

Consultative Workshop on Performance Indicators for ICT in Education



United Nations Educational, Scientific and Cultural Organization
UNESCO Bangkok

Consultative Workshop on
**Performance Indicators
for ICT in Education**

Manila, Philippines
28-30 August 2002



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Consultative Workshop for *Developing Performance Indicators for ICT in Education*, 1st, Manila, the Philippines, 28-30 August 2002.

Consultative Workshop on Performance Indicators for ICT in Education, SEAMEO INNOTECH, the Philippines, 28 to 30 August 2002: [proceedings] Bangkok: UNESCO Bangkok, 2003.

91 p.

1. ICT. 2. INFORMATION COMMUNICATION TECHNOLOGY.
3. COMPUTER USES IN EDUCATION. 4. INFORMATION TECHNOLOGY.
I. Title.

371.334

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Published by the
UNESCO Asia and Pacific Regional Bureau for Education
P.O. Box 967, Prakanong Post Office
Bangkok 10110. Thailand

Printed in Thailand

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1

Executive Summary

Background

- The ICT in Education in Asia and the Pacific Project
- Consultative workshop for developing performance indicators
- Objectives of the workshop
- Expected outcomes
- Participation
- Submission of country reports
- Proceedings of the workshop

The ICT in Education in Asia and the Pacific Project

In the countries of Asia and the Pacific, the use of ICT in education has been developing rapidly. As the presence and use of ICT continue to expand, schools, universities and other educational institutions will need to develop performance indicators to monitor the use and outcomes of technologies, as well as to demonstrate accountability to education stakeholders, funding sources and the public. These indicators are needed to show the relationships among technology use, educational reforms, the empowerment of teachers, changes in teaching and learning processes and student learning. There is a need to show that technology education should be seen not only as an end in itself, but as a means to promoting creativity, empowerment and equality, producing efficient learners and problem solvers.

To study and assess the actual impact of the utilisation of ICT, UNESCO is conducting the Performance Indicators on ICT for Education Project as part of ICT in Education in Asia and the Pacific Programme, an international undertaking funded by the Japanese Funds-In-Trust (JFIT).

The Project will develop a structure of indicators to measure ICT use in education and provide a basis for policy planning and programme improvements, specifically demonstrating how ICT is raising standards in education, serving as a catalyst for educational change. To achieve this objective, the following strategies are being implemented:

- » Undertaking a situational analysis on existing projects/activities measuring the impact of the use of ICT in education within and outside the region and on this basis, identify an appropriate set of performance indicators which could be adapted or developed for application in the region;
- » Pilot testing this set of indicators in selected countries;
- » Developing a systematic mechanism and database for the collection, storage, analysis and dissemination of the indicators based on a network of regional, sub-regional and national focal centres;
- » Promoting data utilisation and undertaking advocacy work to convince educational policy makers and administrators to mainstream the collection and maintenance of indicators into their national educational policies and management information systems;

Consultative workshop for developing performance indicators

Objectives of the workshop

- » Building national capacity in the collection, processing and dissemination of indicators; and
- » Implementing an information repackaging programme to ensure that the results/data collected dealing with these indicators are disseminated and utilised for policy and programme adjustments and improvements.

An initial assessment of the indicators developed in earlier research showed their largely quantitative nature. While data that was collected from these initial indicators could provide an overall view of infrastructural support and ICT penetration, they did not delve into measuring how ICT has been used to promote the development of creativity, interactivity, collaborative learning, critical thinking and problem-solving.

This Project will not stop at constructing new indicators; it will proceed to promoting the use of these new indicators by policy makers. The new ICT indicators will not only take a snapshot of current conditions; they will also point out directions for policy and thus be considered as the stimulus for change. Eventually, educational policy makers and administrators should mainstream the use of these indicators into their national educational policies and management information systems.

However, to be able to assess such relationships, appropriate measurement tools were deemed necessary: a structure of performance indicators that would gauge the level of change brought about by the use of ICT in education towards the formation of a learning and knowledge society. The conduct of the Project would then require the exploration of certain issues: (a) the development of indicators which can represent both quantitative and qualitative improvements in education as a result of ICT use; (b) the measurement of ICT usage with a focus on equity; that is widespread and equal access to ICT (e.g. between gender; between and within countries); and (c) methods of collecting data on the selected indicators.

To initiate the Project, UNESCO held a **Consultative Workshop for Developing Performance Indicators for ICT in Education**, held from 28 to 30 August 2002 at SEAMEO INNOTECH in the Philippines.

The overall objective was to develop a set of core indicators to assess the impact of ICT in education. More specific objectives included:

- » To provide an understanding of how selected countries use computers in schools and of efforts to measure the effects of ICT use in education;

- » To present a regional situational analysis synthesising experiences and lessons learned in the use of ICT indicators in Asia and the Pacific;
- » To share the experiences and initiatives from other regions (e.g. Europe, the Baltic and CIS countries) to measure the impact of ICT in education; the set of indicators used in these various regions; the results of their use and pilot testing; lessons learned and implications of their experiences on Asia and the Pacific;
- » To recommend a set of indicators for measuring ICT use in education in Asia and the Pacific, including a rationale for each and methods of data collection and use; and
- » To recommend methods and mechanisms for pre-testing, data collection, processing, storage and dissemination.

This Consultative Workshop sought these following outputs:

- » A set of core indicators which will be pilot tested in selected countries to measure the impact of the use of ICT in education;
- » Strategies, methods and work plan for collecting, processing, storing, and disseminating data from ICT indicators surveys; and
- » Best practices, successful experiences and lessons learned from selected countries in Asia and the Pacific and other regions of the world in the development and use of ICT indicators in education.

The 13 participants of the Workshop came from:

Australia	South Korea
India	Thailand
Malaysia	Uzbekistan
The Philippines	Viet Nam

The participants were either the head of the ICT programme of the Ministry of Education of their country, the official in charge of Educational Management Information Systems involved in the ICT project; or the head of the group evaluating the use of ICT in education

A number of these participants are in charge of pilot testing the set of ICT indicators generated by this Consultative Workshop.

Four resource persons from *the UNESCO Institute of Information Technology for Education in (Russian Federation)*; *UNESCO Institute for Information Technology in Education (United Kingdom)*; the *Research and Innovation Department of the Southeast Asian Ministers of Education Organisation (SEAMEO) Regional Centre for Educational*

Expected outcomes

Participation

Submission of country reports

Innovation and Technology (INNOTECH), based in the Philippines; and the *New South Wales Department of Education and Training (Australia)* were invited to share experiences on ICT indicators and provide technical advice to the Workshop in formulating the indicators.

Prior to the Consultative Workshop, the participants prepared a report on their country's experiences on the use of ICT in education and their efforts to assess the impact of the use of ICT in education, as can be found in Chapter 2.

Proceedings of the workshop

After the inauguration by Dr Zenaida T Domingo, Head of the Business Development Office and Senior Training Specialist, SEAMEO INNOTECH and the welcome remarks of Dr Eligio B Barsaga, Programme Director for Research and Innovation, SEAMEO INNOTECH, Ms Carmelita L Villanueva, Chief of UNESCO Bangkok Information Programmes and Services and the Regional Clearing House on ICT in Education presented the Keynote Speech on behalf of Mr Sheldon Shaeffer, Director, UNESCO Asia and Pacific Regional Bureau for Education.

Ms Villanueva pointed out that the Consultative Workshop set the tone and served as a springboard for the implementation of the JFIT-funded project on Performance Indicators for ICT use in Education. It was expected to generate a set of indicators which will provide benchmarks and guideposts for the countries' evaluation of their ICT projects in education, as well as UNESCO's ICT and policy and strategy development, teacher training, ICT-based curriculum and materials development. These indicators, Ms Villanueva went on, will be used to monitor the use and outcomes of technologies and to demonstrate accountability to funding sources and the public. The indicators should show the relationships between technology use and educational reforms, empowerment of teachers, changes in teaching and learning processes and student learning.

However, she stated, there had not been systematic efforts in the countries of the region to measure the impact of ICT use in improving the teaching and learning process, not to say the educational system as a whole. In this point, this Workshop was a trailblazer, as it was the first study to assess ICT use in education using a holistic approach. Ms Villanueva showed the objectives, strategies and expected outcomes of the Indicators' Project, as well as how the countries can assist in pilot testing the indicators generated from the workshop.

2

Synthesis of Country Reports

- Policy on the use of ICT in Education
- Financial resources and partners
- Scope of ICT use in Education
- Manner of introducing ICT in schools and non-formal education
- Professional development
- Connectivity
- Evaluations and indicators
- Problems and issues

The following representatives presented reports of their country's experiences on the use of ICT in education and their efforts to assess its impact:

Australia	Ms Paula Christophersen, Manager of the VCE Information Technology, Victorian Curriculum and Assessment Authority
India	Mr Shri Vivek Bhardwaj, Deputy Secretary (SE), Department of Secondary and Higher Education, Ministry of Human Resource Development
Indonesia	Mr Lambas Lambas of the Curriculum Centre
Malaysia	Zainal Abidin Bin Ismail, Co-ordinator of the Teachers' Activity Center, Port Dickson
The Philippines	Ms Marivic Abcede, Department of Education
Korea	Mr Seung-Ku Woo, Director of Division of Information Technology Policy, Ministry of Education and Human Resources Development, and Mr Jung-Woo Cho, Research Fellow of the Korea Education and Research Information Service (KERIS)
Thailand	Mr Narongsak Boonyamalik of the Monitoring and Evaluation Division, Bureau of Policy and Planning, Ministry of Education
Uzbekistan	Mr Ziyovuddin Jaloliddinov
Viet Nam	Mr Nguyen Anh Tuan of the Education Management Information Centre of the Ministry of Education and Training in Viet Nam

Below is a synthesis of these countries experiences in the use of ICT in education.

All of the countries have developed their policies on ICT in education. The objectives of these polices range from promoting connectivity and access to ICT in schools, upgrading teacher competencies, integrating ICT into curriculum, to improving the quality of teaching and learning. A number of countries go so far as aiming to develop a cadre of citizens who can contribute to the workforce and economy of the country.

At the federal level in **Australia**, the Commonwealth Government seeks to achieve two overarching school education goals, that is all students will leave school as 'confident, creative and productive users of new technologies, particularly information and communications technologies, and understand the impact of those technologies on society', while all

Policy on the use of ICT in education

schools will seek to integrate ICT into their operations, to improve student learning, to offer flexible learning opportunities and to improve the efficiency of their business applications.

At the state level, specifically Victoria, schools implementing a Learning Technologies Plan should result in schools':

- » Having access to ICT and curriculum products as part of the school's educational programme;
- » Being routine, competent and discriminate users of ICT in the daily programmes of the school;
- » Developing skills in the use of ICT; and
- » Showing leadership and innovation the use of ICT.

Goals and objectives of the ICT for education programmes in **India** are even more ambitious, being to:

- » Equip all students with basic computer skills;
- » Facilitate IT as a career option for secondary school students;
- » Enhance learning effectiveness through Technology Aided Learning;
- » Promote critical thinking, a spirit of enquiry, make learning joyful and empower teachers; and
- » Address problems of children with special needs.

Similarly, **Indonesia** seeks to ingrain students with the ability to harness new technologies for accessing and disseminating information and knowledge, and to harness these as tools for decision-making. The Curriculum Centre believes that this is an important competency in the era of knowledge and information technology.

It is intended that students will learn to understand when and what kind of knowledge are needed; find and access information from various sources; and evaluate, use and share information with others. The Centre defined ICT in relation to students as "...in ICT students learn to get information, process and use it to communicate effectively through various media."

The government of Indonesia set the following goals and objectives for the integration of ICT in education:

- » Information and Communication Technology in Society: The student understands the benefits and disadvantages, as well as the challenges in information technology;
- » Information and Communication: Students put their knowledge, skills and attitudes into practice relating to Information Technology in getting, processing, arranging, distributing, and keeping information; and

- » System and Design: Students apply their knowledge, skills and attitudes in designing information technology systems, solving problems relating to ICT.

Along the same lines, **Malaysia's** national programme for ICT for education develops the whole individual. Education in Malaysia is an on-going effort towards further developing the potential of individuals in a holistic and integrated manner, to produce individuals who are intellectually, spiritually, emotionally and physically balanced and harmonious.

A crucial component of Malaysia's integration of ICT in education is the *Malaysian Smart School* programme, which intends to "systematically reinvent" learning institutions in terms of teaching practices and school management in order to prepare children for the Information Age. The Smart School System has been pilot tested in 90 schools throughout the country.

Other than working towards these objectives, further specific objectives include to provide opportunities to improve individual strengths and abilities, to produce a thinking and technology-literate workforce and to increase participation of stakeholders.

Meanwhile, **the Philippines'** Department of Education (DepEd) policies on the use of ICT are:

- » Technology must be studied first as a separate subject then applied in other learning areas as a tool for learning how to learn;
- » The application of computer skills to the other learning areas is a curriculum policy that stems from the principle that teaching-learning must not be textbook-driven and educational processes should take advantage of technological developments, including the application of ICT in teaching and learning, where appropriate; and
- » An education modernisation programme will equip schools with facilities, equipment, materials and skills and to introduce new learning and delivery systems necessary to capitalise on recent technological developments.

The goal of the Philippine Education Technology Master Plan is to deliver quality education that is accessible to all through the use of IT and other innovative technologies.

Under this framework, the DepEd is implementing an ICT Plan for Basic Education, which has the following objectives:

- » To provide the physical infrastructure and necessary technical support to make ICT accessible and useful to students, teachers, administrators and school support staff;
- » To develop teacher competence in the use of ICT and in the design, production and use of ICT-based instructional materials;
- » To ensure access to the latest developments in ICT and to support research and development;
- » To undertake a curriculum improvement that would integrate technology with the different learning areas; and
- » To promote the use of appropriate and innovative technologies in education and training.

The Philippine Education Technology Master Plan has the following operational targets by the year 2009:

- » All public secondary schools shall be provided with an appropriate educational technology package,
- » 75 per cent of public secondary schools shall have a computer laboratory equipped with basic multimedia equipment,
- » All public secondary schools shall have an electronic library system,
- » 75 per cent of public secondary schools teachers shall have been trained in basic computer skills and the use of the Internet and computer-aided instruction,
- » All learning areas of the curriculum shall be able to integrate the application of ICT, where appropriate.

In **South Korea**, the project for adapting education to the information age was started in July 1970 as a plan for computer education. In the early 90s, state level policy was outlined by the Framework Act for the promotion of ICT, and in July 1996, the Enforcement Plan for Adapting Education to the Information Age was formulated.

The general objectives in using ICT for education are to:

- » To stimulate students to actively participate;
- » Enhance students' ability to carry out self-directed learning;
- » Use ICT as a tool for learning; and
- » Use ICT to provide quality education inexpensively to everyone.

The Ministry of Education prepared the Second Stage Comprehensive Plan for Developing ICT Use in Education to address new challenges by 2005. The Second Stage Comprehensive Plan promotes educational reform and human resources development. The vision includes:

1. The general teaching and learning environment will be enhanced by the upgraded ICT infrastructure. The use of ICT in classrooms will increase greatly, allowing students to use multimedia educational materials in the classroom. Student-PC ratios will drop to 1:5 and communication will become much faster. Students will access the Internet and retrieve information easily from the digital library. Teachers will get a wide variety of multimedia teaching-learning materials and guidelines from EDUNET.
2. The Integrated Human Resources Information Network will be completed in 2005. The network will connect those who want to develop their skills for jobs, the institutions that provide educational and training services and the industries that need skilled manpower. This integrated network will create a database on job opportunities and current training services.
3. The quality of education administration will be greatly improved by the year 2003. The online network of the Nationwide Educational Administration Information System will be completed in 2002.

The National Education Act 1999, **Thailand's** first of its kind, forms the core of the education reform movement. For the first time, the direction points toward the philosophy of education provision for the purpose of lifelong learning and societal participation.

Three categories of education management are identified including the formal education, non-formal education, and informal education. Under the principle of equality, people are guaranteed of their rights and opportunities in education.

The goals and objectives of the ICT for Education Programme are to:

- » Give all teachers, college lecturers and professors, school children and college students opportunities to learn to use ICT. Employ ICT as an enabling tool to access information and gain knowledge through self-paced learning, or through interactions with teachers and fellow students;
- » Link schools, colleges, universities, and libraries electronically to provide students, teachers and lecturers with an enriched environment in which distant resources can be made available remotely; and
- » Make full use of ICT and distance education to meet the needs and aspirations of all citizens for continuous education and skills upgrading without regards to age, profession, distance, or geography.

Specifically, the Educational ICT Programme aims to:

- » Introduce at least one computer per 40 primary school students and one computer per 20 secondary school students by the year 2006;
- » Allocate, on a continuous basis, an annual budget of 1,000 million baht to acquire ICT equipment such as PCs, communication modems and, where appropriate, satellite receivers, and multimedia equipment. The amount should be sufficient to equip state schools with up to 30,000 PCs a year; and
- » Connect all universities, colleges, and later on, secondary schools to the UniNet, EdNet/Internet.

