Developing and Using Indicators of **ICT Use in Education**

United Nations Educational, Scientific and Cultural Organization
UNESCO Bangkok

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Compiled by

UNESCO Asia and Pacific Regional Bureau for Education, Bangkok
and Southeast Asian Ministers of Education Organization Regional Center
for Educational Innovation and Technology (SEAMEO INNOTECH)
Metro Manila, Philippines

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1

Introduction: Indicators and Rationale of Use

In evaluation studies, indicators are used as evidence or signs by which we can assess or evaluate materials, methods, an intervention, a programme or a project. Indicators are measuring devices. They define concepts in terms of the measurements and data it is possible to collect and analyse. They define what data to collect and at what time intervals.

Basic approach to formulating indicators

To develop good indicators, we need first to have a clear view of what we are trying to achieve and to measure. The first requirement for a systematic development of indicators for Information and Communication Technology (ICT) is to identify the results, objectives, outputs and key concepts of the ICT project, as part of the evaluation system plan.

The basic approach involves four steps:

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

Step	Action
Step 1: Identify all concepts to be measured, especially project objectives and outputs	▸ Review all concepts, objectives, results, and output statements to clarify them and reach agreement ▸ Be clear about what type of change is implied (a situation, state, condition, attitude, behaviour) ▸ Clarify whether the outcome sought is an absolute change, a relative change, or no change ▸ Specify where and when the change is expected (what target group, what location, and in what time frame) (this identifies the appropriate unit of analysis) ▸ Determine the relationship between project activities and their outputs or objectives (are these outputs or objectives direct or indirect?)
Step 2: Develop a list of possible (trial) indicators	▸ Think of possible alternative indicators for each concept, objective, and output, without being too restrictive ▸ Conduct internal brainstorming sessions ▸ Consult stakeholders and other experts ▸ Try to borrow from other projects and studies
Step 3: Assess each trial indicator against criteria	▸ Establish an agreed set of criteria for indicators (see Table 2) ▸ Use a scoring scale (1-5) to determine the usefulness of each trial indicator (but be flexible and use your own judgment)
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 that is consistent and complementary in terms of data-collection methods and time frames ▸ Avoid having too many indicators (it may indicate that the objectives and outputs are not clearly defined) ▸ Be prepared to update your indicators - the best indicators may change as projects develop (one common change occurs after using input indicators at first and then realizing that output indicators were what was needed)

Table 1. Describes the actions required in each step

Table 2 below summarises the criteria that can be applied in assessing potential indicators, based on the recommendations of the Centre for Development Information Evaluation, an institute of USAID. These criteria are to be used flexibly. For instance, according to the Centre, direct measures are not always better than indirect measures, while quantitative measures are not always better than qualitative measures.

Table 2. Criteria for assessing indicators

Criterion	Description
Direct measure	▸ 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	▸ 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 at a time) ▸ Indicator can be quantitative or qualitative, as long as it is clearly and consistently defined and interpreted
Adequate	▸ 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	▸ Quantitative indicators are more objective than qualitative ones ▸ Qualitative indicators should be adequately specified to be objective and consistent
Disaggregated	▸ The more disaggregated the indicator, the more easily data can be manipulated to answer questions not anticipated at the outset
Practical	▸ 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	▸ 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

The process of developing indicators involves a combination of activities, such as brainstorming, multi-stakeholder discussions and being clear about definitions, criteria, goals and priorities. More focused and cost-effective monitoring and evaluation of ICT use in education is expected. Indicators are based on assumptions about what is relevant - they are expressions of value or of what is desirable. Thus, it is important that researchers and evaluators involve stakeholders in developing the indicators to ensure that the data collected will respond to their information needs.

Section

2

Using Indicators to Assess Impact of ICT in Education

Synthesis of country experiences on ICT indicators and related issues (Attachment II)

Below is an attempt to synthesise several countries' efforts and initiatives in conducting research to evaluate the use of ICT in education, and, for some countries, the development of ICT indicators. Among these countries are:

Australia	Canada	CIS and Balkan countries
India	Indonesia	Japan
Korea, Republic of	Malaysia	New Zealand
Philippines	Singapore	Slovenia
South Africa	Thailand	United Kingdom
United States	Uzbekistan	Viet Nam

The development or potential development of indicators in the region follows three paths:

1. Ministries of Education or the Government set up Task Forces or committees, to take charge of developing indicators measuring the use and impact of ICT in education
2. The vision and goals of the ICT programme serve as basis for the formulation of ICT indicators
3. The impact of the use of ICT in education is determined through surveys and research and thus, serves as basis for the formulation of national indicators

While the government of Korea has "Cyber Korea 21" and the "White Paper", the government of Japan has "eJapan Priority Programme" and Europe has the "eEurope" initiative. These programmes are all aimed at improving the ICT sector and carry with them built-in indicators for measuring the achievement of these goals.

Today, most countries include ICT integration, either in their national policies or in laws pertaining to the education sector. In Australia, at the federal level, the Commonwealth government has set goals for schools in relation to ICT development. The government wants students to leave school as confident, creative and productive users of new technologies, particularly ICTs, as well as understanding the impact of those technologies on society (http://www.curriculum.edu.au/mceetya/nationalgoals/natgoals.htm). Schools are expected to integrate ICT into their operations.

In Thailand, the national Education Act of 1999 formed the core of education reform towards ICT use in education, as guided by three principal strategies: value-added, equity and quantum-jump (http://www.unesco.org/bangkok/education/ict/ict_enabling/ap_policy/Learntec-Tongyoo.pdf) . Similarly, the Law on Education in Uzbekistan outlined the inclusion of ICT in the education sector. Meanwhile, the Philippines' Department of Education has also formulated policies for the use of ICT. The same trend is seen in Indonesia, Malaysia, Uzbekistan, Viet Nam and others, where the national government sets goals for ICT integration in education.

Kinds of indicators developed, based on visions or goals and surveys

Within the region, the *Republic of Korea* is the most advanced in terms of indicator development on the use of ICT in education. The Ministry of Education and Korean Educational Research and Information Service (KERIS - _http://www.keris.or.kr/english) have formulated and used a set of indicators, categorised into support, input, utilisation or output. The support indicators include training hours given to teachers and principals, budget allocation, the year plan and incentives for teachers.

The input indicators consist of the ratio between computers and students, Internet connectivity and speed, educational software and the number of applications used. The utilisation indicators include subjects using multimedia, the percentage of classes using a Web board or computer labs, the percentage of teachers joining ICT associations and discussion forums, student usage of computers and usage of the internet. Output indicators include teachers and students having an email address, a homepage and ICT certificates and students also having completed a 32 hours ICT course.

In *Australia*, the Ministerial Council of Education, Employment, Training and Youth Affairs (MYCEETA) is currently looking into the use of performance measures for student achievement relating to new technologies. Taking the National Goals for Schooling as the starting point, 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 the report *Monitoring Progress towards the National Goals for Schooling: Information and Communication Technology (ICT) Skills and Knowledge*. Basically, 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 relation to 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 the knowledge of school students; and identifies further work required to establish an operational monitoring programme.

There have also been several initiatives undertaken to measure the impact and use of ICT in education in different States of Australia. The trends show that these indicators are increasingly focusing on qualitative indicators, measuring teacher and student outcomes. For example, the University of Sydney looked into whether student-centred learning took place, along with student improvement in high-order thinking skills. As far as the teachers are concerned, the indicators assess changes in teaching practice and improvement in the ability to use emerging technologies. However, connectivity remains a strong indicator in Australia, focusing on the number of teachers with a notebook, the computer-student ratio, bandwidth available in schools and the type of Internet connection.

In *Malaysia*, the creation of the Smart School System serves as benchmark for ICT integration in schools (http://www.mdc.com.my/msc/flagship/ss.html). The Malaysian Smart School programme is aimed at reinventing learning institutions, in terms of teaching practices and school management, preparing children for the Information Age. Some of the initial proposed indicators by the ICT project are both quantitative and qualitative. They focus on the use of ICT in curriculum, in pedagogy, in assessment and materials. The quantitative indicators include decreased drop-out rates and recorded achievement gains each year, among others, while the qualitative indicators include caring and competent teachers and a broad, flexible curriculum that caters to the differing needs and abilities of students.

