ICT lessons*learned* Series 2004

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Integrating ICTs into Education: lessons*learned*

A Collective Case Study of Six Asian Countries
Indonesia • Malaysia • Philippines • Singapore • South Korea • Thailand

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ICT IN EDUCATION

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Preface

This package entitled "Integrating ICTs into Education: Lessons Learned" arose from the rapidly growing body of experiences, and innovative strategies and approaches from countries in Asia and the Pacific. Although the region has recently embarked on this new field of largely untested grounds, since many countries have leap frogged into the opportunities that ICTs can offer, showing exciting results, this wealth of experiences certainly deserves attention. Numerous case studies have already been written on the use of ICTs for education in Asia and the Pacific, but distilling these experiences, and culling out lessons learned, and innovative strategies and practices has not yet been conducted. This becomes all the more needed when one thinks of the potential waste of funds and investment (setting up ICT infrastructure and facilities), if we are to avoid re-making mistakes and losing good opportunities. Moreover, a synthesis becomes all the more important when one thinks of the little time that policy-makers and managers have to plough through all the available information, much of which could be repetitious or with inconsistent content, not to mention outdated data.

This activity is part and parcel of the *Strengthening ICT in Schools and SchoolNet Project in ASEAN Setting* funded by the Japanese Funds-in-Trust and the ASEAN Foundation. The Project is an attempt to demonstrate that the use of ICT in education will make a difference in improving the teaching/learning process through the systematic integration of the use of ICT into existing educational curricula on science, mathematics and language. In order to attain this goal, the following supporting strategies are implemented: a) documenting of successful

experiences and innovative strategies in the use of ICT in schools from the more advanced countries to serve as benchmarks and guidance for programme planning and implementation; b) policy and strategy development, specifically dealing with integration/mainstreaming of ICT into national education curriculum; c) development of integrated ICT-based curriculum, teaching and learning materials and applications for teaching science, mathematics and language; d) establishing connectivity and pilot testing the use of ICT in 24 schools in eight ASEAN countries based on the previous activities; e) training of teachers in computer literacy, the use of the ICT-based teaching/learning materials in science, mathematics and language, telecollaboration and use of SchoolNets; f) establishment and use of national SchoolNet to promote sharing of information and resources; g) the creation of national and ASEAN SchoolNets and telecollaboration among pilot schools in eight ASEAN countries; and finally, h) sharing of best practices.

The first activity of the project was documenting the experiences of selected countries in the South East Asian countries on the use of technology in education in order to learn from their successes, as well as avoid the pitfalls and failures that have occurred in these initiatives. Such tested techniques and strategies could be adopted to promote the use of ICT in schools in a most integrated way, contributing towards improvements in educational quality and learning.

The documentation of experiences was undertaken through country case studies written by ICT specialists who are directly involved in the implementation of the ICT for education programmes in their respective countries in order to:

1 Document, synthesize and extract lessons learned in the use of ICT in schools and the setting up / impact of SchoolNets in selected countries in order to help improve planning, management and implementation of ICT for education programmes;

2 Provide tools for advocacy as well as guidelines for policy-makers and practitioners to support ICT in education initiatives; and

3 Serve as benchmarks for implementing the project activities of the JFIT-funded Strengthening ICT in Schools and SchoolNet Project in ASEAN Setting, specifically the integration of ICT into national curricula of ASEAN countries, the development of Startup toolkit and operation of SchoolNets

These six case studies are from the following countries and experts:

1 Indonesia – Harina Yuhetty, Director, PUSTEKKOM, Jakarta, Indonesia

2 Malaysia – Chan Foong Mae, Principal Assistant Director, Communication and Training Sector, Educational Technology Division, Kuala Lumpur, Malaysia

3 Philippines – Victoria L.Tinio, Director of E-Learning, Foundation for Information Technology Education and Development Inc., Manila, Philippines

4 Singapore – Lim Cher Ping, Assistant Professor, National Institute of Education, Singapore

5 South Korea – Okhwa Lee, Chungbuk National University, Seoul, South Korea

6 Thailand – Pornpun Waitayangkoon, Assistant to the President, The Institute for the Promotion of Teaching Science and Technology, Bangkok, Thailand

The case studies are very robust and provide a mine of information which can be overwhelming to the readers, especially the policy-makers who may not have the time to go over them.