Thailand goes as far as to specify 3 sets of strategies towards implementation. The “value-added” policy proposes the following actions:

- » Prioritise the provision of useful software, content and necessary supporting IT curriculum via searching, localizing, producing to make better use of existing hardware in schools;
- » Train teachers to gain literacy in computer and internet uses;
- » Establish maintenance programme for the existing hardware;
- » Enhance the capabilities of organisations that can provide support and services to schools by forming network of agencies and individuals; and
- » Continuously monitor and evaluate the use of technology for education and collect data for planning purpose.

Even though there have been huge investments in IT at school level, statistics show that such investments are not evenly distributed. In fact, a relatively large number of schools and communities are left behind. In dealing with this “digital divide”, the following “equity strategy” attempts to remedy the situation taking into consideration the financial difficulties the country is facing.

- » Provide a set of minimum requirement equipment and facilities to needy schools including electricity, 3 telephone lines, 5 computer sets, 1 printer, 3 sets of televisions, 5 sets of radio, 3 internet accounts of 100 hours per month via the SchoolNet programme;
- » Provide a “Digital Learning Centre” (DLC) to the community; and
- » Train teachers and trainers in IT & Internet literacy.

Information and Communications Technologies and the Internet in particular provide vast opportunities for a country like Thailand. In this light, ICT provide opportunity for a nation to leap-frog the development in general and in the education sector in particular. Some of the measures to accomplish the quantum-jump strategy include:

- » Set a target for all teachers and students to be IT and Internet-literate by the year 2002;
- » Centrally produce 250 titles of academic software and contents annually and provide funding worth 500 million baht per annum to various communities for content development as well as provide budget for localizing 2,000 titles of useful foreign content;
- » Set PC density target by the year 2006 as follows:
 - 1:20 for Secondary School level
 - 1:40 for Primary School level
- » Investment in the production of IT and network equipment for use in the education sector including software and multimedia;
- » Provide IT for education and professional development to the underprivileged, the disabled, and common people seeking lifelong education;
- » Provide adequate radio frequencies for the education sector;
- » Invest in research and development in IT for education at least 400 million baht per year;
- » Establish monitoring and evaluating procedures and protocols; and
- » Establish a National Institute of Technology for Education.

In 1992, the government of **Uzbekistan** adapted the Law on Education, which was amended in 1997 to meet the demands of the National Programme on Personnel Training. This programme introduces reforms in the education system and part of these reforms is the integration of ICT in education.

The national policy stresses the need to achieve computer literacy among all students, promote the use of ICT in schools and everyday life and the integration of ICT in education and other industries.

The goals and objectives of the ICT for education programmes focus more on infrastructure:

- » Establish regional and national networks with global access;
- » Change teaching practices and methods;
- » Reduce education gap between regions;
- » Access to global network for the use of additional materials;
- » Increase of software supply; and
- » Use ICT in management and monitoring of education system.

Financial resources and partners

Viet Nam conducted a campaign to “universalise” primary education from the year 1990 to 2000. Now, it is set to universalise secondary education by 2010. For the centralised planning and administration of education and training, the Education and Training Management Information System (EMIS) was designed.

Meanwhile, the goals and objectives of ICT for education programme for the year 2010, similar to Uzbekistan, focus on implementing the technology:

- » Establish ICT departments in universities to train teachers for schools;
- » Make ICT a subject in general education;
- » Train teachers to make them qualified;
- » Provide computer labs in all schools; and
- » Promote collaboration in international training about ICT; and apply ICT in school management.

It was found that some countries have realised the importance of allocating funds to support their ICT for Education projects if they are to achieve their objectives.

In **Australia**, the Queensland government committed A\$ 59.4 million to ICT in education for 2003 to 2004, and an additional A\$ 35 million to improve ICT access and the ICT skills of students and teachers. Meanwhile, in Victoria, A\$ 20 million was made available through 1:3 subsidies, there is state-wide licensing of products and software, SOFNet, a satellite television network to meet the needs of students and school communities and VicOne (wide area network) was established so schools will have access to a minimum of 64 kbps ISDN line at no cost. Furthermore, an e-mail account was set up for every principal and school council president (up to 3 million messages sent each month at no cost to schools), while seven navigator schools provide accessible working models of educational environments incorporating ICT. In the same state, Net Day uses corporate sponsorship to network classrooms so that students can obtain enhanced access to the Internet.

In **the Philippines**, since 1996, an annual appropriation has been provided for the procurement of computer hardware, software and courseware for teacher-training. In 2002, this allocation amounted to P 155 millions (US\$ 3.1 million), mostly from government funding. However, the DepEd involves other government agencies, local governments, and the private sector to finance various components of building up a programme in ICT in education.

To fast-track the connectivity of schools, DepEd is undertaking Project LINK, which will upgrade computer resources in schools to allow access to the Internet, and give training to teachers on the use of the Internet for research and distance learning. The government will finance a large part of the cost for this project. The costs of connectivity will be carried out by the local businesses, and the operation and maintenance costs shouldered by city and municipality governments.

On the whole, the countries introduce ICT in the elementary (primary) level and in subjects such as Maths and Technology. Yet some do not start introducing ICT until the secondary level, while South Korea covers all levels, including university.

Education systems in **Australia** are expected to organise their curriculum around these eight key learning areas:

- English
- Mathematics
- Science
- Technology
- The Arts
- Health and Physical Education
- Languages other than English
- Studies of Society and the Environment

ICT in **the Philippines** is introduced in the elementary level as a subject called *Home Economics and Livelihood Education (HELE)* and in the secondary as *Technology and Home Economics (THE)*.

In **India**, the ICT for education programmes target all secondary schools and all subjects where ICT is applicable.

ICT in **Indonesia** begins earlier, being introduced to students in primary school. However, most innovatively, schools introduce ICT according to student needs. ICT subjects are taught 4 hours a week. Schools are likewise encouraged to upload their ICT curriculum on the Internet. ICT is also used for school management. In the non-formal education sector, private computer courses are offered or sometimes, ICT is offered as an extra-curricular subject.

In **Korea**, the scope of ICT application is wide, with the specific tasks to adapt education for the information age are carried out in four levels:

1. The elementary and secondary level;
2. Research and universities;
3. Educational administration; and
4. Life-long education.

Scope of ICT use in education

Manner of introducing ICT in schools and non-formal education

To date, there are 9,668 schools in **Uzbekistan**. Out of these schools 4,597 have computer classes of different models. ICT is a required subject in schools and computers are used for subjects like Physics, Chemistry and Biology. ICT is a compulsory core subject in Grades 8, 9, 10 and 11 which covers one and half million students every year. ICT as a subject is taught 2 hours a week.

Meanwhile, ICT in **Viet Nam** is offered only as an optional subject in schools. In schools where there are computer laboratories, students are able to practice their computer skills. In lower secondary schools, students study Winword and Excel; in upper secondary schools, students study basic programming.

The way in which countries are focusing on developing ICT use in schools varies greatly, depending on how established ICTs are already in the countries education systems. All countries already offer Computers as a separate subject. Most are now beginning to focus on integration of ICTs into other subjects, a process in varying stages of development. While in the Philippines and Uzbekistan, ICT is used to supplement instruction, India is beginning to integrate ICT within the textbooks of technical subjects. Others have developed complex systems of integration, such as in Malaysia and Thailand, including ICT within pedagogy and management systems.

The EdNA website (<http://www.edna.edu.au>) provides an electronic community for sharing information and resources on ICT in education in **Australia**, providing an invaluable resource for all working in the field. Other supporting organisations include The Department of Education and Training in Education and Training in Victoria, which supports the successful use of ICT in education through a range of initiatives, including the IdeaBank, a database of teaching and learning strategies to help students achieve CSF (Curriculum Standards Framework) learning outcomes.

The Victoria government has a *Curriculum and Standards Framework (CSF)*, developed by the Victorian Curriculum and Assessment Authority (www.vcaa.vic.edu.au) which identifies what students should know and be able to do in the eight key learning areas from Preparatory Year to Year 10. Within these key learning areas, the major knowledge and skills are arranged into strands, within the Technology Key Learning Area are three strands: Information, Materials, and Systems, for which indicators are provided to inform teachers of the evidence they should look for in student performance.

India is seeking to introduce ICT in Education through a multi-layered approach, with ICT first being integrated in textbooks for computer subjects like Introduction to Computer Science, Informatic Practices, and ICT Systems. ICT is likewise used in face-to-face learning.

The primary teaching and learning components of the Smart School in **Malaysia** are Curriculum; Pedagogy; Assessment; and Materials. Each of these components has unique features. The key features of the Smart School curriculum are:

- » Overall development;
- » Knowledge, skills values and language across curriculum;
- » Explicit learning outcomes for different levels of ability; and
- » Integration of knowledge, skills and values for the information age.

The key features of the pedagogy followed for the Smart schools are:

- » Varied learning strategies to ensure basic competencies and overall development;
- » Teaching that responds to different learning styles; and
- » Classroom environment that is conducive for a variety of teaching and learning strategies.

The materials used in Smart Schools are intended to fulfill curriculum teaching and learning needs and challenge thinking, motivate learning, encourage active participation. There are also a variety of materials for networking between teachers and students. Conventional materials are complemented by electronic materials.

The Smart Schools' management system is comprised of:

- » Technology (system implementation, system maintenance etc.)
- » Financial management (budgeting, reporting, accounting, purchasing etc.)
- » Human resources (teacher scheduling, hiring, staff training management etc.)
- » Facilities (maintenance, asset management etc.)
- » External resources (database management, liaison with external resources etc.)
- » Educational resources (resource database management, input to curriculum management etc.)
- » Student affairs (student profiles, performance evaluation etc.)
- » School governance (communications, public relations, curriculum management etc.)
- » Security (Physical security, IT security etc.)

In the Smart School System, technology is used as an information processing and productivity tool; to enhance professional development; and to automate instruction.

In the majority of cases in **the Philippines**, ICT materials (software, multimedia) are used to supplement instruction. These materials may be produced by teachers themselves (as in the case of animated PowerPoint presentations) or ready-to-use courseware either purchased from abroad or leased to the school as part of the hardware. Currently, there is no integration of the application of ICT with textbooks.

In **South Korea**, the focus is on:

- » Restructuring the curriculum to integrate the application of ICT to teaching and learning;
- » Improving the delivery support system of basic education so that it includes the use of ICT as a component of multi-channel learning;
- » Generating funds through non-traditional financing schemes; and
- » Retooling human resources at different levels involving sub-systems (Central office, field offices, and schools) and focusing on the different components of basic education.

In **Thailand**, most schools adopted ICT in their curriculums. ICT is used in formal and non-formal education in a number of ways.

- » Word processors to write and present their work;
- » Using a spreadsheet to enter data collected in investigations, creating charts, and interpreting the results;
- » Creating databases as part of investigations, interrogating the database by searching and sorting for problems-solving;
- » Using hypermedia to write, lay out and present work for publication on the Internet; and
- » Using the Internet and CD-ROMs in research and investigation.

The teachers also use ICT in a variety of ways:

- » Using word processors to publish their text book, and test-book;
- » Using spreadsheet for data processing and statistics;
- » Using PCs to prepare teaching materials; and
- » Using the Internet and CD-ROM in teaching and assignment.

In the non-formal education sector, the Center for Educational Technology (CET), a unit of the Non-formal Educational Department in the Ministry of Education, is responsible for the production and promotion of educational media for the formal, non-formal, and informal education sectors.

The Center is also responsible for the production and broadcasting of educational radio and television programmes, educational computer

media, media for the disabled, printed materials, as well as video and audio tapes to supplement existing materials in the formal, non-formal and life-long education sectors.

An easy-to-use tool was also developed for teachers to create their own content or teaching materials to add to the digital library.

The SchoolNet Project achieved a “universal access” status since 1997. The project was cited in UNDP’s Human Development Report of 2001.

UniNet (Inter-University Network), established in 1997, is a national network administered by the Office of Information Technology Administration for Educational Development, Ministry of University Affairs, providing national and international education network services to enable research and development technologies to support all universities and institutions of higher education in Thailand. Self-study centres are being developed with electronic library databases, Internet, multimedia, video on demand, to be connected to the high performance network.

In **Uzbekistan**, ICT is a required subject, while computers are also used during teaching other subjects (Physics, Chemistry, Biology and others). Methodological support to ICT education programmes is given by the Republican Education Centre. Developed educational materials are analysed thoroughly by experts before being recommended to schools.

Most countries are now recognising the importance of effective teacher training. Both pre-service and in-service training in ICT is offered on the whole, while a few countries offer more advanced training in integration of ICT within key subjects, curriculum development and classroom management. With most courses being offered by the relevant governmental agencies in each country, policy frameworks for training are generally established.

The Federal Government of **Australia** has a tradition of supporting the professional development of its educators, and provides continuous training through a range of programmes. The local government of Victoria conducts professional development opportunities for teachers through which to develop confidence and competence in the use of ICT in education. These teacher-training programmes span three key areas: computer software skills, curriculum development, and classroom management (curriculum delivery, assessment, and reporting).

While schools conduct their own programmes, which include: Navigator School Programmes and Leading Practice Programmes, teachers may also use self-paced learning materials in the CD-ROM format. There are also programmes for school leaders: Using Basic Computer Applications, Learning Technology Planning for School Leaders, and Computer and Technology Skills for Leaders.

Professional development

The various education department agencies provide their on-line activities for teachers. The *Victorian Information Technology Teachers Association* (www.vitta.org.au) and the *Information and Communication Technology in Education* (www.ictcv.vic.edu.au) are among these agencies.

In-service training of teachers is conducted in State Councils for Education Research and Training. Meanwhile, the National Council of Teacher Education provides the framework for pre-service training of teachers. In addition to these, the government works hand-in-hand with private organisations for other ICT related training for teachers.

In **Indonesia**, teachers' courses are provided by the education board as well as by non-government organisations.

Since 2000, it has been the policy of the DepEd in the **Philippines** to give preference to the hiring of teachers who are computer literate; most teacher-training institutions offer computer education as a required course. Usually, public schools send a few teachers to computer literacy training, who would then pass on the training to peer teachers. Private schools usually hire ICT service providers to give training to their teachers. Public school teachers handling THE classes receive training on ICT. Since 1997, the DepEd has intensified the provision of ICT training to teachers of English, Science, Mathematics and THE.

There has been some private sector support for teacher training. Intel and Microsoft have a current programme – “*Intel Teach to the Future*” – which aims to teach 1,000 teachers on the condition that each teacher would train 20 others. Other training programmes for teachers are funded by other private organisations.

In **Thailand**, training of teachers and related personnel in ICT is a critical step in any effort to promote the use of ICT in the classrooms, since teachers determine how ICT will be used in instruction. Thailand viewed the ICT personnel skill training as an important project, and allocated a large budget for training programmes. To date, 71,442 out of the country's total of 358,781 teachers and education personnel in the primary education level have already been trained. And 25,000 out of 125,983 in the secondary education level have also been trained. Only 21 per cent of teachers/personnel have been trained in ICT. Meanwhile the total number of PCs used is nearly 200,000 and more than 150,000 were used in the learning/instruction process.

Uzbekistan, like Thailand, includes both pre-service and in-service training. The former is conducted through five pedagogical higher education institutions and as special courses in other high education institutions. Meanwhile, in-service training is conducted through the provision of special courses and training in 14 provincial institutes of in-service training and the Central Institute for In-service Training for Public

Education Managers. The Ministry of Public Education launched a Basic Education Staff Development Programme that uses distance learning in teacher training. It is planned to establish 70 Professional Development Centres in selected schools to promote the professional development of teachers and the use of new technology and methods in teaching.

Few teachers in **Viet Nam** have graduated from ICT-related courses. One of the things being done about this is to train Maths and Physics teachers in ICT.

Connectivity is a complex issue, with countries again varying in approach, whether improving bandwidth, providing teachers with notebooks or setting up LANs. While all countries have provided schools with computers to some extent, student/computer ratios vary from 80-1 to 3.9 to one. Some are also making distribution of computers to teachers of importance. Internet connectivity also varies greatly, with 19 per cent connectivity in the Philippines, but 100 per cent through LANs in Korean schools.

In 1998, Victoria in **Australia** started the programme *Notebooks for Teachers and Principals* to encourage teachers integrate the use ICT into teaching and administrative tasks, providing notebook computers to these educators through an affordable lease scheme (A\$ 150 year for three years) and on the condition that they take courses in professional development (40 hours in the first year) and to use the notebook in their teaching.