In the *Philippines*, the Senate Committee on Education, Arts and Culture commissioned SEAMEO-INNOTECH to conduct the national survey to profile the ICT capabilities of elementary and secondary schools in the Philippines. SEAMEO-INNOTECH was responsible for formulating the indicators/items on the survey (http://www.seameo-inotech.org/frames.html). These include the existence of an enabling environment, the computer skills of school personnel, the presence of computers in schools, instructional or academic use of computers, ICT infrastructure and Internet connectivity. The Department of Science and Technology, in collaboration with the Department of Education, has also conducted a survey, not only looking at the infrastructure and hardware support indicators, but also with regard to how computers had been used and integrated into the curriculum, as well as in teaching and learning.

In *Thailand*, initial use of indicators through a survey included Internet connectivity in schools, the computer-student ratio, and usage of ICT in schools and school administration and connection to SchoolNet as main issues. The annex found at the end of this document also shows a variety of potential indicators which fall under their ICT project's three principles/strategies, namely, value-added, equity and quantum-jump strategies. A committee was formed to concentrate on formulating indicators to measure the impact of ICT use in schools.

Uzbekistan, through its Ministry of Public Education, has carried out monitoring and evaluation through the 14 Provincial Departments of Education and 15 In-service Training Institutes. Under these, indicators have been examined, such as the availability of computers in schools, the number of students using computers, the number of computer classes, integration of ICT in subjects and teacher training. It was reported that the evaluation of student computer ability and performance is difficult, as different computers are being used throughout the country.

In *India*, the ICT programme statement of goals brought about potential indicators that include the presence of MIS and software, ICT in textbooks, ICT in computer subjects and in-service and pre-service training of teachers.

Though *Indonesia* has not developed its set of indicators, its ICT in education programme goals and objectives also imply that the following indicators can be potentially useful: student's understanding of the benefits of ICTs - disadvantages as well as challenges; student's use of ICT knowledge in acquiring, processing, arranging, distributing and keeping information; and student's application of knowledge, skills and attitudes in designing information technology systems and solving problems relating to ICT.

Similarly, while *Viet Nam* has not developed its indicators, its ICT goals imply indicators in the following areas: ICT as a subject in general education, number of trained teachers and establishment of ICT departments in universities to train teachers, provision of computer labs in schools and the application of ICT in school management.

In *Singapore*, as the process of IT integration in schools reaches a considerable level of maturity, the question being asked is: How do we integrate IT in schools so learning opportunities are optimised? Research undertaken by the National Institute of Education and Ministry of Education, entitled "Effective Integration of IT in Singapore Schools" (http://eduweb.nie.edu.sg/projects/ITintegration/), focused on the general pedagogical practices and socio-cultural policies of IT integration in Singapore schools, not just the innovative and best practices. The indicators used included infrastructure and resources, school IT culture, staff development, teacher use and student use. The research sought answers to the following questions or indicators of a qualitative nature:

- What are the pedagogical practices of teachers and students that promote or hinder the integration of IT?
- What are the roles of the human participants, activities and tools in such an environment?
- How does a change in the curriculum promote a culture that facilitates integration of IT?
- How does a change in the mode of assessment affect integration of IT?

The UNESCO Institute of Information Technology in Education (http://www.iite.ru) based in Moscow undertook a survey of the use of ICT in education in Baltic and CIS countries, making use of the following indicators: a) *Official documents* on ICT usage in education; b) *ICTs in curricula* - as a separate subject or to support other subjects; c) *Equipment* (computer-student ratio, computer availability in classrooms; multimedia system and LAN connection); d) *Software* (percentage of schools with DOS and Windows and using software for teaching subjects, and software designed

by local and foreign experts); e) *Global communication means* (percentage without Internet access; with limited Internet access -- only e-mail; access via dial-up or dedicated line, and those with web pages); and f) *Personnel development* - percentage of elementary school teachers, subject teachers, and teachers of Informatics and EI administration who have undertaken the computer literacy course, for certain hours during a certain time frame, and the computer skills of elementary school teachers, subject teachers and teachers of Informatics and administration.

Standards for technology use

What kinds of changes in knowledge, skills and competencies are required from teachers and students in the use if ICT? In order to serve as a basis for developing knowledge, skills and competencies in the use of ICT, as well as in comparing outcomes of ICT use against goals set, few countries have standards for technology use.

In Australia, however, the Victoria government has a curriculum standards framework (CSF) developed by the Victorian Curriculum and Assessment Authority, which identifies what students should know and be able to do in eight key learning areas from preparatory year to year 10. In New South Wales, the Government has foreshadowed the introduction of an external Computer Skills Assessment for all years 6 and 10 students to determine their knowledge, skills and understanding in the use of ICT. Western Australia has a Competency Framework for Teachers and in Queensland these competencies are identified in *Minimum Standards for Teachers-Learning Technology* (http://education.qld.gov.au/curriculum/learning/technology/ mst_int.html#introduction). Queensland also produced a document *ICTs for Learning: School Information Kit 2002–2003*, which details benchmarks established around teaching, learning and the curriculum; learning and development; ICT infrastructure; connectivity; ICT support; and innovation. Furthermore, the development of indicators will be based on the following: a) definition of content domain, including functional skills in a cross curricular context, manageability in its complexity, delineates between Year 6 and Year 10 in terms of the curriculum context and the hierarchy of skills identified; and b) the development of a scale of competence, including basic and functional skills, as well as complex thinking, and facilitating the reporting of a range of achievement.

The United States and Europe utilise a set of standards for the technology use of students, teachers and school administrators. The International Society for Technology in Education (ISTE) came up with the National Education Technology Standards (NETS) Project (http://cnets.iste.org/) the primary goal of which is to enable stakeholders in PreK-12 education to develop national standards for the educational uses of technology that will facilitate school learning (see attached for more details on the ISTE NETS standards).

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.

Levels of integration

In most of the countries researched on, the studies have been limited to ICT indicators used in the primary and secondary level. There are, however, instances where other levels are included, such as the case of Republic of Korea, where university level is included and in Slovenia, pre-school. In the United States, those in physical education and special education subjects in the primary and secondary levels were excluded. Japan is noteworthy, as its ICT policy includes even special schools for the blind and the disabled. Australia incorporates those in non-formal education in their studies.

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 either an aid or a barrier to equity in access.

ICT infrastructure, hardware and connectivity

The number of computers or Internet connections in schools dominates statistics. In fact, only six countries specified indicators pertaining to other ICT technologies, such as telephone lines, fax machines, LCD projectors and the like. These countries are Australia, India, New Zealand, Republic of Korea, Thailand and the Philippines.

Perhaps, future studies should also look into other types of ICTs in addition to computer-based and Internet. 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.
- **Information literacy** is the combination of knowledge, understanding, skills, and attitudes that students need to fully contribute as members of society in the information age. When students become information literate, they develop an ability to select, interpret, evaluate, manipulate and present information.

Teacher's use of ICT

Studies on how teachers use ICT are also included in most ICT integration programmes. Many looked into how teachers have used ICT in teaching specific subjects; into how they have employed Internet resources in teaching; how they have used email in communicating with students and other teachers; and whether they have developed their own homepages. In Australia, for example, teachers make use of self-paced learning materials on ICT use in CD-format. In other countries, preference is given to teacher applicants who are already computer literate, such as in the case of the Philippines. In Korea and Australia, teachers are provided with PCs. These provides an overview of ICT indicators related to teacher's use of ICT.

Targets of indicators surveys

Respondents for the different surveys in the US, New Zealand, the UK, South Africa and Europe usually included teachers. Students are included in surveys to determine their perceptions towards ICT, such as in the 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 their respondents were.

Types of indicators

While some countries use qualitative in addition to quantitative indicators, their use is obviously limited. Quantitative data usually includes ICT infrastructure and connectivity, consisting of hardware, 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 computer/student, computer/classroom, computers/teacher; type of computers (stand alone, multimedia in network)
- Availability of connectivity and bandwidth of the computers. Type of bandwidth for connections includes high-speed, broadband, wireless

Quantitative data can be collected from indicators that will provide an overall view of infrastructure support and ICT presentation in schools. 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, which 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 indicators.

Canada included "obstacles to fuller use of information technologies" in its list of indicators (http://www.cmec.ca/stats/pceip/1999/Indicatorsite/english/pages/page19e.html). In Europe, "teacher confidence in the use of ICT, change in teaching methods and desirable ICT skills" is assessed (http://www.eurydice.org/Documents/TicBI/en/FrameSet.htm).