Thus a synthesis was necessary to highlight lessons learned for the benefit of the following audiences:

1 Policy-makers with responsibility for education and ICT issues, especially but not limited to those within the ministries of education

2 School-level practitioners especially at the secondary level, (administrators, teachers, technical support staff), and those involved in the pilot ASEAN SchoolNet project

The synthesis of these case studies was prepared by Dr. Lim Cher Ping, an assistant professor at the National Institute of Education, Nanyang Technological University. He is the chief investigator of two funded research projects: (1) Effective Integration of ICT in Singapore Schools: Pedagogical and Policy Implications (MOE/Singapore), and (2) Supporting E-discussions with New Technologies in Learning Communities (M1/Singapore). He has published widely and internationally in different areas of education technologies, namely online learning and other ICT-based learning environments in schools and corporations. Carmelita Villanueva, Chief of Information Programmes and Services at UNESCO Bangkok and Tinsiri Siribodhi, ICT Specialist, have also extensively contributed to editing the manuscript.

Executive Summary

Rapid global technological and economic developments have placed greater demands on education systems. The need to inculcate among students the importance of lifelong learning, that is, to constantly seek new information, to think critically and to take initiative has become ever more pressing in our fast-changing world. Countries in Asia and the Pacific have responded to these challenges in different forms and at varying levels so as to enable their people to adapt to change, inspire creativity and innovation, and enhance their ability to apply knowledge and solve emerging problems with confidence.
Policies and strategies have been developed to integrate ICTs into education.

While ICT use in education in Asia and the Pacific is relatively recent, it has nevertheless made an impact on education systems. A wealth of experiences, good practices and lessons have been generated for the benefit of countries where ICT use in education has just begun as well as those countries where ICT application and integration in education are well established. This collective case study aims to:

i. describe lessons learned in integrating ICT in education programmes, based on the experiences of six Asian countries namely, Indonesia, Malaysia, Philippines, Singapore, South Korea and Thailand; and

ii. synthesize and analyze ICT integration experiences in connection with specific lessons learned and highlight best practices and the need for further improvements.

In these six countries, ICT use in education is at different stages of development. In its review of 90 ICT projects in Asia, the UNESCO (2003) comprehensive report groups the countries into three categories:

1. Advanced countries with integrated ICT in the education system. These include Australia, South Korea and Singapore. Some typical characteristics of these countries are as follows: almost all classrooms are equipped with computers and other ICT tools; the student/computer ratio is high; Internet access is available in all schools; curriculum revision ensures nationwide ICT integration; delivery of education is increasingly online.

2. Countries where national ICT policies and master plans have been formulated and various ICT integration strategies are being applied and tested (although ICT is not fully integrated in the education system). These include China, Thailand, Japan, Malaysia, the Philippines and India. While there is great variation in their characteristics, there are nevertheless some common features as follows: national ICT policies in education have been developed, and the goals and objectives for introducing ICT in various aspects of education have been established.

3. Some countries where efforts towards ICT integration efforts and formulation of national policies have just begun. There are also countries that have no relevant policies but are running pilot ICT projects. In both instances, however, there is insufficient budget to implement policies and work plans and ICT infrastructure and penetration are poor. This

third category includes Myanmar, Lao PDR, Viet Nam, Cambodia, and Bangladesh, among others.

Because of the different levels of ICT integration in the six countries, alongside many similarities in their experiences of ICT integration, there is a variety of approaches that should be explored and examined. An analysis of experiences and best practices and associated problems has generated lessons learned in the following eight components of ICT integration in education: (i) broader environmental context, (ii) policy and regulatory environment, (iii) management and financing, (iv) ICT in schools – policy, vision and strategy, (v) technology infrastructure and connectivity, (vi) curriculum, pedagogy and content development, (vii) professional development, and (viii) monitoring and evaluation.

These components provide the key foundation and framework in setting up ICT for education programmes. A synthesis of lessons learned from selected countries in the region provides the basis for the development of tools and blueprints to guide policy formulation and programme improvements. It also serves as an advocacy instrument to gain the support of policy-makers and other stakeholders for the appropriate use of resources to support the integration of ICT in education.

The following summary provides an overview of lessons learned.