By November 1998, 29 per cent of Australia's teachers had a notebook computer. By November 2000, the number grew to 80 per cent, and by July 2001, 91.7 per cent of teachers. Evaluations eventually showed that the number of teachers using a computer at home and at school grew (from 52 per cent to 77 per cent of teachers). Classroom use of computers by teachers grew by half, from 36 per cent to 50 per cent of the programme participants. Also, teachers with notebooks routinely used computers 20 per cent more than their counterparts who had none. A year 2000 report showed that 37 percent of school computers were in laboratories and 31 percent were in classrooms. Laptops comprised 16 percent of all school computers, and secondary schools had lower student:computer ratios than primary schools.

A February 2002 study shows that in Victoria, the average computer: student ratio was 1:3.9 (the highest in Australia). This study also indicated that 88 percent of schools had a computer:student ratio of 1:5. Presently, Australia's schools have a total of 136,000 computer units.

Connectivity

The bandwidth available to schools varies from state to state, and the type of connections to the Internet ranges from ISDN (the most common) to ADSL, and some schools even have cable and satellite Internet. The majority of schools have either a 64 kbps or a 128 kbps ISDN line. In Western Australia, the majority of schools have 64kbps dial on-demand connections, and in the Northern Territories, schools have 400 kbps satellite connections. Some states, specifically Western Australia, will soon implement a rollout programme to provide 10 Mbps bandwidth connections to metropolitan schools, 2 Mbps to regional high schools, and 512 kbps to regional primary schools.

Meanwhile, schools in **India** are provided with computer, networking facilities, printers and scanners. Computer software is also provided such as MS Windows, MS Office, CorelDraw, MS Encarta, and Educational CDs. Internet connection however is limited to Types A and B Cities.

Use of the Internet in **South Korea** is seen as an indispensable part of ICT use in education and is promoted by the mandatory provision of LAN in the construction in all schools. LAN construction started in 1997 and was completed in 10,064 elementary and secondary schools by 2000. The school LANs help teachers and students use ICT and access the Internet.

Efforts have been made to distribute PCs to computer labs, the foundation for ICT use in education. It also supports the increase of computer use in elementary school education and the emphasis on ICT use in the Seventh Educational Curriculum. A total of 431,981 units were distributed among more than 10,000 schools in the year 2000. Part of the goals of the Plan is to provide a PC for each teacher in elementary and secondary schools in the year 2000. A total of 340,854 units were distributed to teachers by the end-2000.

The main goal of the advancement of teaching facilities is to provide multimedia equipment to 200,000 classrooms (elementary, middle and high school). The equipment is classified as essential and optional. Essential equipment includes 586 or upper level CPU computers and one image device, including a projection TV, a monitor, and an LCD projector depending on the school level, grade and the number of students per school. Optional equipment comprises visual presenters, scanners and or digital cameras.

Eighty-one percent of schools in the **Philippines** have no access to the Internet. The schools in Metro Manila, the Philippines' capital, have the greatest access to the Internet, but the incidence of connectivity decreases as one goes northwards and southwards throughout the archipelago.

At the higher education level, all universities in **Thailand** are connected to the Internet, but only 22.50 per cent of secondary schools and 1.19 per cent of primary schools. Plans target that by the year 2002, the student-to-computers ratio in secondary schools should be 40:1, and in primary schools 80:1 (compared to 114:1 in year 2000). The use of PCs for learning and instruction versus the use in office administration at the primary school is 29:1, and in the secondary school 3:1. Plans indicate that in the primary level, PCs are used mainly for learning and instruction. The country aims for 100 per cent connectivity for secondary schools by the year 2002, and for primary schools by 2004; but figures show these targets may not be met.

Another use of ICT via Internet is the schoolnet Thailand programme, (<http://school.net.th>). Presently, SchoolNet Thailand connects over 4,300 schools to the Internet. The network has been designed to serve the goal of universal access for every school nationwide. More specifically, a school only pays the telephone charge at the local-call rate per connection (at 8 US cents per call), and no Internet access charge, regardless of where they are located.

Furthermore, content creation programmes and activities have been initiated to promote the use of Internet in teaching and learning, for example, digital library and digital archive, which contains digitised materials in various forms with proper indexing and a search engine for ease of use.

Thailand set up the ICT infrastructure connecting all universities, institutions, and campuses in the country, called 'UniNet', by establishing ATM network via 155 Mbps bandwidth fiber optics; the infrastructure will connect the networks in Bangkok to the rural provinces through digital leased lines with 2 Mbps (E1) bandwidth.

Annually, the Government of **Uzbekistan** funds to procure 100-150 computer classroom sets (each set includes 10 computers). PCs are supplied with Microsoft Office and other software. Less than 2 per cent of schools have access to Internet or modern hardware to establish local networking. One of the main issues with Internet access is the cost of communication, as most school budgets cannot afford the Internet. Local computer networks (Intranet) have been set up within educational institutes, which will introduce local distance learning.

Most countries have started to evaluate but few indicators have been set up yet. South Korea has become systematic, having developed its set of indicators, collected data and maintained a database. Australia has developed its set of indicators but they have to be tried out in the coming years. While generally research, surveys and indicators are still at the infancy stage in other countries, some are increasing their efforts to evaluate and assess.

Evaluation and indicators

The Ministerial Council of Education, Employment, Training and Youth Affairs (MCEETYA) in **Australia** is looking into the use of performance measures for student achievement relating to new technologies. MCEETYA also conducted a survey on students' IT skills in information processing and computing.

The University of Sydney conducted research investigating the changes in student performances after integrating ICT into education. Key findings include:

- » ICT increased student engagement, enthusiasm and motivation;
- » More student-centred learning took place;
- » Students' higher-order thinking skills improved;
- » Changes occurred in the teaching practice; and
- » Ability to use emerging technologies improved.

To evaluate all the efforts being made in **India**, a Management Information System (MIS) is being developed. This MIS includes:

- » Student Information Module
- » Assessment Tracking Module
- » Collaborative Module
- » Administration Module
- » Content Updating Module

Since assessment is an important component of the Smart schools, it consists of an on-line assessment system, a database and training and certification for assessors.

The Department of Science and Technology (DOST) in **Malaysia** conducted a survey of schools that gathered baseline data on schools' Mathematics and Science teachers and the extent of the schools' use of ICT for instruction and other purposes. The survey, which covered 4,310 public schools, used the following indicators:

- » The percentage of computers used for instruction and the percentage of computers used for administrative work;
- » The percentage of classes (by subject types) that use computers in instruction;
- » The percentage of schools that engage an outside technician to maintain the computer system;
- » Percentage of schools with telephone line;
- » Observation of teacher and student practices; and

- » Interviews of innovative teachers on practices (teacher and student) related to innovation, problems, solutions and prospects for sustaining and continuing innovation.

ICT indicators in **South Korea** include:

- » Percentage of schools connected to a network (currently 100 per cent);
- » Budget source (currently 25 per cent from the central government and 75 per cent from the regional government);
- » Speed of network;
- » Accessibility to PC (includes number of students per PC which is currently at 1 PC: 8.13 students, number of teachers per PC/ Notebook which is currently at 1:0.9); and
- » Accessibility to equipment.

While **Thailand** has an educational ICT policy and has set up targets for monitoring and evaluation in 1995, the actual monitoring and evaluation activities are lagging behind schedule. Formative evaluation has been done to improve project implementation, but only on a small scale. Summative evaluations have been done, but only with a few projects and with inadequate standards, due to constraints in time, knowledge, financial support and expertise. The Ministry of Education set up a committee to monitor and evaluate the use of ICT in education project recently, but the committee is only beginning its process and will require time to achieve its task.

The Ministry of Public Education in **Uzbekistan** conducts monitoring and evaluation through its 14 Provincial Departments of Education and 15 In-service Training Institutes. School computers are assessed in terms of availability of computers in school and the number of students using PCs. These computers are used to exchange information with the Ministry on regular basis and to receive test results on the knowledge of a) students lower secondary level (7-9 grades) and b) school graduates to access their abilities before applying to higher education institutions.

As mentioned previously, infrastructure still provides a major problem for most countries, as well as integration of ICT within the curriculum, while India and Australia also identify teachers' attitudes as a hurdle.

Some of the problems encountered by schools in **Australia** regarding the implementation of ICT in education were: the cost of infrastructure, unreliability of hardware, lack of management support, teacher reluctance to embrace change, lack of graded professional

Problems and issues

development and lack of strategies and criteria for assessment of non-cognitive outcomes (such as social and affective development, workplace competencies). On the more basic level, connectivity and broadband connection are also issues, specifically relating to price, availability, management issues, and technical support problems.

Similarly, in **India** there are still many challenges and obstacles to hurdle. Among these are software content, infrastructure, lack of trained teachers and lack of motivation in all concerned.

In **Indonesia**, challenges focus more on the integration of ICT in the curriculum, the decentralisation of the educational system and the high cost of Internet connections.

In the **Philippines**, the following were identified as key problem areas for implementing ICT in basic education:

- » Teachers' fear of the technology;
- » School principals' closed mindset to and non-appreciation of the value of ICT to transform and improve education;
- » Constraints of the annual Education Budget;
- » Maintenance of ICT resources and lack of technical staff;
- » Sustainability; and
- » Limited availability of education software and courseware.

In **Thailand**, major issues include:

- » **Accessibility and affordability.** Radio frequency for education is now a major issue facing the education community during this transition period of the commercial liberalisation of the telecoms market.
- » **Networking.** In this area, investment and utilisation are piecemeal, redundant, and cost-ineffective.
- » **Curriculum and content.** The inadequacy of ICT curriculum still impedes technology literacy, while quality contents for on-line and off-line learning remain minimal.
- » **Manpower.** Shortages - in the numbers of computer teacher, qualified IT graduates, researchers, and IT technicians - are impacting on the quality of computer literacy attained.
- » **Investment.** Most investment in-flows were for the hardware end, and little for improving teachers' literacy and content production.

In summary, the problem of the used of ICT for education in Thailand can be classified into three groups: (i) Accessibility and Affordability (ii) Need for appropriate content, and (iii) Need for ICT literate teachers.

The problems in **Viet Nam** remain more fundamental:

- » Price of computers;
- » English language skills are low; and
- » The disparity in living conditions between urban and rural areas.

Statistics from studies reveal that only 2.59 per cent of lower secondary school students and 11.52 per cent of upper secondary school students are trained in ICT.

In Uzbekistan, less than 2 per cent of schools have access to the internet or modern hardware to establish local networking. Most schools cannot afford Internet, as the connection is so costly. Equipment is old and outmoded, while programme support and other office programming is not yet available in all languages of instruction in schools. Teacher training is also scant as yet. The Government is currently employing a range of initiatives to solve these issues.

3

Situational Analysis on Developing and Using ICT Indicators in Education

Introduction

- Indicators and the rationale for using them
- Basic approach to formulating indicators
- Using indicators to assess impact of ICT in education

Appendix I

- Situational Analysis of ICT Indicator-related Concerns in Different Countries

Appendix II

- Studies on the Use and Impact of ICT in Education

Dr. Eligio B. Barsaga, Programme Director of the Research and Evaluation Division of SEAMEO INNOTECH
presented a situational analysis on developing
and using ICT indicators in education

Indicators are measuring devices. They define concepts in terms of the measurements and data it is possible to collect and analyze. They define **what data to collect** and **at what time intervals**.

To have good indicators, we need to have a clear vision of what we are trying to achieve and what we are trying to measure. The basic approach involves four steps as follows:

- » Identify what is to be measured;
- » Develop trial measures;
- » Assess each trial indicator, using agreed-on criteria; and
- » Select the best indicators for a specific project.

These steps are discussed in further detail below as well as the key actions involved in each process.

Step 1: Identify all concepts to be measured, especially project objectives and outputs

Some of the key actions involved in this process are:

- » Review concepts, objectives, results, and output statements for clarification;
- » Clarify whether the outcome sought is an absolute change, a relative change, or no change; and
- » Determine the relationship between project activities and their outputs or objectives (are these outputs or objectives direct or indirect?)

**Introduction:
Indicators and
the rationale for
using them**

**Basic approach
to formulating
indicators**

Step 2: Develop a list of possible (trial) indicators

- » Think of possible alternative indicators for each concept, objective, and output, without being too restrictive; and
- » Conduct internal brainstorming sessions.

Step 3: Assess each trial indicator against criteria

- » Establish an agreed set of criteria for indicators; and
- » Use a scoring scale (1–5) to determine the usefulness of each trial indicator.

Step 4: Select the best indicators for this project

- » Consider each indicator on its merits against the criteria;
- » Consider the mix of indicators to construct a robust set consistent and complementary in terms of data-collection methods and time frames;
- » Avoid having too many indicators; and
- » Be prepared to update your indicators.

The table below summarises the criteria that can be applied in assessing potential indicators. These criteria are based on the recommendations of the Center for Development Information Evaluation, an institute of USAID.

Criteria for assessing indicators

Criterion	Description
Direct measure	<ul style="list-style-type: none"> ■ Indicator is intuitively understood (high face validity) ■ Indicator is a direct measurement, rather than a proxy that depends on assumptions for its validity ■ Indicator is supported by a body of research
Objective	<ul style="list-style-type: none"> ■ Indicator is unambiguous about what it is measuring ■ Different people will collect comparable data based on the indicator ■ Definition remains stable over time, so change can be measured ■ Indicator is unidimensional (measures only one thing) ■ Indicator can be quantitative or qualitative, as long as it is clearly and consistently defined and interpreted
Adequate	<ul style="list-style-type: none"> ■ Either by itself or with a minimal companion set of indicators, the indicator provides reasonable confidence that it accurately measures the attribute ■ Object is to have as few indicators as possible per attribute (should be three or fewer) — more is not necessarily better ■ Number of indicators will depend on the complexity of the object, or what is being measured
Quantitative	<ul style="list-style-type: none"> ■ Quantitative indicators are more objective than qualitative ones ■ Qualitative indicators should be adequately specified to be objective and consistent
Disaggregated	<ul style="list-style-type: none"> ■ The more disaggregated the indicator, the more easily data can be manipulated to answer questions not anticipated at the outset
Practical	<ul style="list-style-type: none"> ■ Data can be collected at reasonable cost, given their utility ■ Data are available and can be collected at suitable time intervals ■ Data can be readily collected in various projects for comparison
Reliable	<ul style="list-style-type: none"> ■ Indicator is reliable within the context of the evaluation purpose and resources ■ Data-collection process is consistent across different time and space scales, using comparable methods and sampling procedures Indicator is based on representative data

A. *Synthesis of country experiences on ICT indicators and related issues (see Appendices I and II of this section)*

Several countries, namely, Canada, Japan, Korea, New Zealand, Philippines, Slovenia, South Africa, United Kingdom and the United States conducted several researches and studies on ICT and its indicators. In some countries, specifically, Korea, Japan, and in Europe, their country's vision for the ICT sector served as basis for the formulation of ICT indicators or benchmarks. For example, the government of

Using indicators to assess impact of ICT in education

Korea has "Cyber Korea 21", the government of Japan has the "eJapan Priority Programme" and Europe has the "eEurope" initiative. These programmes are all aimed at improving the ICT sector.

In other countries, certain organisations conducted the survey and thus, formulated the indicators. In the Philippines for example, the Senate Committee on Education, Arts and Culture commissioned SEAMEO-INNOTECH to conduct the national survey that will profile the ICT capabilities of elementary and secondary schools in the Philippines. SEAMEO-INNOTECH was responsible for formulating the indicators/ items on the survey.

For other countries, the basis for their ICT indicators was not made clear.

The United States utilises a set of standards for the use of technology by students, teachers and school administrators. The International Society for Technology in Education (ISTE) came up with the National Education Technology Standards (NETS) Project. The primary goal of the ISTE NETS Project is to enable stakeholders in PreK-12 education to develop national standards for the educational uses of technology that will facilitate school improvement in the United States. The ISTE standards are also currently being adapted in Europe. Other countries did not indicate any standards for technology use in education.

The fact that the other countries did not indicate any existing standards that can monitor the use of technology reflects the lack of qualitative indicators. Many countries merely focus on providing the technology, that is, making computers and Internet access available. However, there have been few efforts to ensure that technology is used effectively and efficiently.

In most of the countries researched, the studies have been limited to ICT indicators used in the primary and secondary level. These countries are Canada, Japan, Philippines, Slovenia, Korea, UK and US. There are however, instances where other levels are included, such as the case of Korea where university level is included and Slovenia where pre-school is included. In the United States, those in physical education subjects and special education subjects in the primary and secondary levels were not included. Japan is noteworthy for its ICT policy, which includes even the schools for the blind and the disabled.

This situation tells us something about the issue of equity in the use of ICT in education. There are times when the government policy itself can serve as an aid or barrier to equity in access.

The number of computers or Internet connections in schools dominates statistics. In fact, only three countries specified indicators pertaining

to other ICT technologies such as telephone lines, fax machines, LCD projectors and the like. These countries are New Zealand, Korea and the Philippines.