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 (http://education.pwv.gov.za/teli2/research/ICT%20audit/ICTaduit.htm) attempts to measure practical, foundational and reflexive competencies of educators, along with how well students enjoy ICT-related activities and learner's perception of how the use of computers improves learning and attitudes.

Meanwhile, the UK (http://www.dfes.gov.uk/statistics/DB/SBU/b0296/) looks at teacher confidence in ICT use and the benefits of ICT in subjects, while 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.

The Republic of Korea includes output indicators, teachers and students now having email addresses and a homepage to deliver information and exchange school work and ideas, as well as more participation in ICT extra curricular activities (http://www.icce2001.org/cd/pdf/p12/ KR115.pdf).

Research in Japan, the Philippines, Slovenia and other countries 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.

Qualitative indicators mentioned in the research include:

- How much students think they have improved
- Change in teaching methods
- Desirable ICT skills
- Factors that encourage telecommunications use
- Students who had 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,
- Barriers to computer related activities

Some indicators appear to be unique or were only mentioned for some countries.

In Europe, for example, ICT indicators include the ICT policy and strategy of each country in the CIS and Balkan study, looking at Denmark, Sweden, Finland, Norway and the UK. These indicators measure objectives of each country in national ICT projects, along with the schedule of implementation.

In the Republic of 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.

The establishment of a network can be considered a quantitative indicator in the sense that it is a physical phenomenon, where hardware or portals/platforms are provided for networking in a digital form to take place. However, networking can also be a qualitative indicator if the focus is on developing competence in disseminating knowledge and information quickly and to large numbers of people. The level or quality of networking among organisations can also be used as a qualitative indicator.

Furthermore, most of the countries give themselves a deadline or a yearly achievement target. For example, in the Republic of Korea, the targets for the year 2000 are to provide PCs and other infrastructure to schools, for 2002, the establishment of a Nationwide Education Administration Information System and for 2005, the setting up of the Integrated Human Resources Information Network.

The use of ICT in the school system in the Asia-Pacific Region, as in the other Regions of the world, is widespread and continuously growing. Many believe that ICT will empower teachers, transforming teaching and learning processes from being highly teacher-dominated to student-centered. Arguably, the quality of student learning will improve tremendously, as use of ICT will create opportunities for student to develop their creativity, problem-solving abilities and other higher-order thinking skills.

It appears though that while ICT has revolutionised business, industry and entertainment, indicators to prove that it has had the same effect on student outcomes are lacking as yet. Moreover, ICT has brought with it its own problems, such as the oft-mentioned "digital divide," exacerbating the problem of access to ICT between rich and poor, male and female and between and among teachers and school administrators. Moreover, 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 even greater need for performance indicators to monitor the use and effects of ICT, demonstrating accountability to these various funding sources and to the public.

While these problems are known to our policy makers and educators, information on the extent of these problems remains scant, due to lack or absence of monitoring and evaluation systems concerning the use of ICT in schools and its impact on teaching and learning. There is an urgent need, therefore, for a monitoring and evaluation (M and E) system, if current efforts to make ICT use an integral part of the education system are to succeed. Such M and E systems should start with formulating a set of indicators of ICT use and impact in education.

This effort is not new in other parts of the world, such as in the USA, Europe, the UK, Canada, Australia, New Zealand, and the like. (A listing of ICT indicators developed in these countries is given as Appendix I to this paper.) However, in most of the Asia-Pacific countries, there has been little systematic work in the use of ICT indicators in the field of education, except that of the Republic of Korea and soon, Australia.

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. Rather, it is better to arrive at a consensus on common *core indicators* that can be used regardless of the ICT utilisation stage which a country has reached. Important criteria to be observed in formulating these core indicators would include local relevance, reliability and robustness when these are used for comparison of one ICT project or country with another.

Assessment and evaluation methods

In most of the studies reviewed, traditional or standard assessment methods were used. Assessment rubrics were designed for specific projects, lessons, and/or classroom experiences, in addition to standard assessment tools, except in a primary school in Sunnyside Elementary School, Putnam, Washington. In this study, parents were also involved in the assessment process, preparing reports of their children's progress.

The ways that technologies are being used in schools change the teacher's role from that of technology-as-teacher to technology-as-partner in the learning process. As students increasingly use technologies as learning tools, they will produce technology-based artifacts - student-constructed knowledge bases. These knowledge bases are rich, multi-modal indicators of what students have learned. Moreover, as learning becomes more meaningful, so it becomes more authentic and more complex. Thus, authentic assessment and other non-standard assessment methods, such as rubrics, need to be designed to capture meaningful learning experiences of students brought about by these new technologies.

Unfortunately, not too many teachers have acquired the competencies to conduct authentic assessments for student learning, using learning portfolios and rubrics for performance evaluation. The need for such learning assessment competency becomes even more urgent as educators move away from the behaviourist and objectivist perspective of learning to that of a more constructivist view.

Using the type of indicators used by countries as basis for categorising them based on the extent and impact of ICT and using the input-process-output model, the results would be:

Country	Level*	Type of indicator	
		Quantitative	Qualitative
Australia	3		x
CIS and Balkan countries	2		
Canada	3		x
Europe (Denmark, Sweden, Finland, Norway, UK)	3		x
India	2		
Indonesia	1		
Japan	2		
Korea, Republic of	3		x
Malaysia	2		
New Zealand	2		x
Philippines	1		
Slovenia	1		
South Africa	3		x
Thailand	2		
UK	3		x
USA	3		x
Uzbekistan	2		
Viet Nam	1		

* Level 1 - Includes input indicators only Level 2 - Includes input and process indicators
Level 3 - Includes input, process and output indicators

Section

3

Methods of Collecting Indicators

Survey questionnaire

There are various ways of collecting data based on predetermined ICT indicators. Of course, the most popular one is the use of survey questionnaires, farmed out to a representative sample of schools, school heads and teachers, either on a regular or one off basis. Clearly, those done more regularly can track the behaviour of the indicators over time. Weaknesses in ICT implementation can be remedied in due course; new strategies in ICT implementation can be worked out and carried out, thus increasing the probability of success of ICT programmes and projects. The one-shot survey is more appropriate for a summative kind of assessment, in which we are more interested in finding out, for instance, the longer-term impact of ICT use.

Telephone interview

Where the telephone system in a particular country is well developed enough that most homes have access and long distance calls are cheap, the telephone interview is a more cost-efficient method of data collection. For example, EURYDICE, Basic Indicators on the Incorporation of ICT into European Education Systems Project ((http://www.eurydice.org/Documents/TicBI/en/FrameSet.htm) conducted Eurobarometer surveys over the telephone in 2001, covering a representative sample of school heads and teachers in each EU country. The questions put to the school heads were mainly concerned with their school ICT equipment and facilities, while those asked of the teachers included the use of computers and the Internet with their pupils (time spent using them, frequency of their use, reasons for not using them, etc) and how ICT had changed the way they taught. Slovenia also made use of telephone interviewing as a method of data collection, augmented by public opinion surveys in person on a one-to-one basis (http://www.ris.org/). Data on information-telecommunication infrastructure, such as telephone, cellular phone and ISDN connections, number of Internet providers, backbone providers and the like were gathered from the telecommunication companies themselves (Details of indicators used in the above surveys are in Appendix I).

3 -yearly sample assessment

In Australia, the national monitoring of ICT skills and knowledge of students in Year 6 (aged 10-12 years) and Year 10 (aged 14-16 years) will be done by means of three-yearly sample assessments, commencing in 2005. Student outcome information is the focus of the reporting agenda. 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 PMRT and where performance in different years in a particular domain is the focus of measurement, a single domain scale should underpin measurements of student achievement. The assessment methods will include a mix of tests on paper and on line and performance assessment tasks with teacher assessment.

The study by Singapore to measure the effective integration of ICT in schools indicated that to gather accounts by various groups and individuals in the learning environment, both qualitative and quantitative methods were drawn upon, such as observations of IT and non-IT based lessons, face-to-face interviews with principals and IT co-ordinators, group interviews with students and teachers, questionnaires for teachers and students and samples of students' work.

Internet-based surveys

Where there is a saturation of Internet connectivity in the country, that is, most of the homes, schools and offices are connected, use of questionnaires posted on the website of the institution/agency conducting the surveys can be an efficient method of collecting data on indicators. Furthermore, communication by emails 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/agency's computer server located thousands of miles away.