I. Broader Environmental Context

1. Education System Responsiveness

- *A well-planned and responsive education system provides an appropriate enabling environment for the successful implementation of ICT in education policy and programme*
- *To make ICT an integral part of the education master plan and ensure programme support, the ICT in education policy should share the same vision as other educational policies or initiatives*

2. ICT in Education Policy and ICT Infrastructure Support

- *An ICT in education policy that is driven by a vision which can be translated into action targeted at realistic and manageable goals contributes to successful programme implementation*
- *A holistic approach to ICT in education policy goes beyond a technological dimension*
- *Adequate physical and technological infrastructures are necessary conditions for effective ICT integration*

3. Economic and Social/Cultural Context

- *A well-developed ICT infrastructure in the economic sector facilitates successful implementation of ICT in education policy*

- *ICT in education policy is one of several key economic strategies to ensure sustained economic development of any country*

II. Policy and Regulatory Environment

1. Policy Development

- *To ensure that ICT in education policy is integrated in the national ICT policy, Ministries of Education (MOE) should work closely with other government organizations, especially those in charge of implementing national policies on ICT and telecommunications*

- *Lessons learned from pilot projects and studies in education that are carried out at different levels of the school system provide the basis for further policy expansion*

- *Harmonized implementation of ICT in education programmes can be achieved by defining clearly the roles and responsibilities of all departments (within the MOE and other relevant ministerial departments) in the implementation of ICT master plans, showing clearly the different components of project activities, including budget allocations, manpower requirements and timetables.*

2. Transforming Policy into Action

- *Phased implementation of ICT in education policy ensures that the implementation process is manageable and the development of best practices and lessons learned is gradual. It also provides opportunities for evaluations so that the policy can be revised and fine-tuned*

- *Central support from the MOE to pursue a clear and measurable vision helps in developing and implementing a comprehensive programme for the capacity building of schools in using ICT in education*

3. Legal and Regulatory Framework

- *Initial filtering of the Internet from undesirable websites is necessary in order to prevent their harmful influence on younger students who may not be able to discern the veracity and reliability of information*

- *More than any software or hardware device, better protection is ensured by making education on safety issues pertaining to the Internet an integral part of parenting as well as of teaching and learning activities at home and in the school*

4. Macro-Economic Impact

- *To narrow the digital divide, ICT in education policy should complement other government initiatives, such as public education on ICT, donation of computers and provision of free Internet access*

5. Inter-Ministerial Collaboration

- *Sharing expertise, experiences and infrastructures among ministries and government agencies helps to coordinate and harmonise implementation of ICT in education programmes*
- *Creating a national policymaking, regulatory and implementing agency for ICT development systematizes inter-ministerial cooperation on ICT in general, including education*
- *Beyond ministries and government agencies, inter-ministerial collaborations could involve private sector participation*

6. Advocacy and Support from Policymakers and Other Stakeholders

- *By linking the objectives of ICT in education policy with national education objectives, support from policymakers and other MOE stakeholders, including human capacity building, could be more forthcoming*
- *By making policymakers and stakeholders regularly aware of and updated on the benefits of ICT to education, based on research results and documentation of experiences, advocacy for the acceptance of ICT use in education is further strengthened*
- *By making all decisions taken or amended by the MOE's highest steering committee known to all members of the committee and heads of departments, their sense of ownership and involvement is enhanced*

III. Management and Financing

1.Leadership and Management

- *Having a champion at all levels in the education system promotes ICT acceptance*
- *Including 'ICT in Education' as an important component in the development programme for administrators supports the introduction of innovative use of ICT in schools*

2. Harmonizing ICT in Education Programmes with Other ICT and/or Education Initiatives/Projects

- *To avoid duplication of work and dilution of funds, there should be coordination of ICT in education projects and sharing of information on ICT*

3. Dichotomy between Educators and Technologists

- *To ensure that ICT in education projects are not just technology-driven, they should be managed by a team composed of educators and technologists*

4. Resources at Ministerial and School Levels

- *To ensure the site readiness of all schools, there must be adequate, initial financial investment by the government at the national level, especially on basic ICT infrastructure and resources*
- *Every school is different and each one should be given some autonomy to select ICT resources that are most suitable to the needs of teachers and students*
- *Investments in ICT infrastructure and resources in schools create an environment that is conducive to learning*
- *The MOE should be encouraged to establish a standard budget based on school size and existing resources rather than to apply one formula for all schools*