Perhaps, future studies should also look into other ICTs. In doing so, there should be a clear definition of what ICT is. The following definitions can serve as a guide:

- » **Information Technology (IT)** is the term used to describe the items of equipment (hardware) and computer programmes (software) that allow us to access, retrieve, store, organise, manipulate and present information by electronic means. Personal computers, scanners and digital cameras fit into the hardware category. Database storage programmes and multimedia programmes fit into the software category.
- » **Communication Technology (CT)** is the term used to describe telecommunications equipment through which information can be sought and accessed, for example, phones, faxes, modems and computers.

Respondents for the different surveys and researches in the US, New Zealand, the UK, South Africa and Europe usually include teachers. Students are likely to be included in surveys aiming to determine their perceptions in the use of ICT technologies such as the case of surveys conducted in UK and South Africa. In other cases, school heads are taken as respondents such as in the Philippines and New Zealand. It was not clear from the results in other countries such as Canada, Korea, Japan and Slovenia who the respondents were.

Most countries use both quantitative and qualitative indicators. However, there are far more quantitative indicators than qualitative indicators in the countries included in our research.

Quantitative data usually include those pertaining to ICT infrastructure. ICT infrastructure consists of hardware, e.g. PCs, servers, etc., and the physical networks that connect the computers locally and globally.

Common indicators used for measuring or determining ICT infrastructure include:

- » Availability of computer hardware; ratios of students per computer, computers per classroom, teachers per computer; types of computer set-ups (standalone, multimedia in network).
- » Availability of connectivity and bandwidth of the computers: type of bandwidth of the connections, high-speed, broadband, wireless.

However, it is equally important to examine indicators that will show how ICTs have been used not only as a basic operational tool but also as a communications tool that promotes the development of creativity, interactivity, collaborative learning, critical thinking and problem-solving.

There are countries that are already attempting to include attainment and ICT impact in their indicators. Canada included “obstacles to fuller use of information technologies” in its list of indicators. Meanwhile, researches in Europe included “teacher confidence in the use of ICT, change in teaching methods and desirable ICT skills” in its list of indicators. In New Zealand, “obstacles faced by teachers in using ICT, factors that encourage use of ICT, student’s positive views about technology activities in school” are among the qualitative indicators.

South Africa attempts to measure the practical, foundational and reflexive competencies of educators. Researches in South Africa also include items on how well students enjoy ICT-related activities and learner’s perception of how the use of computers improves learning and attitudes.

UK’s qualitative indicators include teacher confidence in the use of ICT and benefits of ICT in subjects. In the US, most qualitative indicators pertain to the teacher’s perceived value of Internet use relative to the teacher’s educational background, school level taught, location of access etc.

Researches in Japan, Korea, the Philippines and Slovenia show that these countries are still concentrating on providing ICT infrastructure, that is, making the technology available in their respective countries rather than measuring impact and effectiveness.

Some of the qualitative indicators mentioned in the researches are:

- » How much students think they have improved;
- » Change in teaching methods;
- » Desirable ICT skills;
- » Factors that encourage telecommunications use;
- » Students who have positive views about technology activities in schools;
- » Teachers agreeing that telecommunications technologies can enhance learning and teaching;
- » How much learners think they have improved in various activities;
- » Teacher confidence in the use of ICT;
- » Development of practical, foundational and reflexive competencies;
- » Impact of computers on educators and learners; and
- » Barriers to computer related activities.

Some indicators are unique or were only mentioned for some countries.

In Europe for example, ICT indicators include ICT policy and strategy of each country included in the Europe study namely: Denmark, Sweden, Finland, Norway and the UK. These indicators measure objectives of each country in national ICT projects, and the schedule for implementing national ICT education projects among others.

In Korea, the establishment of an education network (Korea Education Network) serves as one of the ICT indicators for higher education. Korea also uses the establishment of a networked research system (Research Information Service System) for higher education as another indicator.

B. Issues in ICT in education

While ICT has revolutionised business and industry and entertainment and has made very dramatic effects in the quality of products and services delivered by these sectors, it has not produced the hoped-for improved quality in student academic performance. The ICT promise appears to have fallen short of the expected effects on student learning outcomes. Moreover, ICT has created newer problems such as the oft-mentioned “digital divide,” exacerbating the problem of access to ICT between the well-off students, who have better access to ICT in the schools and even at home, and the mass of poor students, who have less access or no access at all.

This divide has even extended to the disparities in access between male and female students, between and among teachers and school administrators. As countries continue to invest in ICT for use in education, drawing financial resources from a variety of sources including the private sector and bilateral funding agencies, there is an even greater need for performance indicators to monitor the use and effects of ICT and to demonstrate accountability to these various funding sources and the public.

There is an urgent need, therefore, for a monitoring and evaluation (M and E) system if current efforts to make ICT use as an integral part of the education system are to succeed. Such M and E system should start at formulating a set of indicators of ICT use and impact in education.

This effort is not new in other parts of the world, e.g., the United States, Europe, the United Kingdom, Canada, Australia, New Zealand, and the like. However, in **most** of the Asia-Pacific countries, there has not been systematic work in the use of ICT indicators in the field of education.

Given that Asia-Pacific countries differ widely in regard to the scope and variety of use of ICT in education, it would be unrealistic and inappropriate to attempt to formulate a uniform set of indicators that can be used to frame data collection for ICT in education projects. What is realistic and appropriate, however, is for us to arrive at a consensus on common **core indicators** that can be used regardless of the ICT utilisation stage at of a country. Important criteria to be observed in formulating these core indicators includes local relevance and reliability and robustness when indicators are used for comparison of one ICT project or country with another.

C. Methods of collecting indicators

There are various ways of collecting data based on predetermined ICT indicators. Of course, the most popular one is the use of survey questionnaires distributed to a representative sample of schools, school heads and teachers.

Where the telephone system in a particular country is well developed enough so that most homes have access to a telephone and the cost of placing long distance calls is reasonably low, the telephone interview is a more cost-efficient method of collecting data based on indicators.

Where there is a saturation of Internet connectivity in the country, that is, most of the homes, schools and offices are connected to the Internet, use of questionnaires posted on the website of the institution/agency conducting the surveys can be an efficient method of collecting data on indicators. Communication by email between the respondent schools; school heads, teachers and even students will facilitate data gathering. Data entered into the web-based questionnaire can be automatically uploaded to the institution's or agency's computer server located thousands of miles away.

The method of data collection for ICT indicators will vary from country to country, depending on the spread of telecommunication use such as the telephone and the Internet. It will also depend on whether the Ministries of Education's current M and E systems could accommodate additional data collection tasks to monitor and evaluate the use and impact of ICT in the schools, and additional variables based on ICT indicators could be integrated into the current database system.

D. Possible software or database systems for storing indicators

Below are a few of the software or database systems worth considering in developing the databases for the ICT indicators:

- » Spreadsheet programmes (e.g., IBM Lotus 123 and MS Excel);
- » Statistical Programmes (e.g., Statistical Package for the Social Sciences);
- » Customised database programmes using MS Access (for small databases);
- » SQL Server, MAGIC (for big databases); and
- » Database-driven web applications (Visual Interdev, Java, Visual Basic).

Other software available in the market can be used to create the ICT databases. Technical staff will be able to assist in determining the most feasible and user-friendly software adequate to answer specific needs.

Situational Analysis of ICT Indicator-related Concerns in Different Countries

Country	Basis for ICT Indicators/agency who formulated ICT Indicators	Presence of standards for technology use	Educational level covered	Respondents of studies	Technologies covered in studies	Presence of indicators addressing equity, ethics and investment issues	Presence of indicators on ICT integration in curriculum, impact etc.
Canada	<p>Two criteria for development of indicator set:</p> <ul style="list-style-type: none"> • Type of education, information needed for policy development • Practical availability of data <p>Indicators developed by Pan-Canadian Education Indicators Programme (PCEIP)</p>	None	Elementary and secondary level	Not specified	Computers and internet	None	Yes, specifically, on what encourages teachers and students to use computers
Europe 1	<p>Indicators based on the eEurope initiative of the European Union, Action line: "European youth into the digital age". The goal for the said objective is to turn digital literacy to a basic competence for all young Europeans/ SIBIS Study</p>	Yes. ISTE (NETS) standards	<p>Various researchers covered different level: public primary and lower secondary; primary, secondary and special schools; head teachers and teachers</p>	School heads, teachers	ICT in general, computers and internet access	Yes, specifically on national policies and expenditure	Yes, on competency of ICT instructors

Country	Basis for ICT indicators/agency who formulated ICT indicators	Presence of standards for technology use	Educational level covered	Respondents of studies	Technologies covered in studies	Presence of indicators addressing equity, ethics and investment issues	Presence of indicators on ICT integration in curriculum, impact etc.
Europe 2	Eurydice	Yes, ISTE (NETS) standards	Primary and secondary level	Not specified	Computers and internet	Mainly on expenditure, distribution of budget	Yes, on integration of ICT in subjects
Japan	eJapan priority policy programme/ various surveys conducted by e.g. government agencies on ICT in general. those conducted by the Ministry of Posts and Telecommunications Survey on Social Education	None	Elementary and secondary in some indicators; not specified in other indicators	Not specified	Computers and internet	Yes. Government general IT policy on elementary and secondary schools the same for schools for the blind and disabled	None
Korea	Cyber Korea 21, Vision: "To prepare students for the knowledge based society by realizing life-long learning via cyber-education system" Korea National Statistics Office	None	Elementary, secondary, university	Not specified	Computer, internet and other ICT related technologies such as LCD projects, camcorders etc.	Yes, specifically one of the goals of Cyber Korea 21 is to provide ICT training to 500,000 economically disadvantaged students and create CD-based software for vocational students	None
New Zealand	Research conducted by the Telecom Education Foundation	None	Not specified	Teachers and principals	Telephone lines, fax machines, computers and internet	None	Yes, specifically on what encourages teachers and students to use computers

Country	Basis for ICT Indicators/agency who formulated ICT Indicators	Presence of standards for technology use	Educational level covered	Respondents of studies	Technologies covered in studies	Presence of Indicators addressing equity, ethics and Investment Issues	Presence of Indicators on ICT integration in curriculum, impact etc.
The Philippines	Senate Committee on Education, Arts and Culture with SEAMEO-INNOTECH	None	Public and private elementary and secondary schools	School heads	All ICT related technologies such as television, projectors, radio/cassette players, computers, computer peripherals and internet access	Yes, specifically those pertaining to use of computers by non-formal education students	None
Slovenia	Research on internet in Slovenia	None	Primary, secondary, youth hostels and kindergartens	Not specified	Computers and internet access	None	None
South Africa	School net	None	Not specified	Students and teachers	Computers and internet access	None	Yes, on competency of ICT instructors
UK		ISTE (NETS) standards	Primary and secondary schools	Students and teachers	Computers and the internet	Yes, mainly on expenditure and budget allocation	Yes, includes teacher confidence in the use of ICT and benefit of ICT
US	Teaching, learning and computing – a study of teacher's use of computer technology, their pedagogies, and their school context	ISTE (NETS) standards	Public and private schools, elementary, middle school and high school, all subjects except physical education and special education	Teachers	Computers, internet use (includes use of various software, CDROM etc.	Yes, includes indicators that determines technology intensive areas, software saturation etc.	Yes, specifically pedagogical motivations for student computer use

Studies on the Use and Impact of ICT in Education

Several studies have been conducted on ICT and its use and impact on education, some of which are included below.

A. Survey of information and communications technology in schools 2001 (England)

This survey on the information and communications technology (ICT) provisions in schools in England was carried out in April 2001, the findings of which were compared to similar surveys conducted in 1998, 1999 and 2000. The surveys collected information on the number and type of computers available in schools, expenditure in schools, the extent and benefit of the use of ICT across curriculum subjects, the use of internet and other electronic network communication links; and teacher usage of computers and their confidence in the use of ICT in the curriculum.

B. The networked readiness index: Measuring the preparedness of nations for the networked world

The Center for International Development (CID) at Harvard University conducted a research which came up with the Network Readiness Index (NRI), a major international assessment of countries' capacity to exploit the opportunities offered by ICTs.

The Network Readiness Index is an assessment of a country's capacity to make use of ICT resources. It shows how nations are performing with regards to their participation in the Networked World.

C. Profile on information and communications technology capabilities of elementary and secondary schools in the Philippines, 2000-2001 Project TAO CARES (Computer-Assisted Reforms for Schools)

This is a national population survey of public and private elementary and secondary schools conducted by SEAMEO INNOTECH in the Philippines under Project TAO CARES last March 2001. Its main objective is to determine ICT capabilities of schools. The survey questionnaire consisted of 42 items mostly focused on the readiness of schools in terms of infrastructure, hardware, software and manpower capabilities on ICT.

D. The 1996 national survey on computer education – Philippines

This study was conducted by the New Educational Technologies Foundation, Inc., a non-profit organisation composed of schools that believe in the capacity of IT in improving the quality of student learning and efficiency of teaching. The questionnaire was divided into two parts, the first part asked about perceptions, level of awareness and attitudes regarding the value of computer education and was answered by users and non-users of computers. The second part which deals with the actual use of computers was answered by users only.

E. The impact of networked ICT on Literacy Learning in English, 5 – 16

This report is the result of a literature review conducted, first, to identify a number of studies that might shed light on the major impact of ICT on literacy learning in English for 5 to 16 year olds, and the second, to undertake an in-depth review of the papers that were identified as being on the impact of networked ICT on literacy learning in English for ages 5 to 16.

F. Effective integration of IT in Singapore schools

The “Education research fund: Effective integration of IT in Singapore schools – pedagogical and policy implications” is a report on the key findings of a questionnaire survey aimed at identifying the degree of information technology (IT) integration among Singapore schools. The survey is the first part (Phase One) of a larger study funded by the Ministry of Education of Singapore aimed to examine and analyze where and how IT is integrated in Singapore schools to develop pupils' higher order thinking skills.

4

Summaries of Experiences from Other Regions

Paper No. 1

Developing performance indicators for ICT in education:

Australia's experience

by Dr Michelle Bruniges, Director, Strategic Information and Planning, New South Wales, Department of Education and Training

Paper No. 2

The UNESCO IITE Project: Development and use of indicators of ICT in education for the Baltic and CIS countries

by Dr Boris Kotsik, Senior Programme Manager, UNESCO IITE

Paper No. 3

The development and use of indicators to measure the impact of ICT use in education in the United Kingdom and other European countries

by Mike Aston, Consultant, UNESCO IITE

Three resource persons provided overviews of researches on various ICT in education programmes conducted in Australia, the Russian Federation and Western Europe. These presenters are from

- *UNESCO Institute of Information Technology for Education in (Russian Federation);*
- *UNESCO Institute for Information Technology in Education (United Kingdom); and*
- *The New South Wales Department of Education and Training (Australia).*

Following are the summaries of their reports.

**Developing performance indicators for ICT in education:
Australia's experience**

*by Dr Michelle Bruniges, Director, Strategic Information and Planning,
New South Wales Department of Education and Training*

Dr Bruniges presented the highlights of Australia's experience in integrating ICT in the education system, and in developing monitoring and evaluation mechanisms to track how ICT has impacted on the performance of teachers and learners.

Each of Australia's seven States and Territories has a Minister for Education and Training. Together with the Commonwealth Education and Training Minister, they form the Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA). MCEETYA is the key body in Australia that formulates national education policy, goals and objectives.

The implementation of MCEETYA's national policies at the state and territory level (such as how ICT will be implemented in schools) is the jurisdiction of the individual state and territory Ministers of Education.

**1. Goals and objectives of the ICT for education
Programme – Australia's National Goals for
Schooling and ICT**

The key national goal that frames Australia's ICT programmes in schools specifies:

"when students leave school, they should ... be confident, creative and productive users of new technologies, particularly information and communication technologies, and understand the impact of those technologies on society."

Australian policy on implementing ICT in education is geared to actualise the role of education and training in the strengthening of "an equitable, imaginative and economically strong knowledge society... Education and training will continue to grow in importance as Australia's economy and society become more knowledge-based and globally integrated." ICT is integrated into education to improve and increase the quality, accessibility and cost-efficiency of the delivery of education, while taking advantage of the benefits of networking learning communities together to tool them for the challenges of global competition. To achieve this

**Australia's
policy on the
use of ICT in
education**

shared vision for all Australian students, teachers, schools and school systems, MCEETYA focused on the following priorities:

- » Ensuring that the education and training sector is able to provide all learners with opportunities to develop their ability to use technology confidently;
- » Supporting education and training workers to acquire and maintain the skills needed to take full advantage of the potential of ICT to transform learning;
- » Providing effective and affordable access to the Internet for all learners, regardless of their geographic location;
- » Promoting collaboration in the development and dissemination of high quality digital educational content, services and applications that enable learners to gain maximum education benefits from the online revolution, while also developing a market and generating export income;
- » Sharing leading practice and research on ICT issues;
- » Working across agencies at all levels of government to ensure the development of a policy and regulatory framework that supports the uptake of ICT in education and training.