Notably, the UNESCO IITE survey met with some difficulties because the collection of data depended primarily on the efforts and contributions of heads of departments, senior specialists and the staff of national Centres of Informational Technologies in Education or Centres of Teacher Training, Retraining and Educational Support, who were not given any financial support, agreeing to work due to an official memorandum. Thus, many of the results were generated from experts' estimates, rather than direct collection of data from teachers, students and schools.

Web-based self-evaluation tool

EnGuage, a new Web-based framework developed by NCREL in the USA (http://www.ncrel.org/engauge/), is a response concern regarding the ever-increasing investment in educational technology, by providing answers to three significant questions, to wit: What value does technology bring to the schools? How can our schools ensure a return on these investments? And why does technology work in some schools and not in others? EnGuage is a tool set designed to help schools and school districts use technology effectively for learning, teaching and managing.

The School Technology and Readiness (STAR) Chart (http://ww2.iste.org/starchart/) provides another web-based self-evaluation tool, providing schools with the information they need to better integrate technology. With STAR Chart online, multiple-choice questionnaire can be completed that will provide instant feedback. The Chart identifies and defines four school profiles ranging from the "Early Tech" school with little or no technology to the "Target Tech" school that provides a model for the integration and innovative use of educational technology. It is not meant to be a measure of any particular school's technology and readiness, but rather is intended to serve as a benchmark against which every school can assess and track its own progress.

The STAR Chart can help any school or community answer three critical questions:

- Is your school using technology effectively to ensure the best possible teaching and learning?
- What is your school's current education technology profile?
- What areas should your school focus on to improve its level of technology integration?

The method of data collection for ICT indicators will then 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 existing M and E systems can still accommodate additional data collection tasks to monitor and evaluate ICT impact in schools. Additional variables based on ICT indicators can be integrated into the existing database system.

Section

4

Various Software or Database Systems for Storing Indicators

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

- Spreadsheet programmes, such as IBM Lotus 123 and MS Excel
- Statistical programmes, such as Statistical Package for the Social Sciences (SPSS)
- Customized database programmes using MS Access (for small databases)
- SQL Server, MAGIC (for big databases)

For data-based driven web applications (Visual Interdev, Java, Visual Basic), there is anoother software available in the market which 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.

Attachment

I

ICT Indicators Used in Different Countries

ICT Indicators in Australia

Agency responsible for data gathering	ICT indicators	Components of ICT indicators
Government University of Sydney	What students should know and be able to do at a certain level	
	Connectivity	▸ Number of teachers with notebook ▸ Computer, student ratio ▸ Bandwidth available in schools ▸ Type of internet connection
	Changes in student performances after integrating ICT into education	▸ Increase in student engagement, enthusiasm and motivation ▸ If student-centred learning took place ▸ Improvement in students' high-order thinking skills improved ▸ Occurrence of changes in teaching practices ▸ Improvement in the ability to use emerging technologies

ICT Indicators in Baltic and CIS Countries

Agency responsible for data gathering	ICT indicators	Components of ICT indicators
UNESCO Institute of Information Technology in Education	Official documents	▸ Official documents in IT/ICTs in secondary education ▸ Official documents in IT/ICTs in secondary education currently in force
	ICT in curricula	▸ Available state curriculum on informatics and/or Information Technologies ▸ Informatics and/or Information Technologies as a separate subject ▸ ICT usage to support other subjects implied in curricula on these subjects
	Hardware equipment	▸ Computer classroom availability in educational institutions (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 classroom number ▸ Percentage of EI equipped with local network to total EI equipped with computer classrooms number
	Software	▸ Percentage of computers with installed OS DOS™ to total number of computers in computer classes ▸ Percentage of computers with OS Windows™ of Apple Macintosh to total computer number in computer classes ▸ Per cent 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: 1. Elementary School subjects 2. Science subjects 3. Humanities 4. Informatics or information technologies ▸ 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, informations/ 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
	Global communication	▸ 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

ICT Indicators in Baltic and CIS Countries (cont'd)

Agency responsible for data gathering	ICT indicators	Components of ICT indicators
	Personnel development	▸ 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 1. Less than 50 hours (Index 1) 2. 50-100 hours (Index 2) 3. Over 100 hours (Index 3) ▸ Computer skills of elementary school teachers, subject teachers and teachers of Informatics and administration 1. Elementary computer literacy 2. Proficiency in ICT field

ICT Indicators in Canada

Agency responsible for data gathering	ICT indicators	Components of ICT indicators
Pan-Canadian Education Indicators Programme (PCEIP)	Pupil-computer ratio	The pupil-computer ratio is a proxy measure of the access of availability of computer to students in schools. Only computers used for educational purposes are included in the ratio.
	Internet connectivity	This is a measure of the percentage of students attending schools that were connected to the internet for educational purposes at the time of the survey. Schools that were connected for administrative purposes only were excluded.
	Internet activities of students	School ICT co-ordinators were questioned about instructional activities involving the use of the internet. They were asked to identify typical activities that students at certain grade levels would have engaged in by the end of the school year.
	Obstacles to fuller use of information and communications technologies	Principals were asked to identify the major barriers hindering the achievement of their school's computer-related goals for students. In this section items are presented that are identified as major obstacles by principals of schools representing at least 50 per cent of enrolments at each of the three levels of schools. The obstacles noted have been grouped into three categories: those relating to hardware and software, those relating to instruction, and those relating to the training of teachers.

ICT Indicators Used in Europe (Denmark, Sweden, Finland, Norway and UK)

Agency responsible for data gathering	ICT indicators	Components of ICT indicators
Information Society Technology Programme funded by the European Community	Policy and strategy	▸ Countries with an official policy on the use of ICT ▸ Schedule for implementing national ICT education projects ▸ Responsibility for the purchase and maintenance of hardware ▸ Objectives in national ICT projects ▸ Inclusion of ICT in the national curriculum ▸ Schools with ICT implementation plan (simple) ▸ Schools with ICT implementation plan (detailed) ▸ Approaches of ICT defined in the curriculum ▸ Objectives defined in the curriculum for the teaching or use of ICT ▸ Schools with autonomous decision power

ICT Indicators Used in Europe (Denmark, Sweden, Finland, Norway and UK) (cont'd)

Agency responsible for data gathering	ICT indicators	Components of ICT indicators
	Economy and infrastructure	▸ Average expenditure on ICT in schools ▸ Sources of funding for ICT in schools ▸ Total expenditures on ICT in schools ▸ Distribution of the specific budget between the purchase of equipment and expenditure on human resources ▸ Number of computers per 100 pupils ▸ Number and quality of computers available for administration, pupils and teachers ▸ Expected increase in the number of computers ▸ Computers with access to school net and/or internet ▸ Quality of internet access in schools ▸ Placement of the computers ▸ Schools with own website ▸ Schools with on-line services ▸ Schools with intranet, website, e-mail
	Use and access	▸ Pupils and teachers with a personal e-mail address ▸ Use of ICT in areas of the curriculum ▸ Use of external electronic communication services ▸ Teachers use the internet for non-computing teaching ▸ Internet use in teaching ▸ Teachers opinion about the internet as a tool ▸ Pupils access to the internet ▸ Teachers access to computer and internet at home ▸ Who pays teachers home access ▸ Teachers who connect with other schools via the internet
	Competencies	▸ New ICT and media students in percentages of all students ▸ New ICT and media students by level of education ▸ Qualifications and degrees in information technology and media studies ▸ Population with a degree of qualification in ICT and media studies by field of study and level of education ▸ Hours/years spent to pedagogical IT guidance ▸ Hours/years spent to technical IT guidance ▸ Teachers confidence in the use of ICT ▸ Students and teachers knowledge regarding ICT ▸ Specialist ICT teachers ▸ ICT courses during initial training of general class teachers ▸ ICT trained teachers ▸ Change in teaching methods