5. Resources from Donors and the Private Sector

- *Financial and resource support for the implementation of ICT in education policy is mobilized if school-industry partnership is an integral part of such policy. In addition, schools are able to explore and experience emerging technologies and pedagogies.*

6. Strategies to Ensure Sustainability

- *Preparing and disseminating guidelines on how to source funds empower schools to look for their own funds and to identify expertise to promote sustainability*

IV. ICT in Schools – Policy, Vision and Strategy

1. ICT in Schools: Vision and Plan

- *A clear vision of ICT integration in schools that is shared by all members of the school community promotes effective use of ICT in the classroom*
- *An ICT master plan that is formulated according to a school's vision and its socio-cultural setting assures effective integration of ICT*

2. Supporting Policies to Facilitate Uptake of ICT

- *To promote ICT uptake in schools, school leaders should initially adopt strategies that make ICT part of the daily routine or tasks of the teachers*
- *To promote use of ICT in schools, the MOE should set guidelines for schools on the integration of ICT in the curriculum, without necessarily imposing these as rules or regulations to be strictly adhered to*
- *ICT use in schools is more likely to be facilitated if school leaders employ strategies that provide teachers with a platform and support for the integration of ICT in the school curriculum*
- *Appointing an ICT coordinator or head of ICT department in each school helps to ensure administrative and pedagogical support for the teachers*

3. Management of ICT Resources

- *Carrying out a SWOT analysis and applying its findings help to optimise use of ICT resources*

4. Translation of Laws into Acceptable School-Level Regulations

- *Translating ICT in education policy and laws into a set of school-level regulations and procedures provides a clearer blueprint for schools on the use of ICT*

5. Parents and Community Involvement

- *ICT bridges and strengthens the home-school connection and, if properly harnessed, promotes parents' activities and involvement in the school*
- *When parents are encouraged to participate in and contribute to change management activities within a school's ICT master plan, change occurs more quickly*
- *As ICT opens opportunities to collaborate with different organizations and people in local and international communities, schools should establish linkages with different communities to help in developing the overall character of students*

V. Technology Infrastructure and Connectivity

1. Mobilizing Support from Telecommunications and ICT Organisations and Industries

- *Tapping local telephone companies and ICT industries for support promotes affordable Internet connectivity and computer hardware and software*

2. Choice and Mode of Deployment of Technologies

- *When deploying technologies to schools throughout the country, establishing a balance between equity and effectiveness is necessary*
- *Deploying ICT in different types of pilot schools or demonstration schools will generate lessons on how to increase ICT use at different school levels and cull best practices*

3. Connectivity Options/Alternatives

- *Use of satellite and Internet schemes has enabled some countries to reach marginalised areas or economically disadvantaged groups*
- *Working closely with Internet Service Providers (ISPs) helps in determining appropriate bandwidth connection in schools and homes*

4. Infrastructure to Support and Deliver Teaching and Learning

- *There is no perfect combination of online and offline resources to promote effective teaching and learning*
- *Digital libraries for schools may be introduced as infrastructure to support and deliver teaching and learning*

5. Emerging Technologies: Dealing with Rapid Development of Technologies

- *ICT pilot projects should not take more than three years to complete since the obsolescence rate of present-day technologies is increasing*
- *Mobile computing offers schools many opportunities that include overcoming constraints of space and giving flexibility in anytime-anywhere utilization of ICT in schools*
- *Leasing equipment from private companies can be one solution to the problem of rapidly increasing obsolescence rate of present-day technologies*

6. Donation of Computers

- *Vocational colleges can be tapped to provide maintenance service for computers donated to schools*
- *Donated computers that have exceeded their lifespan may be redeployed for other uses or may be offered to needy students in other schools or some government and charity organizations.*

7. Open Source Software

- *Although open source software (Linux-SIS, locally-developed word processor and digital toolkit for developing web content) is encouraged in the schools, there are limitations that must be taken into account before schools decide to use open source software*

8. Guidelines on Information Security

- *Preparing and disseminating guidelines on ICT security help in dealing with information security problems in schools*

9. Integrating School Management Software with Learning Management System (LMS)

- *Maintaining the inter-operability of a common school management system while ensuring that decoupling is built into the system is a need expressed by most countries*
- *There should be adequate in-house training to help school staff and students in using LMS and in coping with the transition from manual to automated processes*