MCEETYA's strategies are grounded in pursuing collaborative action across all education and training sectors. To date, four national strategic action plans have been developed:

1. The National Education and Training Action Plan;
2. The action plan for the vocational education and training sector;
3. The action plan for the higher education sector; and
4. The action plan for the school education sector, *Learning in an On-line World*.

Monitoring and reporting on Australia's National Goals. To actualise the National Goals for Schooling, MCEETYA established the National Education Performance Monitoring Taskforce (NEPMT), whose responsibility was to develop key performance measures for monitoring and reporting the achievement of the National Goals for Schooling on a nationally comparable basis.

A key priority for the initial development of performance measures was Information and Communication Technology (ICT), which was considered crucial to Australia's educational, economic and social well-being. The NEPMT commissioned a project in 2000 to develop key performance measures for monitoring the ICT knowledge and skills of Australian school students. The outcome of this process was a report

to the NEPMT, *Monitoring Progress towards the National Goals for Schooling: Information and Communication Technology (ICT) Skills and Knowledge*. The report:

- » Describes the context of learning ICT skills and knowledge as an outcome of schooling;
- » Identifies and describes performance measurement approaches, definitions and sources of data currently used in schooling, research and national and international reporting on ICT skills and knowledge;
- » Evaluates the ICT measures currently in use in the context of the National Goals for Schooling in the 21st Century;
- » Proposes a strategy for monitoring the profile of ICT skills and knowledge of school students;
- » Identifies further work required to establish an operational monitoring programme;
- » Explores the costs and benefits to school systems of introducing a national monitoring programme.

The NEPMT proposed the following definition of ICT as *technologies used for accessing, gathering, manipulation and presentation or communication of information*. (July 2001)

In July 2001, MCEETYA established a new national taskforce, the Performance Measurement and Reporting Taskforce (PMRT) to continue the work of the NEPMT and further investigate key recommendations of the NEPMT report. The most recent achievements of the PMRT, which were recently endorsed by MCEETYA in July 2002, include the:

- » Development of a *Measurement Framework for National Key Performance Measures* as the basis for reporting on progress toward the achievement of the *National Goals for Schooling*.
- » Development of an Information Framework for the *National Report on Schooling in Australia (2002)*. This document is published annually in hard copy and electronically (<http://www.curriculum.edu.au/anr>) and represents the key public accountability mechanism for reporting on the performance of Australia's schools and school systems.

In relation to ICT, MCEETYA endorsed the recommendations of the PMRT to conduct the **national monitoring of ICT skills and knowledge of students** in Year 6 (aged 10-12 years) and Year 10 (aged 14-16 years) by means of three-yearly sample assessments, commencing in 2005.

2. Scope of ICT use in education

a) NEPMT evaluation of ICT usage in Australian schools

The NEPMT report, *Monitoring Progress towards the National Goals for Schooling: Information and Communication Technology (ICT) Skills and Knowledge*, released the findings concerning the scope of ICT use in Australian schools in 2000:

- 71 per cent of schools had a student-computer ratio of 15:1 or less and this ratio is decreasing each year.
- 37 per cent of the computers in schools were in laboratories and 31 per cent in classrooms.
- Laptop computers comprised 16 per cent of all computers used for educational purposes in schools - most of these in the non-government school sector.
- Secondary schools generally had lower student-computer ratios than primary schools.
- Secondary schools were more likely to place computers in laboratory settings and offer specific ICT courses rather than integrating their use in classrooms across the curriculum.
- Most computers used for educational purposes in Australian schools ran at 100MHz or faster and students had access to printers, modems, scanners, file servers and digital cameras.
- Common applications in schools included integrated packages, reference CDs, educational games and virus protection.

It is difficult to make an accurate estimate of current levels of student participation in the ICT learning area in Australian schools, because a great deal of the learning takes place in integrated settings.

In addition, some Australian students participate in studies that are specifically directed to the ICT learning area and there is evidence to suggest that the degree of such participation is increasing.

b) Longitudinal surveys of Australian youth

This research programme, jointly managed by the Australian Council for Educational Research (ACER) and the Commonwealth Department of Education, Science and Training, looks at subject choice in the final year of secondary school (Year 12 students aged 16-17 years) using a national, stratified sample of students who were in Year 9 in 1995 (aged 13-15 years).

One aspect of this study looks at enrolments in the eight key learning areas and at Computer Studies and related subjects within the Technology learning area. The overall growth in enrolments can be summarised by the findings that:

"The growth area from 1993 appears to be in the Technology Key Learning Area, accounting for almost one-fifth of enrolments (18 per cent) compared to just over one-tenth (11 per cent) of students in 1993.....Computer Studies was the subject in this area most frequently chosen by students"

c) **PISA: An international study of student outcomes**

The Organisation for Economic Co-operation and Development (OECD) Programme for International Student Assessment (PISA) aims to measure how well students nearing the end of their compulsory schooling are prepared for adult life. The assessment is forward-looking, focusing on students' ability to meet real-life challenges, rather than testing whether they have mastered a particular curriculum.

The first PISA survey was carried out in 2000 in 32 countries, with about 265,000 students doing the assessments. In Australia, 231 schools participated in PISA, with over 5,000 students doing the assessment. Some of the key findings of the survey were:

- Nearly 85 per cent of Australian students have access to computers at home almost every day compared to 63 per cent of their counterparts in other OECD countries.
- At the same time, there were 9 per cent of Australian students who never have access to computers at home, compared with 23 per cent of the OECD population.
- 43 per cent of Australia's students use a computer almost every day at home compared to the OECD average of 38 per cent.
- Just over 31 per cent of Australian students access the Internet almost every day, and a further 32 per cent access it a few times a week.

d) **Australian Bureau of Statistics Surveys on student access to computers and the internet at home**

The Australian Bureau of Statistics' publication, *Household Use of Information Technology* (May, 2001) conducted four quarterly surveys in 2000, which presented a picture on computer and access to the Internet in Australian homes different from the OECD's PISA study. It revealed:

- The proportion of Australian households with access to a computer at home has increased steadily from 45 per cent in 1998, to 48 per cent in 1999 and 53 per cent in 2000.
- The increase in the number of households with access to the Internet continues to rise strongly. In 2000, 33 per cent of Australian households had access to the Internet at home, up from 22 per cent in 1999 and 16 per cent in 1998.
- The growth in home Internet access is much higher than the growth in home computer access. For households with a home computer, the proportion which also had home Internet access was 63 per cent in 2000, up from 47 per cent in 1999 and 37 per cent in 1998. The proportion was expected to rise to 77 per cent in 2001.

3. *Manner of introduction of ICT in schools*

Development of on-line curriculum and resources. Australia's national action plan for schools, *Learning in an Online World*, includes as one of its key action areas: "Access to and application of online resources and services that support continuous improvement in curriculum practice, in classroom and distance settings, and in school administration."

The plan's framework for action set four goals:

1. A viable market will be established for the generation of quality online curriculum content for Australian school education.
2. All students will have access to quality digital education materials that support Australian school curricula and that optimise opportunities provided by new technologies for learning.
3. EdNA Online will support access by educators and students to high quality public domain online resources and services relevant to Australian curricula. EdNA Commercial will provide access to relevant commercial online products and services.
4. Schools and schooling systems will provide education services using efficient and effective online business practices.

The following section of this paper examines progress towards the achievement of these goals.

National Online Content Initiatives – Le@rning Federation: Schools Online Curriculum (www.thelearningfederation@edu.au) The Commonwealth, States and Territories are jointly funding this initiative, and preliminary work has accomplished:

- Developing standards for interoperability, intellectual property and educational soundness including accessibility;
- Devising quality assurance processes;
- Agreeing on curriculum priority areas for development of content during the years 2001 – 2006, including

Science P-6 & 9/10	(2001 – 2003)
Maths/Numeracy P-9	(2001 – 2003)
LOTE Chinese, Indonesian, Japanese	(2001 – 2006)
Australian Studies P-10	(2002 – 2006)
Innovation, Creativity & Enterprise P-10	(2002 – 2006)

The 2001-2006 Schools Online Curriculum Content Initiative will:

- Develop the information exchange system;
- Scope and develop online curriculum content;
- Continually refine the standards and the content development processes; and
- Develop an Australian education market place.

EdNA Online (<http://www.edna.edu.au/>). EdNA Online developed a gateway to digital resources and services that supports access by K-12 educators and students to high quality public domain online resources and services relevant to Australian curricula. This was achieved by building quality collections of material for education and training, including:

- 5,400 core quality online resources items and over 350,000 items linked to the core collection;
- Improved quality of metadata for customer focussed resource discovery;
- Online resources aggregated through a distributed management system;
- Conferlinks, a collation of resources supporting themes at conferences; and
- InfoLinks – a collation of resources supporting themes in publications.

Curriculum Corporation (www.curriculum.edu.au). The Ministerial Company, Curriculum Corporation, is a major Australian innovator in the development of ICT based resources for the K-12 sector. Most work has been undertaken within government-funded projects, although a number of private sector relationships have also been important.

Work completed covered a range of forms of digital delivery of resources, online support for teachers, and the conduct of market research and development of underpinning technology to support more flexible and effective resource production.

State and territory initiatives to support online learning. As well as the national initiatives described above, each of the States and Territories has made considerable progress in the development and use of online materials. Links below show some of these developments at the end of 2001.

<http://education.qld.gov.au/learningplace/html>

<http://education.qld.gov.au/learningplace/onlinelearning/schools/>

<http://education.qld.gov.au/staff/learning/courses/>

<http://education.qld.gov.au/curriculum/learning/courses/>

www.education.vic.gov.au

www.sofweb.vic.edu.au

<http://www.sofweb.vic.edu.au/catw/>

http://online.curriculum.edu.au/anr2000index.asp?pg=ch10_case7.htm

<http://www.tsof.edu.au/lt.sa/>

http://www.asptrial.e2c.wa.edu.au/about_e2c/about_e2c.html

4. Teacher professional development

New technologies are already being used extensively by Australia's teachers. In a report commissioned by the Curriculum Corporation, researchers investigated how Australian primary and secondary school teachers were identifying, storing, using, reusing and sharing online and offline resources and how they anticipated the new media would impact on teaching and learning.

The study found that 73 per cent of the teachers surveyed described themselves as quite confident at using a computer or having advanced or high level skills and only 2 per cent described themselves as beginners. 83 per cent of the teachers indicated that they had been using computer-based curriculum resources with their students for a period of 1-10 years and 42 per cent had been using them in their classrooms for longer than five years.

Quality Teacher Programme (QTP). In the 1999 Federal Budget, the Government announced it would provide \$77.7 million over three years to States and Territories to strengthen the skills of the teaching profession under what is known as the Quality Teacher Programme (QTP). Information technology is one of six priority areas of the QTP. Reports from States and Territories in August 2001, indicated that about

25 per cent of participants in the QTP had undertaken professional development in information technology. This is one of the largest areas of participation across the six priority areas.

Teacher professional development models for the integration of ICT. The first phase of this Commonwealth funded project was completed in 2001. It involved a detailed examination of existing models of pre-service education and in-service professional development, both in Australia and overseas. Planning also began on the second phase, focusing on developing effective collaborative mechanisms to facilitate collegiality and the sharing of information through the use of online networks. The outcomes of this project will inform future government decisions about the development and resourcing of professional development programmes in ICT.

ICT competency standards for teachers. Work commenced on this project in 2001 to examine ways in which different Australian school systems are using criteria, standards and benchmarks for beginning and existing teachers to underpin effective use of ICT in curriculum practice. The ICT requirements included in teacher education courses were also reviewed. The aim is to develop a framework for describing teacher competency standards that can be used to inform the work of teacher education faculties and education authorities.

5. Connectivity – IT systems, software and hardware

One of the key areas identified in the national action plan for Australian schools, *Learning in an Online World*, is that of infrastructure where the goal is to provide:

“Access to an advanced information and communication technology infrastructure that supports good teaching and learning and delivers efficiencies in business practice.”

Bandwidth. The national action plan for Australian schools, *Learning in an Online World*, identifies a need to ensure bandwidth for school education that is:

- Commensurate with the current and emerging needs of schools;
- Accessible from all parts of Australia, both urban and rural;
- Available at a cost that enables schools to participate in and contribute to the information economy.

6. Measuring student outcomes

To measure the impact of ICT on student performance, MCEETYA endorsed a *Measurement Framework for National Key Performance*

Measures as the basis for reporting on progress toward the achievement of the *National Goals for Schooling*. It will conduct a national monitoring of ICT skills and knowledge of students in Year 6 (aged 10-12 years) and Year 10 (aged 14-16 years) by means of three-yearly sample assessments, commencing in 2005.

Key Performance Measure (KPM) is defined, in the Australian context of national reporting, as that which “*quantifies a dimension of student participation or achievement and enables progress to be monitored against National Goals*”. The principles underpinning the development and use of KPMs are:

- Student outcomes information is the focus of the reporting agenda;
- Performance measures should take account of State and Territory curriculum and assessment frameworks;
- Assessment techniques should be innovative and model good assessment practice, and wherever possible, assessment materials developed for national sample assessments should be available for use by systems and schools;
- Collection and use of data for national purposes will in all respects conform to the guidelines provided in the report *Data Principles and Protocols* agreed by the Performance Measurement and Reporting Taskforce (PMRT);
- Access to data collections will be available to interested parties subject to privacy and confidentiality provision (as specified in *Data Principles and Protocols*);
- Where performance in different years in a particular domain is the focus of measurement, a single domain scale should underpin the measurement of student achievement; and
- The key performance measures should enable the range of student achievement to be reported.

As a result of these Ministerial decisions, the PMRT is addressing the challenge of developing key performance measures for reporting on student ICT outcomes on a nationally comparable basis. It is anticipated that this work will involve:

- Defining content domain;
- Developing a scale of competence; and
- Developing assessment methods that include a mix of tests on paper and on-line, and teacher performance assessment tasks.

To progress this work, some of the challenges that lie ahead include:

- Reaching agreement that the focus should be on student skills and knowledge outcomes data and not access and attitudes, at least in the initial trial stage;
- Defining the domain to be assessed in Year 6 and Year 10;
- Defining standards, based on the achievement scale, in terms of what students typically know and can do;
- Trialling a range of assessment instruments, including online delivery; and
- Conducting a trial in a sample of schools across states and territories and across the different school sectors and including schools known to experience variations in access to ICT.

7. Issues and challenges and how they are to be addressed – evidence of uneven distribution of access

The Foundation for Young Australians, in partnership with the International Youth Foundation and the Lucent Technologies Foundation, investigated the issue of public access to the Internet for disadvantaged groups of young people in Australia. Their findings suggest that there is significant inequity in the way access is distributed across the population.

The UNESCO IITE Project: Development and use of indicators of ICT in education for the Baltic and CIS countries

by Dr Boris Kotsik, Senior Programme Manager, UNESCO IITE

Dr Kotsik's report presented the highlights of the researches conducted by the UNESCO Institute for Information Technologies in Education (IITE) in the Baltic countries and Commonwealth of Independent States from 1999 to 2002. His presentation outlined the process of conceptualisation, design, implementation, monitoring and evaluation of these projects.

Indicators of ICT usage in secondary education: UNESCO IITE project for Baltic and CIS states

The creation of knowledge societies depends on the joint process of knowledge usage and the way the educational systems and institutions master the known and upgraded methods of generating, analyzing and spreading of knowledge and information. This poses the challenges related to adaptation and renewal of the system of education to be continuously monitored and to be reported about in the view of the state of education in the world.

Reaching these objectives implies:

- » Use of information and communication technologies, national, sub-regional and regional potential in the fields of policy, planning and simulation, budget formation, education programme cost evaluation;
- » Acquisition, analysis and dissemination of upgraded data and statistical information on educational status-quo in the states participating in the project attracting various data sources and specialized investigations, which add to the systems of regular data collection;
- » Circulation of scientific and research results, information on the effective policy, innovations and experiences, and securing access to such data.

General description

The project sought to acquire and process data on ICT usage in education in the sub-regional level. The project also evaluated main trends and knots, and presented recommendations.

Objective

The project was conducted for the purpose of strengthening ICT application potential for national education capacity-building.

Result

The research findings were submitted to UNESCO Member States to assist them in the elaboration of national action plans for ICT application in education development.

Data gathering

The statistical data was studied and collected in two stages. At the first stage of the IITE preliminary developments, the questionnaire was compiled and expertise was made by foreign specialists with the subsequent changes, which considered the experts' recommendations.

On the basis of the official letters, the ministers of education of the Baltic and CIS states appointed specialists responsible for submission of data on indicators for the project.

The UNESCO Institute for Information Technologies in Education was founded in 1998 to conduct studies on the impact of ICT in education. In 1999-2000, the IITE participated in the G-8 states *Orbit 2000* report. In March 2000 the Institute organised and held the International Expert Meeting on *ICT indicators in education*. In 2001, IITE conducted in 2001 a statistical study on information and communication technologies in secondary education of the Baltic and CIS states. This work is the next in the series of IITE programme activities on *ICT in Education: State-of-the-Art, Needs and Perspectives* and presents an intermediate result of the Institute undertakings in this field during 1999-2000.