ICT Indicators Used in Europe

Agency responsible for data gathering	ICT indicators	Components of ICT indicators
	Primary	▸ Inclusion of ICT in the curriculum ▸ Percentage of teachers who use computers and/or internet in the classroom ▸ Approaches to ICT defined in the curriculum ▸ Objectives defined in the curriculum for the teachingor the use of ICT ▸ Inclusion of ICT in the initial training of all teachers (except specialist ICT teachers)
	Secondary (lower and upper secondary education)	▸ Inclusion of ICT in the curriculum ▸ Percentage of teachers who use computers and/or internet in the classroom ▸ Reasons given for not using internet with pupils ▸ Approaches to ICT defined in the curriculum ▸ Annual number of hours recommended for teaching ICT as a subject in its own right ▸ Objectives defined in the curriculum for the teaching or the use of ICT ▸ Inclusion of ICT in the initial training of all teachers (except specialist ICT teachers) ▸ 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) ▸ Desirable ICT skills according to official recommendations for the initial training of all teachers (except specialist ICT teachers)
	Both	▸ Number of pupils per computer, and number of pupils per computer with an internet connection (primary and secondary education) ▸ Responsibility for the purchase and maintenance of hardware (primary and secondary education) ▸ Distribution of the special budget between the purchase of equipment and expenditure on human resources (primary education, general lower secondary education, general upper secondary education) ▸ Average periods during which primary school teachers use computers (with or without internet connection) in the classroom, hours per week ▸ Specialist ICT teachers ▸ Percentages of primary and secondary school teachers in Europe who have received official training in the use of computers and/or internet in their teaching

ICT Indicators Used in India

Agency responsible for data gathering	ICT indicators	Components of ICT indicators
Ministry of Human Resource Development	Presence of MIS	
	Presence of software	
	ICT in textbooks	
	ICT in computer subjects	
	In-serv ice and pre-service training of teachers	

ICT Indicators Used in Indonesia

Agency responsible for data gathering	ICT indicators	Components of ICT indicators
	Government's goals and objectives	Student understanding of ICT's benefits, disadvantages as well as challenges in information technology
		Student's use of ICT knowledge in getting, processing, arranging, distributing and keeping information
		Student application of knowledge, skills and attitudes in designing information technology systems, solving problems relating to ICT

ICT Indicators Used in Japan

Agency responsible for data gathering	ICT indicators	Components of ICT indicators
e-Japan Priority Policy Programme	Number of internet users	▸ In households ▸ In SMEs (companies with five employees or more) ▸ In corporate (companies with 300 employees or more)
	Public facilities with internet access	
	Number of public schools with internet access and computers	▸ Number of students per PC ▸ Internet access of students
	Number of teachers in public schools who can operate PCs	▸ Number of teachers at elementary, lower and upper secondary schools and special education schools
	Number of human resources with IT-related master's and doctoral degrees	▸ Number who graduated from master's course ▸ Number who graduated from doctoral course
	Number of foreign nationals with the status of residence, "Engineer," and number of nationals entering Japan with the status of residence, "Engineer"	▸ Number of registered foreign nationals ▸ Number of foreign nationals entering Japan
	Ensuring security and reliability	▸ IT security measures (information security policies, presence of firewalls and back-up systems)

ICT Indicators Used in Republic of Korea

Agency responsible for data gathering	ICT indicators	Components of ICT indicators
• Ministry of Education • Korean Educational Research and Information Service (KERIS)	Support	▸ Training hours of the principal ▸ Training hours of teachers implemented by the school itself ▸ Training hours on ICT use in education per teacher ▸ Percentage of operating budget vis-a-vis the total budget ▸ Percentage of teachers in the department of ICT ▸ Whether an ICT yearly plan exists or not ▸ Whether an incentive system for ICT personnel exists or not
	Inputs (infrastructure, hardware, software)	▸ Number of students per computer ▸ Number of computers per teacher ▸ Percentage of computers less than 3 years old ▸ Percentage of computers connected to internet ▸ Speed of internet connection ▸ Number of educational software (CD-titles) ▸ Percentage of computers equipped with 5 basic applications

ICT Indicators Used in Republic of Korea (cont'd)

Agency responsible for data gathering	ICT indicators	Components of ICT indicators
	Utilization	*Teachers* ▸ Percentage of subjects utilising multimedia materials for teaching and learning through WWW ▸ Percentage of classes using web-board ▸ Percentage of subjects using web-board ▸ Percentage of teachers participating in an association regarding ICT use ▸ Percentage of subjects using computer lab ▸ Percentage of functions of the Information System being used ▸ Whether to use electronic decision system ▸ Number of posting written for and by parents *Students* ▸ Hours of use of computer per student ▸ Percentage of students participating in ICT special programmes after school (Elementary) ▸ Whether to teach on computer (Secondary) ▸ Percentage of subjects collecting assignments through web board ▸ Number of search library DB per students ▸ Percentage of student-governing community utilising web environment ▸ Whether a programme regarding internet ethics exists ▸ Number of web communities per class *Internet* ▸ Usage of internet ▸ Number of access to school website per week ▸ How often school websites are revised
	Output	*Teachers* ▸ Percentage of teachers having e-mail address ▸ Percentage of teachers having homepage ▸ Percentage of teachers having ICT certificates ▸ Percentage of teachers participating in educational S/W contests *Students* ▸ Percentage of students having e-mail address ▸ Percentage of students having homepage ▸ Percentage of students having ICT certificates ▸ Percentage of students participating in educational S/W contests ▸ Percentage of students completing the ICT course (32 hours)

ICT Indicators Used in Malaysia

Agency responsible for data gathering	ICT indicators	Components of ICT indicators
Malaysian government (Ministry of Education)	Malaysian smart schools use of technology for information processing and as a productivity tool, to enhance professional development and to automate instruction	ICT in curriculum
		ICT in pedagogy
		ICT in assessment
		ICT in materials

ICT Indicators Used in New Zealand

Agency responsible for data gathering	ICT indicators	Components of ICT indicators
Paper by David Harris, NZCER	Telecommunications equipment	▸ Percentage of schools with telephone lines ▸ Percentage of schools with classrooms that has telephone lines ▸ Percentage of schools with fax machines ▸ Percentage of schools with computers that has access to a modem
	How schools, teachers and students use telecommunications technologies	▸ Number of teachers taking in-service training using a tele-learning approach ▸ Obstacles faced by teachers in using telecommunications technologies ▸ Factors that encouraged telecommunications technology use ▸ Percentage of teachers agreeing that telecommunications technology can enhance learning and teaching ▸ Percentage of students who had positive views about technology activities in school

ICT Indicators Used in The Philippines

Agency responsible for data gathering	ICT indicators	Components of ICT indicators
Project TAO Cares (computer-assisted reforms for schools), senate committee on education, arts and culture Government through the Department of Education	Availability of public/ commercial utilities and services	▸ Percentage of schools with electricity ▸ Percentage of schools whose electricity is available for 24 hours per day ▸ Percentage of schools whose electricity is available year-round ▸ Percentage of schools with ICT equipment ▸ Percentage of schools where public/commercial utilities and services are available ▸ Percentage of schools located in communities where public/ commercial utilities and services are available
	Computer skills of school personnel	▸ Percentage of schools staff who has computer skills ▸ How school staff acquired computers skills ▸ Percentage of school staff with expertise in using different computer software

ICT Indicators Used in The Philippines (cont'd)

Agency responsible for data gathering	ICT indicators	Components of ICT indicators
	Presence of computers in schools	▸ How were computers in the schools acquired ▸ Location of computers in the school ▸ Modes of set-up of the schools computers ▸ Purposes for which computers are used ▸ Operating system used ▸ Software used for teaching and learning ▸ How school acquired software programmes ▸ Percentage of schools with internet access ▸ Source of funds to pay for internet access ▸ Internet connection arrangement (e.g. dial-up, dedicated dial-up or leased line connection) ▸ Who are given access to the internet (e.g. students, principal, administrative staff etc.)? ▸ Financial capacity to have internet access ▸ How often computers are upgraded ▸ Availability of funds for computer maintenance
	Instructional/academic use of computers	▸ Percentage of schools offering computer literacy subjects ▸ How computer literacy subjects are offered (e.g. as part of regular curriculum, integrated with other subjects etc) ▸ School personnel handling computer courses in the school ▸ Purposes for which computers are used as part of instruction ▸ Fees collected for computer use, internet access ▸ Computer use by non-formal education learners