VI. Curriculum, Pedagogy and Content Development

1. Integrating Technology in the Curriculum and Assessment

- *When teachers perceive ICT as a tool to meet curricular goals, they are more likely to integrate ICT in their lessons*
- *Equipping students with ICT skills facilitates the effective integration of ICT in schools*
- *Teachers play a pivotal role in the integration of ICT in the school curriculum and assessment*
- *When ICT is introduced into the assessment process, there is a need to reconsider the assessment approaches*

2. Shift in Pedagogy as a Result of Integrating ICT in the Curriculum

- *Shifting pedagogical approaches to the use of ICT in education is time-consuming*
- *Shifting pedagogies, redesigning the curriculum and assessment, and providing more autonomy to the schools help to optimize the use of ICT*
- *Shifting pedagogical approaches is facilitated through appropriate professional development of teachers*

3. Contents and Services that Support Continuous Improvement of Curriculum Practices

- *Attracting well-established foreign education software developers to work with local companies helps to develop high quality ICT-based resources*
- *Establishing a clearing house or digital libraries of ready-to-use and customizable ICT-based resources promotes better use of ICT in teaching and facilitates quick and easy access to resources for making lesson plans and for teaching*

4. Development and Selection of Culturally Sensitive Content

- *Having a mechanism in place for evaluating content developed for schools ensures political and cultural validity, reliability and correctness*

5. Ethical and Political Implications of English as Lingua Franca

- *While local content in the local language promotes better use of ICT-based resources and materials, the use of English in schools optimizes the potential of ICT (especially the Internet) for teaching and learning*

6. Intellectual Property Rights Related to Educational Software

- A cost-benefit analysis conducted before deciding on whether to acquire the intellectual property rights to educational materials, or to acquire a perpetual license

to use the materials, prevents waste of resources

VII. Professional Development

1. Policy and Management of Teacher Training on ICT

- *To ensure continuous training of teachers from pre-service teacher education to induction to in-service professional development, training agencies should be mobilized and labour divided among them, with the MOE providing central coordination*
- *Professional development is more likely to succeed if continuous training of teachers is a built-in process and is offered as a benefit to them*
- *A centralized training administration system for all teaching and non-teaching staff is crucial to document and monitor professional development*

2. Teacher Training Modalities

- *Peer and school-based training of teachers by their more experienced peers from other schools or senior instructors from the MOE ensures that teachers are trained in the context of their workplace*
- *Incorporating online learning into professional development on ICT enriches teachers' experience and makes them comfortable with online learning*
- *Needs-based just-in-time learning and peer coaching ensure further development of teachers' ICT and pedagogical skills*

3. Teachers' Competencies and Standards

- *ICT competency standards serve as a benchmark for formulating and evaluating teacher training programmes and use of ICT in teaching*
- *Customizing national-level ICT competency standards for each school, depending on its socio-cultural context, ensure ICT integration and acceptance*

4. How to Change Mindset of Teachers

- *A buddy system approach where novice teachers work together with expert teachers in a classroom using ICT contributes towards changing prevailing mindsets*

5. Content Focus of Capacity Building for Teachers

- *Training teachers on ICT-related skills within the context of classroom objectives and activities ensures development of skills in the integrated use of ICT in teaching*
- *ICT professional development programme for teachers should be planned, taking into account the vision of ICT in education policy*

6. Capacity Building for Education Personnel at All Levels

- *Training education personnel at all levels ensures that all aspects of ICT use in schools are implemented in an efficient, coherent and complementary way*

7. Incentive System and Motivational Strategies for Teachers

- *Formal certification of in-service professional development that leads to diplomas or degrees could provide an incentive for teachers to upgrade and update their skills in and knowledge of ICT integration*
- *Teachers' interest in using ICT after their training is more likely to grow if they* are *provided with computers, training materials and software for classroom use*

VIII. Monitoring and Evaluation

1. Documentation of Benefits of ICT Use in Education

- *Proper use of ICT tools offers students and teachers learning and teaching opportunities and improves teaching and learning processes*
- *Investment in research and development projects and centres has contributed towards examining existing pedagogical practices, revising and refining practices, and exploring new pedagogical approaches to ICT in education*
- *Research has helped policymakers to formulate ICT targets and goals*
- *Evaluation can demonstrate the reasons for the under-utilization of ICT resources and identify major obstacles to their full utilization in schools*