The research work on ICT in Education in the Baltic and CIS states started in September 2000. The timeline of related activities was:

- | | |
|------------|--|
| 1999 | • Provision of data on Russian Federation for Orbit - 2000 Report |
| 2000 | • Initiating publication in IITE Newsletter #3, 2000 (http://www.iite.ru/img/upload/indic.doc) |
| March 2001 | • International Expert Meeting <i>ICT in Education: State-of-the Art, Needs and Perspectives – Indicators and Information System</i> |
| June 2001 | • Publication of the proceedings of the Experts' Meeting in IITE Newsletter #2'2001 |

History of the IITE project for Baltic and CIS states

Details of the UNESCO IITE project for Baltic and CIS states

- October 2001 • Publication of the Final Report of the Expert Meeting
- Launching of a sub-regional project for Baltic and CIS States
- April 2002 • Finalisation of the results of sub-regional project
- Sub-regional project proposals for South East Europe
- May 2002 • National project proposals for Russian Federation
- June 2002 • Dissemination of the results of sub-regional project
- July 2002 • National pilot project proposals for Belarus

1. *Components*

- Questionnaire development
- Questionnaire expertise and amendment
- Establishment contacts with ministers of education
- Appointment of data provision experts
- Conducting a workshop on data provision
- Data collection and assessment
- Data precision and primary processing
- Data secondary precision and processing
- Statistical report composition and dissemination

2. *Data structure*

The questionnaire was based, as in similar studies and as recommended by IITE-held international expert meeting on the most relevant indicators reflecting the main factors which determine the efficiency of ICT usage in education. The six indicator groups are:

1. Official Documents on ICT usage in education	<ul style="list-style-type: none"> • Official documents in ICT in secondary education valid till 2002 • Official documents in ICT in secondary education currently in force
2. ICT in Educational Institutions' (EI) Curricula	<ul style="list-style-type: none"> • Available state curriculum on Informatics and/or ICT • Informatics and/or ICT as a separate subject • ICT usage to support other subjects implied in curricula on these subjects
3. Hardware and Equipment	<ul style="list-style-type: none"> • Computer classrooms availability in EI • The average number of students per one computer in EI equipped with computer classrooms • Percentage of IBM- and Apple-compatible computers in total number of EI computers • Percentage of EI equipped with one or more multimedia system in total EI equipped with computer classrooms number • Percentage of EI equipped with local network to total EI equipped with computer classrooms number
4. Software	<ul style="list-style-type: none"> • Percentage of computers with installed OS DOS™ to total number of computers in computer classes • Percentage of computers with OS Windows™ or Apple Macintosh to total computer number in computer classes • Percent of computers with other OS to total computer number in computer classes • Percentage of EI with any educational software for teaching the corresponding subjects to total EI number with computer classes: <ul style="list-style-type: none"> ▶ Elementary school subjects ▶ Science subjects ▶ Humanities ▶ Informatics or ICT • Percentage of educational software designed by the specialists within the country to total number of educational software used in EI for teaching of the corresponding subject curriculum (elementary school, science subjects, humanities, informatics/information technologies) • Percentage of educational software designed by foreign specialists to total number of educational software used in EI for teaching of the corresponding curriculum (elementary school, science subjects, humanities, informatics/information technologies)
5. Global communication means	<ul style="list-style-type: none"> • Percentage of EI without Internet access • Percentage of EI with limited Internet access – only e-mail • Percentage of EI with access via dial-up channel • Percentage of EI with access via dedicated line • Percentage of EI with own web-pages
6. Personnel	<ul style="list-style-type: none"> • Percentage of elementary school teachers, subject teachers (except teachers of Informatics and/or Information Technologies), teachers of Informatics and EI administration who have undertaken the computer literacy course from 1 September 1999 until present time <ul style="list-style-type: none"> ▶ Less than 50 hours (index 1) ▶ 50-100 hours (index 2) ▶ Over 100 hours (index 3) • Computer skills of elementary school teachers, subject teachers and teachers of Informatics and administration <ul style="list-style-type: none"> ▶ Elementary computer literacy ▶ Proficiency in ICT field

3. *Data processing and presentation*

The data was collected by questionnaire in MSWord format, transformed to the MS Excel table, processed according to appropriate formulas and presented in diagrams (the process is described in the Statistical Report).

4. *Dissemination of the results*

The survey results were published as a Statistical Report and disseminated through:

- The net of Focal Points for the cooperation with IITE
- National Commissions for UNESCO
- UNESCO Field Offices
- Educational institutions and organizations
- Series of workshops and consultative meetings in the framework of sub-regional projects, i.e.:
 - a) Consultative workshop for Developing Performance Indicators for ICT in Education, Quezon City, the Philippines, 28-30 August 2002.
 - b) Capacity building of Human Resources: ICT for Education Capacity-Building towards the Construction of a Knowledge Society – project proposals in wake of the *High-Level Conference on Strengthening Cooperation in Southeast Europe*.

Experiences for consideration

The paper presents a unique practice of the specialized comparative research of the state-of-the-art of education in the Baltic and CIS region as well as the comprehensive study of the ICT usage in education. The following can be mentioned as the results of the accomplished work and the collected data analysis:

- ▶ Activity of all the project participants and their interest in the data collection;
- ▶ Lack of elaborated organizational tools of such data acquisition, difficulty in obtaining the homogenous and reliable data, absence of data validation;
- ▶ Considerable scattering of national, geographical, historical, social and economic features of the processes under study, high diversity in different data categories, the complexity of comparative data analysis;

- » Necessity of thorough elaboration of the indicator model, relative data set and appropriate means of data obtaining, processing, presenting, keeping and disseminating as well as timely development of automated tools for these procedures;
- » Need to organize a systematic continuous research to gain the information on the dynamics of the studied processes.

Based on the results of the work the following can be recommended to education policy– and decision-makers in the states participating in the project:

- » To use the materials of the statistic report in shaping national programmes of ICT development in education;
- » To conduct the similar research at the local level to formulate national and local programmes of education development;
- » To consider the recommendations on each indicator when identifying the priorities and choosing the most efficient trends in education development;
- » To disseminate the best practices of the most effective development of certain factors of the ICT usage in education based on the research results.

Major consideration must be directed to the following experiences confronted during the course of the research:

- » The project was under the Council of Ministers of Education of CIS States, and covered the post-Soviet Union territory where about three generations of communist rule had institutionalised a rather strict and centralized system of educational governance; similar structures of education systems, goals, knowledge standards, and teacher training programmes; and prevailing of Russian language prevailing as the main means of communication. Thus many tasks for this project were simplified, though levels of education development of the countries still varied significantly.
- » The project was positioned as a regular activity of National Ministries of Education so data acquisition required no additional budgeting but only a managerial support of National Ministries of Education. Data was gathered by staff members of National Ministries for Education (i.e. heads of departments, senior specialists, staff of national Centres of Informational Technologies in Education or Centres of Teacher Training, Retraining and Educational Support). Data gathering was facilitated by official letters from the Ministries, thus, the obtained data acquired the status of official information.

**Key
considerations
affecting
research
outcomes**

The questionnaires of the *Indicators of ICT Usage in Secondary Education of the Baltic and CIS States* survey were faxed and e-mailed to the addresses given by the Ministries.

A meeting was held on 23 November 2001 in Moscow to discuss the features and details of the information collected, and the unification and simplification methods of data collection. The meeting was attended by representatives of participating ministries of education, international experts (who analyzed the questionnaire), data gathering experts, IITE hosts and managers. The methods of data collection, extrapolation and analysis for the project were debated during the meeting.

- » In discussion of the most appropriate methods of gathering different kinds of data, distinction was made between direct information (national policy documents, curricula), statistical data collected from different sources (amount of hardware), expert estimates (computers age and types, educational software availability, levels of teachers computer confidence), indirect data gathered from various sources (Internet access, number of teachers retrained in computer literacy). Special attention was paid to the necessity of defining exact and inexact data, what are mean and middle values, the difference between statistical data and expert estimates. In the last case an averaged result should be used of values obtained from several experts.

Recommendations were made for the project to include data on ICT application in education in regular national statistics collected by Ministries, to correlate the data with the results of direct sociological surveys and information obtained by independent sources. Concerns were expressed that since data collection was facilitated by high-ranking government officials, some of these data may be incorrect as data results may have been adjusted by the data gatherers to impress these authorities.

Since this research used data obtained from independent sources, the Institute had to work with figures that are contradictory to official statistics. This raised the concern that the financial and managerial support of the project should be independent from national governance.

In this case the overall status of the project and utilization of its results are different and this approach does not well accord with the main principles of IITE project development based on the needs of the UNESCO Member States.

At the second stage of the project, during the collation of collected data, latent uncertainties were revealed as data from different areas were in forms that are not compatible with other areas. To reconcile these differences, the project specialists had to restructure the initial data three or four times. As a result, recommendations were prepared to modify the content of the questionnaire and the method of its filling-out.

- ▶ The above mentioned 'latent uncertainties' were due partly to the data gatherers' not following the instructions, and partly to ambiguities in the definition of indicators, data gathering methods, and the processing of data.

Some uncertainties were evident at the start of the research and were discussed in the November 2001 meeting in Moscow, but these were not addressed by the experts. Among the ambiguities encountered:

- In their calculations, some of the experts mistakenly considered total number as a simple average of numbers for urban and rural schools, while the result depends on the ratio of rural/urban schools,
 - The experts' calculation of the student-computer ratio was taken as the ratio of total number of students in the country to total number of computers in schools (500 to 1000 students per computer unit), and this was used as basis for concluding that, on average, a school of 500 pupils in the country has one-half to one computer unit. The experts did not consider that the student-computer ratio was intended as a measure of didactic usability of computers in schools, relative not to total number of students in the country but only those schools with computer classrooms.
- ▶ It remained unclear in the frame of this Survey how to separate data for elementary and secondary schools in case these schools comprise a single educational institution, so the Survey referred to secondary education consisting of elementary, basic and secondary stages.

It should be more clearly defined in the questionnaire and indicator description how to deal with the cases when one and the same school has both dial-up and dedicated channel access to Internet, or when the same teacher has attended 100-hours computer courses consisting of four 25-hour modules.

During the data precision and processing, some indicators were excluded from the survey data analysis and/or from visual

presentation because of their very small values and large amount of missing data. The excluded indicators numbered 13 out of the total 27.

In further attempts to combine an aggregated index and to compose an integral model on the base of indicator data, most difficult task was to deal with cases of missing data. A special mechanism should be created to avoid these problems in future.

Recommendations for further studies

Recommendations of this research included guidelines for future studies:

- » An **updated indicator system** for the next step sub-regional project Indicators of *ICT usage in secondary education in Baltic and CIS States*;
- » An **indicator system for the national pilot projects** for Belarus and Russian Federation;
- » An **aggregated indicator model** for overall evaluation of ICT usage in education;
- » A **model for integration** of indicator model with overall socio-economic data and education evaluation information;
- » **Indicator models for different education levels, forms and domains** – pre-primary, primary, higher, vocational, supplementary, education for people with special needs;
- » Requirements, structure and implementation of **information system** for automated indicator model data collection, processing, storage, presentation and dissemination;
- » **Position paper** on ICT Integration in Education for **policy- and decision makers** of the UNESCO Member States;
- » **Instruction materials and training courses** on ICT Integration in Education for policy- and decision makers of the UNESCO Member States;
- » An updated indicator system for the next step sub-regional project Indicators of ICT usage in secondary education in Baltic and CIS States.

Issues to be reflected on for IS composition

- » Target *audience* (countries, languages, professional groups, level of computer competence)
- » IS *purpose* (information, inventory, monitoring, research, decision-making, complex)
- » *Scale* (*global*, regional, national, local)

- » GIS data *type* if any (vector, raster, combined, 3D)
- » Data *storage*, updating and administering (periods, type of access)
 - Data processing, modeling and analysis
 - Data control, visualization and output
 - Database features (type, volume, functions, number of users)
 - Distributed access features
 - Data acquisition (web-forms, spreadsheets, text-forms, blanks, DBMS applications)

The Development and Use of Indicators to Measure the Impact of ICT Use in Education in the United Kingdom and other European Countries

by Mr Mike Aston, Consultant, UNESCO IITE

Mr Aston's report provided a historical summary of the conduct of impact studies of ICT on education in the United Kingdom and Western European countries. He touched on the measures and indicators that evolved, current practices being used, and were used in the recent years, as well as specific experiences faced by European nations in the conduct of these studies. He also presented "a more sophisticated model for describing the nature of ICT impact at a national level."

The history of measuring ICT impact

The history of collecting meaningful data about the use of IT (ICT) in schools is relatively short. Microcomputers have been used in schools since 1979. The first survey carried out by the Department of Education and Science (DES) in the UK was in March 1990, the results being published as a Statistical Bulletin in June 1991.

There is no mention of communications other than a note to say that modems were in use in several secondary schools for access to the national viewdata system (Prestel) and mainframe computers. The number of CD-ROM drives was noted as being on average of one for every ten secondary schools.

In 1989, Tim Berners-Lee, a scientist at the European Laboratory for Particle Physics in Geneva, had proposed the World Wide Web project. In 1992, the World Wide Web became accessible to the public and in the spring of 1993, a group of graduate students at the University of Illinois computer laboratories, led by 21-year-old Marc Andreessen, created a "browser" program called Mosaic, and distributed it free. Netscape and then Microsoft followed with browsers that greatly simplified a computer user's ability to search the Internet in search of information.

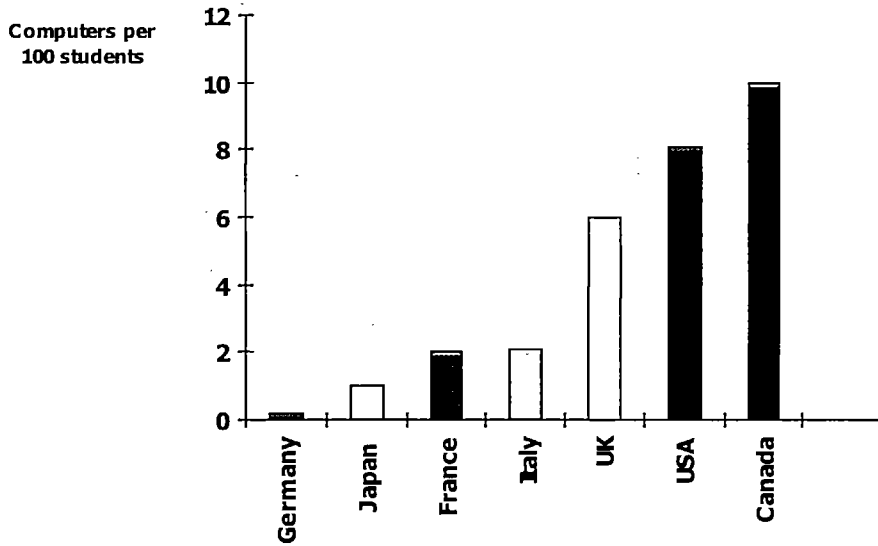
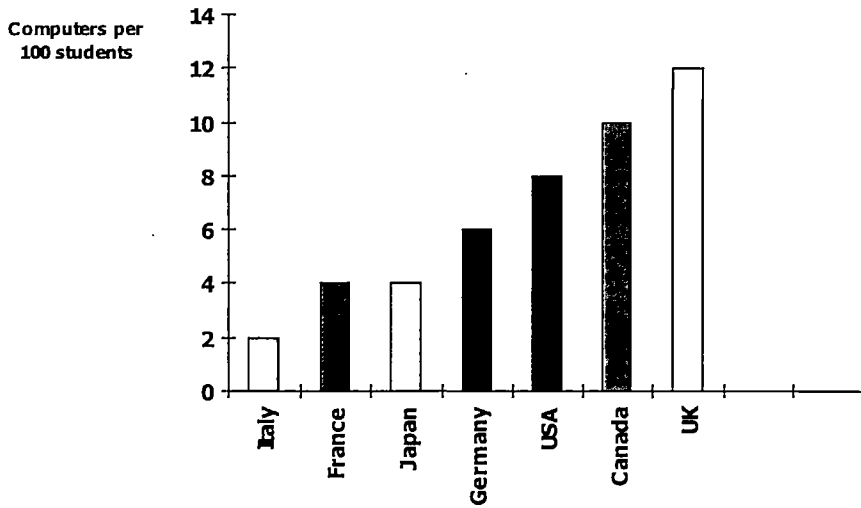
By 1999 there were 150 million users on the Internet with over 800 million web pages accessible to anyone in the world with the necessary equipment and communications facility. By August 2001, the number of Internet users worldwide had risen to 513 million.