ICT Indicators Used in Slovenia

Agency responsible for data gathering	ICT indicators	Components of ICT indicators
Research on internet in Slovenia	Information-telecommunications infrastructure	*Telecommunication* ▸ No. of telephone connections ▸ No. of telephone connections per 100 residents ▸ No. of cellular phone connections ▸ NMT ▸ GSM ▸ No. of cellular phone connections per 100 residents ▸ No. of ISDN connections *Internet* ▸ No. of internet providers ▸ No. of backbone providers ▸ No. of computers connected to the internet per 100,000 residents ▸ No. of www.domain.si web sites
	Schools and related institutions	*Internet* ▸ Schools with internet access (secondary schools, primary schools, youth hostels, kindergartens) ▸ Pupils with internet access ▸ Schools with homepage *Computers, networks and ISDN* ▸ Average number of computers per 100 employees ▸ Average number of computers per 100 pupils ▸ Share of schools with computers connected to network and ISDN

ICT Indicators Used in Africa

Agency responsible for data gathering	ICT indicators	Components of ICT indicators
School net educator development programme	Impact of ICT on quality teaching and learning	1. ICT Skills Level of educator - includes assessment on skills such as basic word processing, e-mail and electronic information accessing skills. 2. Integration Level - to be measured using the following guidelines: Educators' Competence with ICT ▸ Educators should be able to draw on generic ICT applications in order to prepare for teaching ▸ Educators should be generally competent in those ICT resources that could most benefit their teaching and the learners' learning ▸ Educators should understand how to access and use electronic information and communications resources such as the internet, for the benefit of both the educator and the learner ▸ Educators should know how to use ICT to improve their professional and administrative efficiency ▸ Educators should know how to encourage the development of learners' ICT skills within the context of the lessons being taught Integration of ICT with the curriculum ▸ Educators should understand the key learning strategies that influence the use of ICT to support teaching and learning ▸ Educators should know how to organise their class and classroom when making use of ICT to achieve lesson outcomes ▸ Educators should understand the role of computer literacy, with particular reference to the educational use of computers as a tool in a diverse and developing country like South Africa ▸ Educators should know and understand the characteristics of information, particularly its role in learning and its ethical use and its credibility ▸ Educators should be aware of current health, legal and ethical issues regarding the use of ICT in the classroom ▸ Educators should understand how to assess the contribution of ICT to the process of learning An evaluation instrument is created for assessments in this category. 3. The Professional Growth of the educator - This is measured initially by conducting pre-course baseline studies in which the educator reflects on existing practice and perceived shortcomings. This process begins with a workshop and is further pursued by the mentor in the follow-up period. Progress evaluation of the impact of ICT and the development programme on the educator as a professional is monitored by prompting from the mentor and the educator recording entries in an electronic journal. 4. Whole school levels - Whole school ICT use is measured in a number of ways. Staff ICT and integration-related proficiencies are measured individually or on a departmental or whole-staff basis. This is the choice of the school. An instrument is used to measure the instructional use of technology in a school. This instrument categorises 6 levels of computer efficiency, ranging from non-use to refinement. The emphasis in this framework is given to the degree to which technology is used to support a constructivist orientation to classroom pedagogy.

ICT Indicators Used in Thailand

Agency responsible for data gathering	ICT indicators	Components of ICT indicators
Government of Thailand	Value-added strategy	▸ Provision of software, content and necessary supporting IT curriculum via searching, localizing, producing to make better use of existing hardware in schools ▸ Training of teachers to gain literacy in computer and internet uses ▸ Establishment of maintenance programme for the existing hardware ▸ Enhancement of the capabilities of organizations that can provide support and services to schools by forming network of agencies and individuals ▸ Monitoring and evaluation of the use of technology for education and collect data for planning purpose
	Equity strategy	▸ Provision of a set of minimum requirement equipment and facilities to needy schools, including electricity, 3 telephone lines, 5 computer sets, 1 printer, 3 sets of television, 5 sets of radio, 3 internet accounts @ 100 hours per month via SchoolNet programme ▸ Provision of a "Digital Learning Centre" (DLC) to the community ▸ Training of teachers and trainers in IT and internet literacy
	Quantum jump strategy	▸ All teachers and students to be IT and internet-literate by the year 2002 ▸ Production of 250 titles of academic software and contents annually and provision of 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 ▸ 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 ▸ Provision of IT for education and professional development to the under-privileged, the disabled, and common people seeking lifelong education ▸ Provision of adequate radio frequencies for the education sector ▸ Investment in research and development in IT for education at least 400 million Baht per year ▸ Establishment of monitoring and evaluating procedures and protocols ▸ Establishment of a National Institute of Technology for Education

ICT Indicators Used in UK

Agency responsible for data gathering	ICT indicators	Components of ICT indicators
National Grid for Learning (NGFL)	Computers in schools	▸ Computer/pupil ratio ▸ Average number of computers per school ▸ Type, age and multimedia capability of computers ▸ Average number of computers used for management and administrative purposes ▸ Average number of computers linked to an international school network ▸ Different types of computer peripherals available
	Internet and electronic	▸ Connectivity to the net ▸ Number of schools connected to the internet at broadband level ▸ Percentage and number of schools who have their own website ▸ At least one networked computer with internet access in each schooll for management and administration ▸ E-mail access
	Teacher confidence and use of ICT in teaching	▸ Teacher confidence ▸ Use of ICT in subjects ▸ Benefit of ICT in subject
	Expenditure on ICT	▸ Estimated total ▸ Average per school ▸ Average per pupil

ICT Indicators Used in the United States of America

Agency responsible for data gathering	ICT indicators	Components of ICT indicators
Teaching, learning and computing: A national survey of schools and teachers, Centre for Research on Information Technology and Organizations	Internet use by teachers	▸ Public schools with internet access ▸ Internet connections in classrooms of teachers ▸ Teacher's internet access at home and in their classroom ▸ How often teachers use information from internet in lessons ▸ Teacher's use of electronic mail to communicate with teachers in other schools ▸ Per cent of teachers having their students use different types of software ▸ Student use of web browser software in lessons ▸ Internet use for beyond classroom student projects and publishing ▸ Teacher's perceived value of having a computer with electronic mail on their own desk ▸ Teacher's perceived value of classroom world wide web access ▸ Internet use from various locations (home, school etc.) ▸ Internet use by subject matter taught ▸ Internet use by school level taught ▸ Ability to use web search engine

ICT Indicators Used in the United States of America (cont'd)

Agency responsible for data gathering	ICT indicators	Components of ICT indicators
	Presence of computers in American schools	▸ Total instructional computers ▸ Students per computer ▸ Type of computer in each school level ▸ Per cent of computers with selected attached peripherals ▸ Locations of instructional computers ▸ Per cent technology-intensive by school level ▸ Software saturation ▸ Software diversity ▸ Type of internet access ▸ Public schools with internet access
	Teacher and teacher directed student use of computers and software	Teacher directed student use of computers 1. Access to classroom computers: ▸ Computer-student ratios on classrooms ▸ Number of classroom computers ▸ Computer access in lab and media centres versus classrooms 2. Computer platforms used by student Extent and variety of software used and teachers objectives for use 1. Type of software used 2. Software that teachers judge as most valuable for students 3. Objectives for computer use 4. Student computer use for school work on their own time Teacher computer extertise and professional use 1. Use of software in profession 2. Expertise with computers
	Technology support	▸ Average weekly hours spent by technology co-ordinator on designated job tasks ▸ Average minutes spent per week by technology co-ordinator on job tasks per teacher ▸ Percentage of technology co-ordinators reporting additional support from others (e.g. teachers, district officers, aides, administrators etc.) ▸ Teacher rating of availability of technology support (per school level and per type of school) ▸ Total support hours per teacher (per school level and per type of school) ▸ Number of development occasions for teachers (per school level and per type of school) ▸ Technology support content used to deliver technology services to teachers [e.g. (1) facilities: network and internet access, hardware, software (2) staff assistance and necessary services: technical support, help desk, network services (3) one-on-one personal guidance: computer experts for trouble shooting] ▸ Percentage of teachers who have resource (ICT) available for use

ICT Indicators Used in the United States of America (cont'd)

Agency responsible for data gathering	ICT indicators	Components of ICT indicators
	School investments in instructional technology	▸ Per student expenditure on hardware, software and support per school level ▸ Instructional technology expenditure by US schools (hardware, software and support ▸ Per student expenditure on hardware, software and support for one year vs. five-year estimates ▸ Five-year technology expenditures per student for schools with and without their own technology budgets ▸ Five-year technology expenditures (per student) for public and non-public schools ▸ School technology expenditures (per student) by community income level ▸ Five year school technology expenditures (per student) by level of technology penetration