2. Evaluation Methodologies

- *Action research is one of the best methodologies for documenting the process of effective ICT integration*
- *Assessing the learning impact from ICT use is better measured through other means besides the paper-pencil test method*
- *To gather the most meaningful data on the integrated use of ICT in schools, both quantitative and qualitative methodologies should be used, employing various data-gathering instruments, such as case studies, questionnaires, face-to-face interviews and focus groups*

3. Programme Evaluation

- *Evaluation of ICT in education programme should be a continuous process, covering planning, implementation, reflection, refinement, effectiveness and user acceptance*
- *Due to limited experience in ICT use in the region, better quality directions for the programme can be obtained by benchmarking the quality of ICT projects against international studies, standards and best practices*

Abbreviations

AICTP	•	Accelerating the Use of ICT in Primary Schools, Singapore
CAT	•	Communications Authority of Thailand
DepEd	•	Department of Education, Philippines
DTI	•	Department of Trade and Industry, Philippines
DOST	•	Department of Science and Technology, Philippines
ETD	•	Educational Technology Division
IDA	•	Infocom Development Authority of Singapore
IPR	•	Intellectua Property Right
IPST	•	Institute for the Promotion of Science and Technology. Thailand
KERIS	•	Korea Education and Research Information Service, South Korea
NIE	•	National Institute of Education, Singapore
MDA	•	Media Development Authority, Singapore
MDC	•	Multimedia Development Corporation, Malaysia
MICT	•	Ministry of Information and Communications Technology, Thailand
MNC	•	Multinational Company
MOE	•	Ministry of Education
MP1	•	First Master Plan for ICT in Education, Singapore
MSC	•	Multimedia Super Corridor, Malaysia
NCB	•	National Computer Board, Singapore
NECTEC	•	National Electronics and Computer Technology Centre, Thailand
RBEC	•	Revitalized Basic Education Curriculum, Philippines
SEI	•	Science Education Institute, Philippines
SITES	•	Second Information Technology in Education Study
SSMS	•	Smart School Management System, Malaysia
TOT	•	Telephone Organization of Thailand
WAN	•	Wide Area Network

Component

1

Broader Environmental Context

Overview

ICT in education policy falls within a broader environmental context of the education system, covering economic and social infrastructure and policies and global market conditions. Elements in the education system, including the national curriculum; examination boards; leagues; teacher recruitment, training and retention; and the roles of major stakeholders in the education system, may affect the formulation and implementation of ICT in education policy.

Discussions in this component focus on three issues: (i) responsiveness of the education system, (ii) ICT in education policy and ICT infrastructure support, and, (iii) the economic and social/cultural context.

The education system and policy support in the areas of budget, curriculum, professional development and research may facilitate or hinder the launching of a country's ICT in education policy, as well as its expansion and sustainability in the future. The national ICT infrastructure (connectivity and accessibility) may also affect the implementation of ICT in education policy. All these elements are within a larger environmental context that may include the need to develop a competitive workforce – regionally and globally, the economic cycle that a country or the world is undergoing, economic policies (budget cut or expansionary fiscal policy), political and social stability, the bureaucracy of the system, and so on.

Lessons learned

Based on the experiences of the six countries, following are the lessons learned with respect to three issues:

1. **Education System Responsiveness**
   - *A well-planned and responsive education system provides an appropriate enabling environment for the successful implementation of ICT in education policy and programme.*
   - *To make ICT an integral part of the education master plan and ensure programme support, ICT in education policy should share the same vision as other educational policies or initiatives.*

2. **ICT in Education Policy and ICT Infrastructure Support**
   - *ICT in education policy that is driven by a vision which can be translated into action targeted at realistic and manageable goals contributes to successful programme implementation.*
   - *A holistic approach to ICT in education policy goes beyond a technological dimension.*
   - *Adequate physical and technological infrastructures are necessary conditions for effective ICT integration.*

3. Economic and Social/Cultural context
   - *A well-developed ICT infrastructure in the economic sector facilitates successful implementation of ICT in education policy.*
   - *ICT in education policy is one of several key economic strategies to ensure sustained economic development of any country.*