From 1991 to 1999, ICT in schools expanded rapidly in the developed nations through curriculum change, networking, the professional development of teachers and software improvements. Some nations in development also began 'ICT in schools' programmes, notably Chile, Costa Rica, India, Mauritius and Pakistan. During this period, the UK Ministry continued to measure ICT resources in school and other nations started to follow suite with the Netherlands and Japan in the lead.

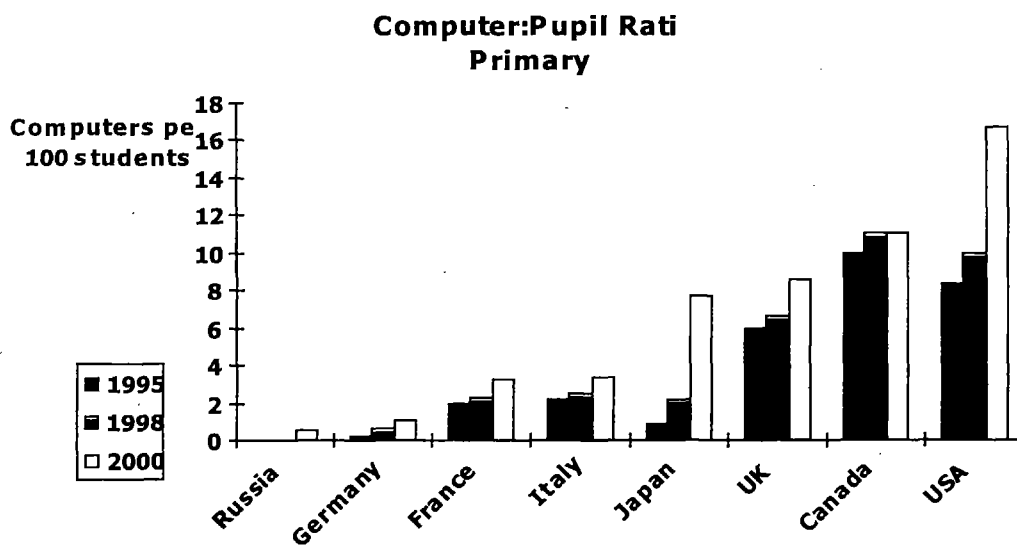
In 1996, a major provider of ICT resources to schools in the UK, Research Machines PLC, commissioned The Advisory Unit: Computers in Education based in Hatfield, UK, to carry out a comparative study of ICT in schools in the G7 nations (Canada, France, Germany, Italy, Japan, United Kingdom and the USA). The study concentrated on collecting quantitative data with methods used including interviews (face-to-face and over the telephone), questionnaires, local and national government statistical reports, ministerial documents and personal contacts. For example, in Japan, the following institutions were contacted for data:

- » National Ministry of Education (MONBUSHO)
- » Government National Computing Commission
- » The National Teacher Training University
- » Hardware manufacturers
- » Educational Software publishers
- » Teacher Training Institutions
- » Universities

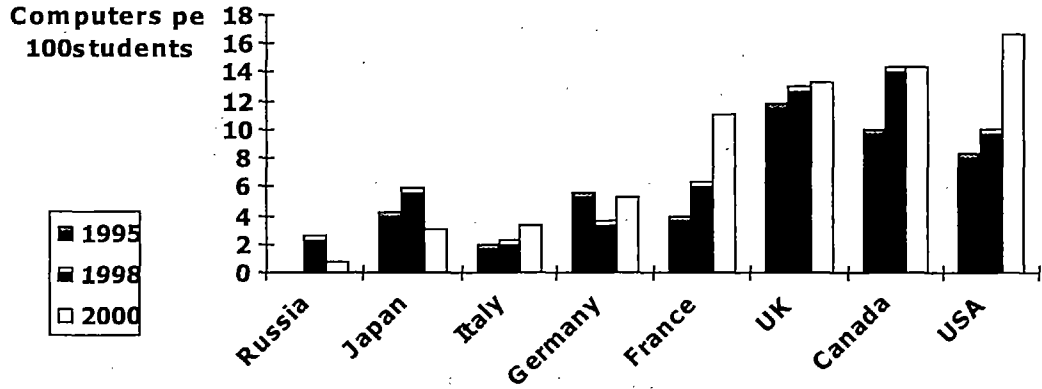
The first comparative results from the first G7 Report were of significant interest, for example:

PUPIL: COMPUTER RATIOS (PRIMARY SCHOOLS)**PUPIL: COMPUTER RATIOS (SECONDARY SCHOOLS)**

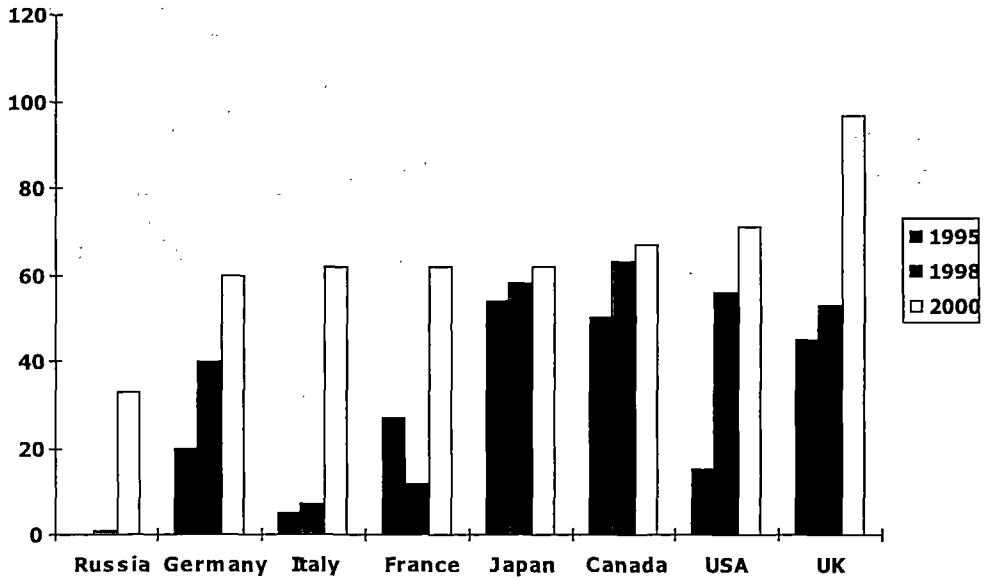
Measuring the impact of ICT on school education systems was certainly not an exact science, as quantitative data often was 'guesstimated' or extrapolated from various sources with widely differing responses. Sometimes, official figures were clearly inflated in referring to figures obtained from end-users. Simple problems of defining a computer or the concept of 'obsolescence' in different mother tongues led to difficulties in obtaining accurate data. The biggest problem to overcome was that of timing: the study took more than three months to carry out, which was against the background of rapidly changing attitudes to ICT in education and technological advances - between them creating a moving set of targets. In many ways, the qualitative data collected on ICT in the curriculum and teachers' take-up of the technology and software in teaching gave a more accurate picture of where a nation progressed. The RM G7 Report became known as the *Orbit Report* and was repeated in 1998 and 2000, allowing year-on-year comparisons among nations.



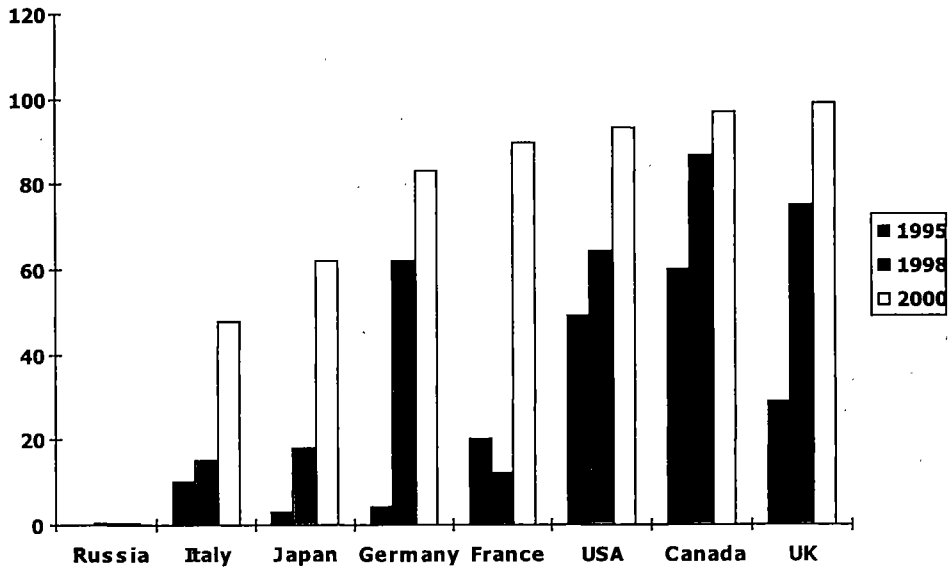
**Computer:Pupil Rati
Secondary**



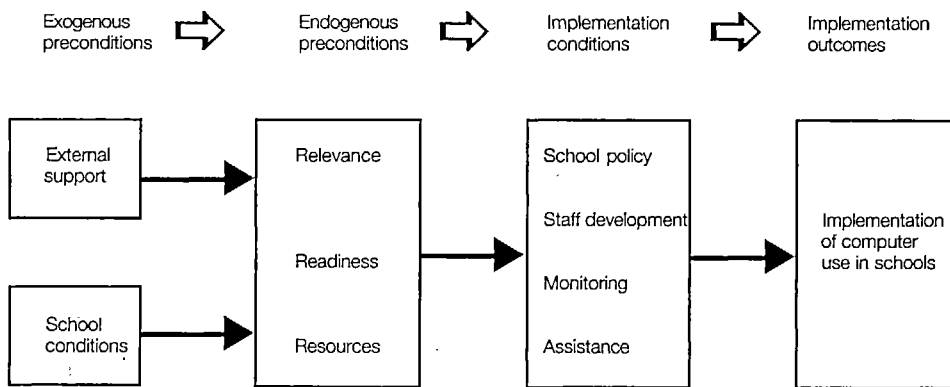
**Percentage of Schools with Local Area Netw
Secondary**



**Percentage of Schools with Access to Wide Area Net
Secondary**



From 1991, Tjeerd Plomp and Willem J Pelgrum at the Faculty of Educational Science & Technology, University of Twente in the Netherlands conducted studies on behalf of the International Association for the Evaluation of Educational Achievement (IEA) and the Organisation for Economic Co-operation and Development (OECD). The data was collected in various countries (the UK, Italy and most of Canada, for some reason did not contribute) by staff from National Project Centres, many of whom clearly did not have a background in ICT in education. Nevertheless, the studies tackled such issues as 'Educating the Educators' and 'Structural Models of Implementation Indicators'. In the IEA publication of 1993, the following diagram below appears in a chapter on predicting computer use:



Further on, the study lists key indicators and notes on their measurement:

- » School size
- » External financial support
- » External training support
- » Previous innovation experience
- » Availability and resource needs
- » Perceived innovation relevance
- » School policy for computer use
- » Internal staff development
- » Internal innovation assistance
- » Teacher competence and readiness
- » Monitoring and problem coping strategy
- » Implementation outcome

These earlier studies failed to predict the growth of local and wide area networking in schools but were extremely rigorous in their statistical analysis.

The last study of note was carried out by the Directorate-General for Education and Culture in the European Commission 2000/2001 that resulted in two documents being published, namely 'ICT@Europe.edu' and 'Basic Indicators on the Incorporation of ICT into European Education Systems – Facts and figures 2000/01 Annual Report'. The first booklet is entirely qualitative and covers the member states of the EU (15), EFTA/EEA (3) and the pre-accession countries (12). For each country, the report describes:

- » Aims and strategies
- » Public/private partnerships
- » Sharing of responsibilities
- » Major initiatives implemented

The second document is largely quantitative, using bar charts or shaded maps of Europe to illustrate comparisons between nations on the National Policy and Basic indicators as listed below.

1. Education levels covered by official documents on the use of ICT. Primary, secondary and higher education (in force during 2000/01).
2. National or official bodies with a remit for supervision and/or promotion of national policy for ICT in education, 2000/01.
3. Implementation schedule for typical ICT projects. Primary and secondary education 1995-2010.
4. Objectives in ICT. Primary education. Projects under way in 2000/01.
5. Objectives in ICT. Secondary education. Projects under way in 2000/01.

National policy descriptors

6. Number of pupils per computer, and number of pupils per computer with an Internet connection. Primary education, 2001.
7. Number of pupils per computer, and number of pupils per computer with an Internet connection. Secondary education, 2001.
8. Responsibility for the purchase and maintenance of hardware. Primary and secondary education. Projects under way in 2000/01.
9. Distribution of the specific budget between the purchase of equipment and expenditure on human resources. Primary education. Projects under way in 2000/01.
10. Distribution of the specific budget between the purchase of equipment and expenditure on human resources. General lower secondary education. Projects under way in 2000/01.
11. Distribution of the specific budget between the purchase of equipment and expenditure on human resources. General upper secondary education. Projects under way in 2000/01.
12. Inclusion of ICT in the curriculum. Primary education 2000/01.
13. Percentage of teachers who use computers and/or the Internet in the classroom. Primary education 2001.
14. Average periods during which primary schoolteachers use computers (with or without Internet connections) in the classroom, in hours per week, 2001.
15. Approaches to ICT defined in the curriculum. Primary education 2000/01.
16. Objectives defined in the curriculum for the teaching or the use of ICT. Primary education, 2000/01.

Basic indicators

17. Inclusion of ICT in the curriculum. General secondary education 2000/01.
18. Percentage of teachers who use computers and/or the Internet in the classroom. Secondary education 2001.
19. Reasons given for not using the Internet with pupils. Secondary education 2001.
20. Approaches to ICT defined in the curriculum. General lower secondary education 2000/01.
21. Annual number of hours recommended for teaching ICT as a subject in its own right. General lower secondary education 2000/01.
22. Objectives defined in the curriculum for the teaching or the use of ICT. General lower secondary 2000/01.
23. Approaches to ICT defined in the curriculum. General upper secondary education 2000/01.
24. Objectives defined in the curriculum for the teaching or the use of ICT. General upper secondary education 2000/01.
25. Specialist ICT teachers. Primary and secondary education 2000/01.
26. Inclusion of ICT in the initial training of all teachers (except specialist ICT teachers). Primary education, 2000/01.
27. Inclusion of ICT in the initial training of all teachers (except specialist ICT teachers). Lower secondary education 2000/01.
28. Inclusion of ICT in the initial training of all teachers (except specialist ICT teachers). General upper secondary education 2000/01.
29. Percentage share of compulsory teaching related to ICT and the number of hours devoted to such teaching, in the initial training of all teachers (except specialist ICT teachers). Lower secondary level 2000/01.
30. Desirable ICT skills according to official recommendations for the initial training of all teachers (except specialist ICT teachers). Lower secondary education 2000/01.
31. Percentages of primary schoolteachers and secondary schoolteachers who have received official training in the use of computers and/or the Internet in their teaching, 2001.
32. Percentages of primary schoolteachers and secondary schoolteachers in the EU who have received official training in the use of computers and/or the Internet in their teaching, 2001.

This range of indicators offers a comprehensive picture of the incorporation of ICT into European Education Systems but is not judgmental in any way. There are a number of blanks (presumably not known) in the data sets and problems of aggregating data for countries like Germany (with 17 distinctive education systems), Spain (with 17 autonomous regions) and the UK (with 4 countries) results in extensive footnotes to the tables and maps.

The three fundamental questions:

- » Who is the information for?
- » Why collect it?
- » Who will be given access to the data?

Also to be considered:

- » Accuracy of data?
- » Interpretation of terminology? Estimates v Guesstimates
- » Differences in educational systems
- » Academic v Technical education
- » Teacher competence – how do we measure?
- » Skills v application
- » Machine functionality, age
- » Networking, access, software
- » Comparisons over time

The UNESCO Institute of Information Technology in Education (IITE) situated in Moscow has initiated a major project to determine ways of measuring ICT impact on national education systems using a series of indicators. An Expert Meeting was held in Moscow during March 2001 with representatives from such widely dispersed countries as Namibia, Pakistan and the state of Brandenburg (Germany). It was agreed to test a set of indicators with a number of countries in the Commonwealth of Independent States (CIS), formerly part of the USSR.

The IITE also initiated a pilot seminar held in Moscow for High Level Decision-Makers in ICT Educational Policy during 2001. Nineteen states (mainly from the CIS) were represented and as part of the development of materials for the seminar two indicator matrices were created. The first, subsequently become known as Morel's Matrix, after Professor Raymond Morel from Switzerland, one of the tutors on the seminar.

**Some Issues
raised by the
various studies
published
so far:**

**The current
scenario**

This, in essence, presents four levels of development, namely Emerging, Applying, Integrating and Transforming. The theory is that a nation's ICT development in its education system can be mapped onto the matrix and can be described in general terms such as 'the majority of the criteria have reached the *Applying* phase but with X still *Emerging* and Y already *Integrating*.

