

From a political perspective, schoolnet plans have to be integrated into the ICT and education country master plans. Schoolnets have to be a member of key structures that determine the future directions in this sphere. Additionally, they have to maintain strong, broad, effective management and be a model for public-private partnerships. The high level "buy-in" and support should always be sustained.

Finally, the economic perspective must be considered. If the social and political aspects are well met, the economic sustainability will be addressed naturally. Three main factors will ensure economic sustainability: maintaining a leading role, keeping in partnership, and effective management. If school networking organisations manage to maintain these three pillars, economic sustainability will be achieved.

With sustainability, we will continue to witness the emergence of school networking formations and programmes in the years to come. These could be called thinking schools, e-schools or something else. Whatever the label, innovation and new initiatives will be the drivers to integrated information technology solutions in education, leading to the creation of unique opportunities for serving the growing information society.

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