Synthesis of Experiences

Issue 1

Education System Responsiveness

lesson*learned* 1

A well-planned and responsive education system provides an appropriate enabling environment for the successful implementation of ICT in education policy and programme

This means that various aspects in the education system, such as policy, budget, curriculum, professional development, teaching and learning assessment practices and research affect the integration of ICT. Ongoing changes in the system and policy may include use of ICT in all aspects of education. The education system must be responsive to technological changes, making it easy to integrate these changes in the system.

a. ***Indonesia***: Further to efforts to enhance the quality of education and to improve educational relevance and efficiency, the Ministry of Education (MOE) is determined to make use of ICT in resolving educational problems. This policy is stated in the Appendix of Presidential Instruction No. 6 in the year 2000. All departments have responded to the policy positively, although the pace and level of implementation have varied. Coordinating teams are being set up to ensure that the policy is implemented effectively and consistently.

b. ***Malaysia***: The Ministry of Education (MOE) considers ICT as a means, not an end in itself. All departments in the MOE are actively engaged in the implementation of the ICT in education policy. The departments work together to develop new media as tools for a richer curricula (tools that provide authentic learning contexts and activities for students), promote enhanced pedagogies (from teacher-to student-centred approaches), facilitate more effective organizational structures in the schools (more autonomy to heads of departments and teachers, more sharing among teachers, and less bureaucracy in the organization), and establish stronger links between schools and society (open communication between schools and parents and collaboration with industries and institutes of higher learning).

c. ***South Korea***: In a knowledge-based society, work and education are integrated. Thus, knowledge is produced not by a small elite class but by a mass of active workers in the workplace. To make the education system more responsive to the needs of a knowledge-based society, the Korea Education and Research Information Service (KERIS, 2002, pp.4-5) has recommended changes to the education system. The first is a change of direction based on learning, not on education. Up to now, the main function of school education has been to deliver knowledge accumulated throughout human history. But in a knowledge-based society, knowledge is delivered and developed by the people. For as long as schools maintain the cramming system of education, it will be difficult to

cultivate new intelligence essential for a successful knowledge-based society.

The second change is to have the education system focus on students. In an industrial society, standardized textbooks and identical teaching methods are used in educating students who have different aptitudes and learning habits. In a knowledge-based society, the main focus of education is the individual student.

The third change is the introduction of a creative and self-directed education method. The new knowledge for the knowledge-based society is living knowledge that takes into account many factors, such as real life situations and problems.

Recognising the social paradigm shift, top-level decision makers have supported the long-term plan for ICT in education, leading to the country's ICT in education policies implemented in 1989 up to the present.

d. ***Thailand***: To make the education system more responsive, the newly established school curriculum standards in eight key learning areas incorporate ICT as a tool to support the shift to student-centred approaches. The integration of ICT in the curriculum is encouraged and driven by several projects and initiatives in line with national and local ICT policies, e.g. EdNet, SchoolNet, Teacher Support System and ICT Training Centre Schools. At the same time, administrative measures at the ministerial level are mandated to facilitate the operation of responsible units at departmental levels in the development of ICT educational resources, e.g. e-Learning, e-Book, on-line testing system and educational multimedia to support teaching and learning in all subject areas. Several special task force committees have been established to move these activities forward.

However, integration requires effective coordination and communication among the decentralized administrative structures, within and outside the MOE. This has been rather difficult to handle at this stage because of frequent staff transfers of personnel in the responsible units. Current efforts focus on the implementation of a school-based management approach in a number of pilot schools to prepare them for responsibilities in the areas of policy, budget, curriculum, professional development, research, and general affairs.

e. ***Singapore:*** Teaching and assessment methods are reviewed and modified continuously to nurture thinking skills and creativity and to encourage knowledge generation and application. Various initiatives have been implemented over the years: Thinking Programme, Project Work, Integrated Programmes (for secondary schools and junior colleges) and Fostering a Spirit of Innovation and Enterprise in Schools. The Project Work (PW), implemented in the schools since 2000, provides students with an integrated learning experience to explore inter-relationships and inter-connectedness among different disciplines. It encourages the application of creative and critical thinking skills and provides opportunities to develop communication, collaborative and lifelong learning skills. Another initiative is the Integrated Programmes (IP) where a broader and more flexible Junior College (JC) curriculum and a more diverse JC/Upper Secondary Programme are developed to better prepare students for varied challenges in the future. The revised JC curriculum will be first offered to JC 1 students in 2006, while the first batch of approved IP schools will admit students in 2004. In all these initiatives, ICT is a mediating tool. The first Master Plan for ICT in Education (MP1) is well placed and supported within the education system.