Applied "Morel's Matrix"

Criteria/Phase	Emerging	Applying	Integrating	Transforming
Context				
Pedagogy				
Vision				
Coverage of ICT Strategy				
Curriculum				
Resources				
Staff development				
Quality assurance				

The second matrix, attributed to Matti Sinko (Finland) and Mike Aston (UK), also tutors on the seminar in Moscow, focuses on National Priorities in the Short (2 years) and Long (3-5 years) terms. The two time periods are further divided into Producing and Updating/Revising phases. The matrix is completed by the National or Regional ICT in Education Strategy leaders or Policy makers and the following areas are covered in the matrix:

General	Curriculum and pedagogical development
Rationale and aims	ICT as a subject
Objectives	ICT across the curriculum
Methods of implementation	Vocational ICT training
Funding plan	
Quality assurance and evaluation, indicators	Software
Focus on primary phase	Generic software tools
Focus on secondary phase	Subject specific software and digital materials
Focus on tertiary phase	Localising, versioning, licensing
Focus on adult education	Production, delivery, updating and use
	Support
Special needs	<ul style="list-style-type: none"> • Technical • Pedagogical • Media design
Capacity building	
<ul style="list-style-type: none"> • pre-service teacher education • staff development 	Technical infrastructure
	Hardware
	Local-area networks
	Wide-area networks (internet)
Management	Student assessment
<ul style="list-style-type: none"> • national level • local level • institutional level 	Other, please specify
Quality assurance, inspection	
Research	

There is a clear need to collect both quantitative and qualitative data on ICT development in different nations and be able to present it in a reasonable concise manner. A combination of the EU data presentation, the IITE questionnaire, Morel's matrix and the Aston/Sinko matrix would provide a comprehensive set of indicators. The next stage is to synthesise the data collection methods and start the process.

Almost every country/region is embarked on a process of significant change in school education as a result of the all-pervasive nature of ICT. The advent of the Internet offers a mechanism for nations and regions to avoid re-invention, to learn from each other and to relate to different circumstances and economic resourcing. UNESCO is a strong contender to act as a clearing-house for this level of dynamic information.

Proposed model for the future

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ICTs in Education: State-of-the-Art, Needs and Perspectives – Indicators and Information Systems UNESCO IITE Moscow 2001.

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5

Proposed Set of Indicators

- **Standards/Parameters for the development of ICT indicators**
- **Indicators for policy, technological infrastructure and access**
- **Situating indicators based on level of ICT development**

The proposed draft set of indicators and parameters or guidelines below were developed by the participants and resource persons based on their group discussions during the last two days of the Consultative Workshop.¹

1. Definition of Information and Communications Technology (ICT)
– ICT is the term used to describe the tools and the processes to access, retrieve, store, organise, manipulate, produce, present and exchange information by electronic and other automated means.²
2. Scope of education to be covered by ICT indicators – primary, secondary, and non-formal education
3. Criteria for developing and assessing ICT indicators (see p. 76)
4. Performance indicator categories – Based on the preliminary discussion by the four workshop resource persons, an examination or review of existing indicators used in many countries worldwide, the following categories of performance indicators were adopted:
 - » Policy;
 - » Technology infrastructure and access;
 - » ICT curriculum;
 - » Teaching and teaching support staff; and
 - » Learning process and outcomes

1. The participants were divided into two groups:

Group 1: Indicator categories discussed: ICT curriculum, teaching and support staff, and learning process and outcomes.

Composition: India, Indonesia, Thailand, Uzbekistan.

Chair: Dr Boris Kotsik

Rapporteur: Dr Michelle Bruniges

Group 2: Indicator categories discussed: policy, technology infrastructure and access (enabling environment, internet connectivity, speed/bandwidth, systems and hardware).

Composition: Malaysia, the Philippines, South Korea, Viet Nam,

Chair: Mike Aston

Rapporteur: Mr Jerrold Huguet

2. These include hardware, software and telecommunications in the forms of personal computers, scanners, digital cameras, phones, faxes, modems, CD and DVD players and recorders, digitised video, radio and TV programmes like database programmes and multimedia programmes.

Criteria for developing and assessing ICT indicators

Criterion	Description
Direct measure	<ul style="list-style-type: none"> Indicator is intuitively understood (high face validity) Indicator is a direct measurement, rather than a proxy that depends on assumptions for its validity Indicator is supported by a body of research
Objective	<ul style="list-style-type: none"> Indicator is unambiguous about what is being measured Different people will collect comparable data based on the indicator Definition remains stable over time, so change can be measured Indicator is unidimensional (measures only one thing) Indicator can be quantitative or qualitative, as long as it is clearly and consistently defined and interpreted
Adequate	<ul style="list-style-type: none"> Either by itself or with a minimal companion set of indicators, the indicator provides reasonable confidence that it accurately measures the attribute Object is to have as few indicators as possible per attribute (should be three or fewer) — more is not necessarily better Number of indicators will depend on the complexity of the object, or what is being measured
Quantitative	<ul style="list-style-type: none"> Quantitative indicators are more objective than qualitative ones Qualitative indicators should be adequately specified to be objective and consistent
Disaggregated	<ul style="list-style-type: none"> The more disaggregated the indicator, the more easily data can be manipulated to answer questions not anticipated at the outset
Practical	<ul style="list-style-type: none"> Data can be collected at reasonable cost, given their utility Data are available and can be collected at suitable time intervals Data can be readily collected in various projects for comparison
Reliable	<ul style="list-style-type: none"> Indicator is reliable within the context of the evaluation purpose and resources Data-collection process is consistent across different time and space scales, using comparable methods and sampling procedures. Indicator is based on representative data

Indicators for policy, technological infrastructure and access

1. Policy

1.	Presence of a national policy for ICT in education (formal and non-formal)	The policy must be articulated and detailed	Confirm the existence of purposeful endeavour	Ministry of Education Website, interview, questionnaire
2.	Presence of a master plan with a timeframe		Evidence of intention	Ministry of Education Interview, questionnaire
3.	Presence of a budget plan (and appropriations)		Measure of implementation	Ministry of Education Interview, questionnaire
4.	Presence of a body responsible for implementing the master plan	(Subcontracted) implementing agent	Evidence of implementation	Ministry of Education Interview, questionnaire
5.	Percentage of a national education budget is allocated for ICT (total amount in US dollars, percentage of total budget)	Purchase of hardware and software, software development, maintenance, in-service teacher training, definitive source of funds	Evidence of commitment	Ministry of Education Interview, questionnaire
6.	Is there a mechanism for monitoring and evaluating the implementation of the programme?	Programme monitoring at both the national and local levels	Evidence of commitment	Ministry of Education Interview, questionnaire
7.	Does ICT in education policy refer to equity of access for remote schools, minorities, girls, children with special needs?	This refers to digital divide issues		Evidence of attention to the digital divide

2. Technology infrastructures and access

a) Enabling environment

				How to collect
1. * No. of schools with <ul style="list-style-type: none"> ● electricity ● computers ● telephone ● intranet ● internet ● TV/VCR/VCD/DVD ● radio 	These should be used for educational purposes	Context of ICT development	Ministry of Education, schools	Questionnaire
2. * Number of computers per 100 students <i>Data must be in bands</i> Open to guesstimates		Measure of implementation	Ministry of Education, schools	Questionnaire
3. Number of hours per week for ICT-aided instruction <i>Data must be banded</i>			Ministry of Education, schools	Questionnaire
4. Percentage of schools using the following equipment for educational purposes <ul style="list-style-type: none"> ● Scanner ● Dot matrix printer ● LCD projector ● Colour printer ● Digital camera 	These should be for educational purposes		Ministry of Education, schools	Interview questionnaire

* To be disaggregated into formal, non-formal, primary and secondary education.

b) Internet connectivity

			From whom to collect	
1. Number of computers connected to the internet <i>Data must be in bands</i>		Measure of connectivity	Ministry of Education, schools	
2. *How many hours a month does the school use the internet?			School heads/ICT co-ordinators of schools	Questionnaire
3. * Number of schools with websites produced by students			School heads/ICT co-ordinators of schools	

* To be disaggregated into formal, non-formal, primary and secondary education.

c) Speed/Bandwidth/Satellite/Wireless

Indicators	Definition	Purpose	From whom to collect	How to collect
1. Percentage of schools with broadband, ADSL, narrowband, wireless		Measure of quality	Ministry of Education of connectivity	Interview, questionnaire

d) Systems and hardware

Pre-pentium	Pentium	Non-pentium	Peripherals available to school children
1. *Number of PCs running on the Windows platform	*Number of PCs with pre-pentium processors <ul style="list-style-type: none"> Without CD drive With CD drive 		Does your school have the following equipment that you use for educational purposes: <ul style="list-style-type: none"> Colour printer Dot matrix printer Scanner Multimedia projector UPS

*To be disaggregated into formal, non-formal, primary and secondary education.

3. ICT Curriculum

Disaggregated by:

- Geographical location (rural or urban)
- Educational level
- Type of education (formal, non-formal, and special education)
- Subject
- National minorities

Indicators	Definition	Purpose	From whom to collect	How to collect
1. Existence of a curriculum that incorporates ICT: <ul style="list-style-type: none"> compulsory or optional 	ISCED - definition of primary and secondary education To be defined: <ul style="list-style-type: none"> compulsory optional 	General purpose: to acquire, update, improve, introduce data in order to monitor and efficiently use ICT: <ul style="list-style-type: none"> Basis for teaching Basis for providing educational content Basis for organizational infrastructure Basis for curriculum construction 	From the ministries, national curriculum development centers, regional or local education centres, research and teacher training institutes, subject area centres	<ul style="list-style-type: none"> Get documents Surveys Document analysis and review

Indicators	Definition	Purpose	From whom to collect	How to collect
2. Existence of ICT as a separate subject in primary education in secondary education			On the basis of national education systems analysis, the mechanism of data obtaining should be defined with the project and suggested in the instructional manual for pilot testing	
3. Number of schools using ICT as a separate subject	Specify overall number of schools, disaggregated by territorial, level of education and other parameters		Ministries of Education, schools, curriculum development centres, regional or local education centres, subject area centres, teachers	<ul style="list-style-type: none"> • Expert opinion • Curriculum statements • Content analysis of curriculum • Evidence of additional instructional materials
4. The extent of ICT integration in the curriculum (none, some, much)	ICT – material intentionally designed for manipulation by automated means			
5. The extent of ICT integration in teaching and learning programmes	Integration is valid only for levels 2, 3, 4. Integration: Existence and number of ICT based lessons in the curriculum relative to the overall curriculum time for the subject			
6. Number of schools incorporating ICT (low, medium, high)	Existence of state approved ICT based instructional materials for usage in appropriate educational domains <ul style="list-style-type: none"> • Percentage of educational content covered by ICT based instructional materials <p>Instructional material is defined as support for teaching and learning ICT.</p> <p>Subject – this listing will be further refined based on an international standard.</p>			
4. Teaching and Teaching Support Staff (includes all staff fulfilling teaching roles like school administrators, school librarians, teachers but excluding maintenance staff)				

Disaggregated by:

- Gender
- Geographical location (rural or urban)
- Age
- Subject taught by a teacher/librarian/administrator/ICT co-ordinator
- Educational level
- Type of education (formal, non-formal, and special education)
- National minorities
- Socio-economic status

Indicators	Definition	Purpose	From whom to collect	How to collect
1. Percentage of teaching professionals who acquired pre-service training	Define pre-service training based in ISCED	To determine the skills, knowledge, attitude, attitude, access and use of the workforce to ICT to serve as a basis for improving teaching staff's efficiency and effectiveness in the use of ICT	Ministries, teacher training institutes, non-formal education centres, schools	Surveys (interviews, questionnaires, telephone interviews, expert estimates)
2. Percentage of teaching professionals who received training in the last 3 years against the total number of education staff of appropriate category			Ministries, teacher training institutes, non-formal education centres, schools	Surveys (interviews, questionnaires, telephone interviews, expert estimates)
3. Type of ICT training <ul style="list-style-type: none"> ● Basic ● Advanced 	Advanced training would include creating web pages, telecollaboration, multimedia, spreadsheet, data analysis		Ministries, teacher training institutes, non-formal education centres, schools	Surveys (interviews, questionnaires, telephone interviews, expert estimates)
4. Length of training <ul style="list-style-type: none"> ● Less than 10 hours ● 10 to 30 hours ● 31 to 70 hours ● More than 70 hours 			Ministries, teacher training institutes, non-formal education centres, schools	Surveys (interviews, questionnaires, telephone interviews, expert estimates)
5. Percentage of teaching professionals who use computers for teaching purposes: <ul style="list-style-type: none"> ● Rarely ● Sometimes ● Regularly ● Always 	Teaching purposes include lesson preparation, teaching, reporting recording, communicating, assessing Comment: Categories (rarely, sometimes etc. should be explained) Addition by Dr Boris Kostsik: Teaching purposes can be divided.		Ministries, teacher training institutes, non-formal education centres, schools	Surveys (interviews, questionnaires, telephone interviews, expert estimates)
6. Existence of technology development plan on different levels			Ministries, teacher training institutes, non-formal education centres, schools	Surveys (interviews, questionnaires, telephone interviews, expert estimates)

5. Learning process and outcomes

Disaggregated by:

- Gender
- Geographical local (rural or urban)
- Subject (this listing will be further refined based on an international standard)
- Education level
- Type of education (formal, non-formal, and special education)
- National minorities
- Socio-economic status

Comments:

- How can socio economic status be measured?
- Look for area based determinants of economic status

Indicators	Definition	Purpose	From whom to collect	How to collect
1. Number of hours of ICT access per learner per school year	School year should be standardised across countries	To determine the skills, knowledge, attitude, access and student's use of ICT to serve as a basis for improving student's specific and general learning outcomes.	Teachers and students Existing documents and secondary sources	Random sampling – some schools, all students and teachers <ul style="list-style-type: none"> ● Cost of data collection ● How can data be collected? ● Concern for validity of students' responses
2. Number of learners with ICT access outside school	Access is the possibility to use ICT for structured learning. Use is the process of manipulation and exchange of information through ICT for structured learning.	To define access to ICT.		
3. Number of learners who demonstrate only basic ICT skills	Basic and advanced ICT skills – can be taken from the description of the national curricula.			
4. Number of learners who demonstrate advanced ICT skills				
5. Purposes for which learners use ICT	Informative: ability to acquire and use information Functional: ability to use and manipulate existing information for educational purposes Creating: ability to compose, compile, produce new information Communication: ability to exchange information			

Situating indicators based on level of ICT development

It was felt that many countries are at different stages of development as far as ICT use in education is concerned, and therefore, indicators to measure ICT use and impact may not necessarily be standard or uniformly applicable to all countries. In the region, for example, one country may already be advanced as far as teacher training or access indicators are concerned, but may not even have developed an official policy. Or another country may have formulated an official policy, but may not have begun integrating ICT into the curriculum. The matrix below is adapted from the Applied Morel's Matrix, which originated from the UNESCO IITE High-Level Decision-Makers in ICT Educational Policy in 2001.

The four categories have been defined as follows:

1. Emerging
2. Applying
3. Integrating
4. Transforming

Indicators	Emerging	Applying	Integrating	Transforming
Policy				
Technology infrastructure				
ICT in the curriculum				
Teaching and teaching support staff				
Learning process and outcomes				

Prior to the opening of the workshop, the resource speakers attempted to fill in the matrix dealing with the indicators

6

Proposed Actions

The Consultative Workshop identified a number of follow-up actions in order to finalise the set of indicators for pilot testing in selected countries.

1. The draft set of indicators will be further elaborated and refined by SEAMEO INNOTECH under the direction of Dr. Eligio Barsaga. The resulting set of indicators will then be validated by the participants and other resource persons through e-mail based consultations.
2. Based on the final and approved set of indicators, SEAMEO INNOTECH will prepare a reference manual which will be used in pilot testing the indicators.
3. The participants and resource persons will be involved in a continuous dialogue and discussion on the concept, definitions, elaboration, methods of refinement of indicators moderated by UNESCO through a bulletin board set up within the ICT for Education in Asia-Pacific website.
4. UNESCO will identify countries to pilot test the set of indicators based on the readiness and willingness of countries to participate. Some participating countries expressed the desire to be included as pilot sites.
5. During the UNESCO-IITE Conference on ICT and Policy Development to be held in December 2000, the set of indicators will be presented to high-level decision makers from the ministries of education to inform them, as well as to obtain their commitment and support in adopting and using the set of performance indicators.
6. Participants are requested to inform their educational policy makers of the purpose and outcome of the Consultative Workshop on Developing Performance Indicators on ICT for education to be followed by orientation or briefing by UNESCO to the countries.
7. UNESCO, IITE and SEAMEO INNOTECH will initiate drafting the terms of reference for database development for storing ICT indicators data.

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