ICT Indicators in Uzbekistan

Agency responsible for data gathering	ICT indicators	Components of ICT indicators
Government		▸ Number of computer classes ▸ ICT integration in subjects like physics, chemistry and biology ▸ Teacher training ▸ Establishment of ICT departments in universities to train teachers for school ▸ IT as a subject in general education ▸ Number of trained teachers ▸ Provision of computer labs in schools ▸ Collaboration in international training about IT ▸ Application of IT in school management

ICT Indicators in Viet Nam

Agency responsible for data gathering	ICT indicators	Components of ICT indicators
Government		▸ Establishment of ICT departments in universities to train teachers for school ▸ IT as a subject in general education ▸ Number of trained teachers ▸ Provision of computer labs in schools ▸ Collaboration in international training about IT ▸ Application of IT in school management

Attachment

II

Comparison of ICT Indicator Themes in Selected Countries

	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	Type of indicators	Presence of indicators addressing equity, ethics and investment issues	Presence of indicators on ICT integration in curriculum, impact etc.
Australia	Goals and objectives of the government: 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 in society	Yes, Curriculum and Standards Framework (CSF)	Primary, secondary, non-formal	Teachers, students	Computers, internet, use of satellite TV	Quantitative and qualitative	Not specified	Yes, specifically, the study conducted by the University of Sydney. Include studies on student engagement, enthusiasm and movitation, improvement of higher-order thinking skills etc.
Baltic and CIS countries	Based on a meeting convened in IITE Moscow in 2000 to develop a set of ICT indicators	None	Primary, secondary and tertiary levels	Heads of departments, senior specialists, staff of national Centres of Informational Technologies and Education or Centres of Teacher Training Retraining and Educational Support	Computers and internet	Quantitative - policy documents: ICTs in curriculum, hardware and equipment, software; Global communication means and personnel development	None	Partly

	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	Type of indicators	Presence of indicators addressing equity, ethics and investment issues	Presence of indicators on ICT integration in curriculum, impact etc.
Canada	Two criteria for development of indicator set: ◆ Type of education, information needed for policy development ◆ Practical availability of data/indicators developed by Pan-Canadian Education Indicators Programme (PCEIP)	None	Elementary and secondary level	Not specified	Computers and internet	Quantitative and qualitative ◆ Pupil-computer ratio ◆ Internet connectivity ◆ Internet activities of students ◆ Obstacles to fuller use of information and communications technologies	None	Yes, specifically, on what encourages teachers and students to use computers
Europe 1	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	Yes, ISTE (NETS) standards	Various researchers covered different level: public primary and lower secondary; primary, secondary and special schools; head teachers and teachers	School heads, teachers	ICT in general, computers and internet access	Quantitative and qualitative ◆ Policy and strategy ◆ Economy and infrastructure ◆ Use and access ◆ Competencies	Yes, specifically, on national policies and expenditure	Yes, on competency of ICT instructors
Europe 2	Eurydice	Yes. ISTE (NETS) standards	Primary and secondary level	Not specified	Computers and internet	Mostly quantitative, very little on qualitative indicators. Examples: ◆ Number of pupils per computer ◆ Desirable ICT skills according to official recommendations for the initial training of all teachers (except specialist ICT teachers)	Mainly on expenditure, distribution of budget	Yes, on integration of ICT in subjects

	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	Type of indicators	Presence of indicators addressing equity, ethics and investment issues	Presence of indicators on ICT integration in curriculum, impact etc.
India	Government	None	Elementary and secondary schools	Not specified	Computers, internet, software	Quantitative	None	None
Indonesia	Curriculum Centre Government's goals and objectives	None	Elementary and secondary schools	Not specified	Computers and the internet	Quantitative. More of internet and computer use and access	None	None
Japan	eJapan priority policy programme/various surveys conducted by government agencies on ICT in general. Like 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	Quantitative. More of internet and computer use and access	Yes. Government general IT policy on elementary and secondary schools the same for schools for the blind and disabled	None
Republic of Korea	Cyber Korea 21, Vision: To prepare students for knowledge based society by realizing life-long learning via cyber-education system"/Korea National Statistics Office	Yes - based on the document entitled: Adapting education to the information age: A white paper	Elementary, secondary,	Teachers and students and school headmasters	Computers, internet and multimedia	Quantitative. More of internet and computer use and access through input, utilization and output indicators	None	None
Malaysia	Government	None	Elementary and secondary schools	Not specified	Computers and the internet	Quantitative	None	None
New Zealand	Research conducted by the Telecom Education Foundation	None	Not specified	Teachers and principals	Telephone lines, fax machines, computers and internet	Quantitative and qualitative ◆ Telecommunications equipment ◆ How schools, teachers and students use telecommunications technologies	None	Yes, specifically on what encourages teachers and students to use computers

	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	Type of indicators	Presence of indicators addressing equity, ethics and investment issues	Presence of indicators on ICT integration in curriculum, impact etc.
Philippines	Senate Committee on Education, Arts and Culture with SEAMEO-INNOTECH Department of Education	None	Public and private elementary and secondary schools	School heads	All ICT related technologies such as television, projectors, radio/ cassette players, computers peripherals and internet access	Quantitative ◆ Availability of public/ commercial utilities and services ◆ Computer skills of school personnel ◆ Presence of computers in schools ◆ Instructional/ academic use of computers	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	Quantitative ◆ Internet access ◆ Computers, networks	None	None
South Africa	School net	None	Not specified	Students and teachers	Computers and internet access	Qualitative examples: Integration of ICT with curriculum instructional practices barriers to computer use	None	Yes, on competency of ICT instructors
Thailand	Government National Education Act of 1999	None	Primary and secondary schools	Not specified	Computers, internet, telephones, computer peripherals, ratio	Quantitative	None	None

	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	Type of indicators	Presence of indicators addressing equity, ethics and investment issues	Presence of indicators on ICT integration in curriculum, impact etc.
UK	National grid for learning	ISTE (NETS) standards	Primary and secondary schools	Students and teachers	Computers and the internet	Quantitative and qualitative ◆ Computers in schools ◆ Internet and electronic communication ◆ Teacher condidence and use of ICT in teaching ◆ Expenditure on ICT	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.	Quantitative and qualitative ◆ School technology leadership and technology outcomes ◆ Pedagogical motivations for student computer use ◆ Internet use by teachers ◆ Presence of computers in American schools ◆ Teacher and teacher directed student use of computers and software ◆ Technology support ◆ School investments in instructional technology	Yes, includes indicators that determines technology intensive areas, software saturation etc.	Yes, specifically pedagogical motivations for student computer use

	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	Type of indicators	Presence of indicators addressing equity, ethics and investment issues	Presence of indicators on ICT integration in curriculum, impact etc.
Uzbekistan	Government Law on Education	None	Primary and secondary education	Not specified	Computer and internet	Quantitative	None	None
Viet Nam	Government Government's goal to "universalize" education	None	Primary and secondary	Not specified	Computer and internet	Quantitative	None	None

Attachment

III

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 in 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. It is a sample survey and the sample is chosen to be representative of different types of schools throughout the country. Some of the findings as categorised are the following;

a. Computers in schools
   - average number of computers per school increased steadily in all types of schools between 1998 and 2001; the increase was noted to be great between 2000 and 2001

b. Internet usage and other external electronic communication services
   - between 1998 and 2001, there was a considerable increase in the percentage of schools connected to the internet

c. Use of ICT in teaching and teacher confidence
   - in each type of school there was an increase in the percentage of teachers reported to feel confident in the use of ICT in 2001

d. Expenditure on ICT
   - the average expenditure on computers per school increased steadily in all school types between 1998 and 2001

Source: Statistics of Education:
Survey of Information and Communications Technology in Schools 2001
National Statistics Bulletin
Department for Education and Skills
Issue No. 09/01
October 2001

B. The Network 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. In the development of the NRI, data sources fall under two general categories. First, a variety of measures, mainly "hard" variables and also "soft" ones from sources such as the World Bank, the International Telecommunications Union, Freedom House, and the Business Software Alliance were used. Second, data collected from the questionnaire responses of more than 4,500 business and government leaders surveyed in 75 countries by the Global Competitiveness Report's 2001 Global Executive Opinion Survey conducted by Harvard University and the World Economic Forum were heavily relied upon.

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. Seventy-five countries were computed NRIs

and the United States of America tops the NRI ranking making it the most highly developed ICT network and it has the greatest potential to exploit network's capacity. Iceland, Finland, Sweden, Norway and Netherlands follow USA. Another Northern European country, Denmark, ranks 7th, followed by Singapore in 8th, Austria in 9th and the United Kingdom in the 10th place. Among the countries in the region which were included are Korea, rank number 20 followed by Japan in the 21st place, Malaysia in number 26, Thailand, number 43, India, number 54, Philippines, number 58 followed by Indonesia in number 59, Sri Lanka in number 62, China in 64, Bangladesh in 73 and Viet Nam in 74.

Two components were taken into consideration in the computation of the NRI. These are network use and enabling factors. Network use is defined as the measure of the extent of increase in the use of ICT in a specific country. This is still narrowed down to five more catagories: Internet users per hundred inhabitants, cellular subscribers per hundred inhabitants, internet users per host, percentage of computers connected to the internet and availability of public access to the internet.

Enabling factors is made up of four sub-indices: network access, network policy, networked society and networked economy. Network access includes variables related to the information infrastructure, hardware, software and support. It measures the extent and quality of the network infrastructure and the existence of equipment, programmes, and support services that enable ICT use. Network policy refers to the information and communications policy environment, and the business and economic climate. It also deals with the levels of competition in the telecommnications and ICT sectors. Networked society measures the quality and extent of use of ICT facilities in the learning process and networked economy assesses the extent of public and private sectors participation and e-government are considered in this sub-index.

Source: http://www.cid.harvard.edu/cr/pdf/gitrr2002-cho02.pdf

C. Profile on the capabilities of elementary and secondary schools in the Philippines, 2000-2001

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 was to determine the ICT capabilities of schools. A total of 45,811 schools were given questionnaires with the school heads as respondent of which 79.37 per cent responded. 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. Outputs of the survey were sixteen regional profiles on the ICT-preparedness of schools which included data on the availability of electricity, access of schools to communication facilities, presence of computers, computer peripherals and other multi-media equipment in schools, sources of funds to maintain ICT-related operations, proficiency of school staff in the use of computers, training received on ICT, computer courses being offered in schools and other ICT-related information.

Some of the major findings of the survey at the national level are the following:

- Only 66.07 per cent of schools have electrical connections
- Only 13.30 per cent have landline telephones, 2.90 per cent have fax machines, and 2.00 per cent have internet connections
- 5,217 schools only or 14.28 per cent have computers with the National Capital Region having the highest percentage at 87.30 per cent
- Only 18.24 per cent of schools have staff proficient in the use of computers

- 78.62 per cent of schools get funding to maintain ICT related operations from the PTCA
- Only very few schools (13.13 per cent) have school heads who have received ICT training in the past five years
- 64.36 per cent of school heads need training on basic computer literacy

D. The 1996 national survey on computer education in the 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 to improve the quality of student learning and efficiency of teaching. A total of 794 schools participated in the survey with school heads in the public and private schools as respondents. 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 dealt with the actual use of computers was answered by users only. Among the findings are the following:

- The number of computers owned by a private schools is twice as much as what a public school can afford
- Computers available in schools are mostly the models AT486
- Most computer units in the public elementary schools were acquired through donations, in the secondary and tertiary schools, most computers were acquired through purchase
- Computers are mostly used to teach different application programmes

Source: The 1996 National Survey on Computer Education, New Educational Technologies Foundation Inc.

E. Use of multiple assessment tools

In a primary school in Sunnyside Elementary School, Pullman, Washington, students are using e-mails, web sites, videos and video conferencing technology tools to develop their learning skills. Through these mediums, the students alongside their global peers identify and share their cultures with one another in new ways. Traditionally, students learn about the world through books, but new technology allows the students to get in depth information about different cultures through writing, reading and communicating with their global peers. The following are the assessment tools used: Assessment rublics designed for specific projects, lesson, and/or classroom experiences; standard assessment tools (i.e., DRA and Wright Group Reading Assessments); teacher anecdotal notes; children's own metacognitive voices in the process of learning; in conference with the teacher, and in self-reflection of work and presentations; parents' reports of student learning progress.

Teaching in non-traditional ways can sometimes be a risky business - with all eyes upon the class to see if learning is taking place. It has been shown that students form teams to read, write, and communicate using technology at rates that meet and exceed standards for primary classes. But along the way, the added value of technology contributes in areas such as thinking skills, social skills, engagement in learning, motivation, teaching, and collaborating as the class sees what is essential to learn in the context of the real world.

Source: http://www.ncrel.org/engauge/framework/efp/align/efpalisu.htm

F. Technology: A major catalyst for increasing learning

by Jody C. Isernhagen, University of Nebraska-Lincoin

Technology Horizons in Education, Journal Online August 1999 - Feature

A rural public school in Nebraska composed of 1,400 students applied for a three-year competitive Excellence in Education Grant in late 1995. Six school administrators and 18 staff members designed a plan to restructure their school and classrooms. The staff members defined that the major skills needed by students are comprehension, reasoning, composition and experimentation. A computer was placed in each classroom (80 classrooms) and 27 computers were located in the elementary Integrated Learning Lab with Computer Curriculum Corporation Success Maker Software. This software automatically diagnoses and places students on the appropriate skill level while using the computer. The computer lab was used by 314 students and 13 teachers in grades 1-3 from January 1996 through May 1998. Teachers were trained on the use of ClarisWorks, Microsoft Word, E-mail, Internet, Presentation Stations and the integration technology as a took in teaching and learning. Activities of the students involved computer building; designing of web pages to help maintain the school's web pages; digitizing video to present to the community; creating panoramic views and interactive virtual reality scenes; preparing letters of application, resumes and cover letters and to search the web for jobs. With all the activities the teacher served as guides, figuring out with the students how to arrive at a productive presentation.

The CAT scores in reading and math for students using an Integrated Learning Lab for 2.5 years showed a significant difference between the means. The scores of students testing below the 50th percentile at grades 1-3 in reading and math increased significantly over time. These findings suggest that using an Integrated Learning Lab with rural primary age children daily over an extended period of time may positively impact achievement for students, particularly those students functioning below the 50th percentile.

Source: http://www.thejournal.com/magazine/vault/articleprintversion.cfm?aid=2126

G. The impact of ICT on literacy learning in English

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. There were 1,871 studies screened following a criteria to identify relevant reports. 188 studies were found that met the criteria in the protocol. These studies were then keyworded, or indexed and the results filed on an electronic database.

Of the 188 studies relevant to the mapping study, 16 pertained to the topic of the impact of networked ICT on literacy learning. Data were extracted from these 16 studies and were used as basis for an in-depth review. Of these, half were outcome evaluations (evaluations of the results of an experiment or innovation), seven were process evaluations (evaluations on how an intervention was delivered, rather than whether it worked or not) and one was a needs assessment.

Results show that as far as the in-depth study on networked ICT goes, results are inconclusive. Concerning policy and practice, the recommendations of this review are highly tentative and take the form of implications or pointers. With regard to policy, they are to focus research funding for large-scale studies; to give consideration to the balance of study type expertise in research teams; and to give consideration

to the fact that the provision of computer hardware and software to schools, and the application of ICT in teaching and learning, need to be informed by research and evaluation.

Source: http://eppi.ioe.ac.uk/EPPEWeb/home.aspx?page=/reel/review_group.../review_one_abstract.ht

H. Education Research Fund Effective Integration of IT in Singapore Schools: Pedagogical and Policy Implications

This 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. A total of 328 schools responded to the survey of which 168 are primary schools, 144 secondary schools and 16 junior colleges/centralized institutes (JC/Cs).

Major findings of the questionnaire survey include:

- Phase I schools in the IT Masterplan have significantly higher pupil and teacher use of IT, greater opportunities for staff development of teachers, and more conducive IT culture than Phase III schools
- Independent-autonomous schools have significantly better management of IT resources, higher teacher and pupils use of IT, greater opportunities for staff development for teachers and more conducive IT culture than government schools
- There are no significant differences among the primary schools, secondary schools and JC/Cs in terms of the management of IT resources, pupil and teacher use of IT, staff development and school IT culture
- The correlations among management of IT resources, pupil use of IT, teacher use of IT, staff development and IT culture are significant and highly positive