lesson*learned*2

To make ICT an integral part of the education master plan to and ensure programme support, ICT in education policy should share the same vision as other educational policies or initiatives

With a clear and common vision, ICT becomes part and parcel of education plans, ensuring its implementation. It also enables education stakeholders to examine opportunities for ICT in education.

a. ***Malaysia***: A mission statement formalized by the MOE in 1995 reflects the Ministry's commitment to the goals of Vision 2020: "To develop a world class quality education system which will realize the full potential of the individual and fulfil the aspirations of the Malaysian nation." This vision is consistent with the objectives of ICT in education policies.

b. ***Philippines***: The overall goal of education at all levels is the development of a higher level of thinking skills (e.g., abstracting, planning, critical thinking and problem solving). In support of this, the ICT in education policy envisions that ICT will be used as a mediating tool in education to engage students in a higher level of thinking.

c. ***Singapore***: MP1 was implemented in 1997, the same year as the launching of the vision, "Thinking Schools, Learning Nation". Under this vision, the MOE has shifted from efficiency- to ability-driven education aimed at developing and harnessing the abilities and potential of every child. This vision is consistent with the objectives of MP1, that is, to create a student-centred learning environment, inculcate good values and nurture thinking skills and creativity through the formal and informal curricula.

d. ***South Korea***: The objectives of the ICT in education policies are consistent with changes to the education system as proposed by KERIS in 2002, covering (i) a change of direction based on learning that is geared towards construction and generation of knowledge; (ii) a focus on students; and (iii) a creative and self-directed education approach where educationstakeholders are given more autonomy.

Issue 2

ICT in Education Policy and ICT Infrastructure Support

lesson*learned* 1

An ICT in education policy that is driven by a vision which can be translated into action targeted at realistic and manageable goals contributes to successful programme implementation

Realistic goals are observable and measurable. For example, "by the end of 2005, X number of teachers would have been trained in the use of ICT in science, mathematics and language" or "by the end of 2005, an electronic library would have been set up to support teaching/learning and training activities". During the different phases of ICT in education policies, these goals can be assessed to identify gaps and adopt strategies to address them.

a. ***Indonesia:*** Based on the vision of life-long learning, the working teams of MOE have developed a five-year action plan (2001-2005) for integrating ICT in education. The Plan covers the following:

- To prepare a masterplan for the development of human resources for ICT.
- To develop ICT networks for public and private universities, as well as research and education networks in the country.
- To develop and implement ICT curricula for all levels of education.
- To use ICT as an essential part of the curricula and learning tools in schools, universities and training centres.
- To participate in global learning and other networks.
- To facilitate the use of the Internet for more effective teaching and learning.

b. ***Malaysia***: The objectives of the ICT in education policy are in support of the goal to achieve a world class education system by 2020. Thus, ICT is used as an enabler to reduce digital gaps among the schools, as a teaching and learning tool, and as a tool to increase the productivity, efficiency and effectiveness of the management system. When fully developed, the Malaysian Smart School is expected have the following features:

- A philosophy that affirms students' ability to learn if taught, and responds to the high expectations from students
- A broad curriculum that considers students' different capabilities and needs
- A school climate that is conducive to learning
- An on-going assessment that supports good instruction
- Strong and professional principals and teachers
- A high level of parent and community involvement and support

c. ***Singapore***: Based on the vision, "Thinking Schools, Learning Nation", the blueprint for MP1 consists of four main goals:

- *Enhance linkages between the school and the world around it, so as to expand and enrich the learning environment*: Teachers and students can access a wealth of educational resources outside the school and collaborate with other educational institutions - local and foreign, and the community at large. With these new learning connections, students develop appropriate perspectives on working and living in an increasingly borderless and complex world.

- *Encourage creative thinking, lifelong learning and social responsibility*: Students develop competencies in accessing, analyzing and applying information, and cultivate independent learning. ICT-based learning strategies help to develop the students' ability to think creatively, to cooperate with one another and to make sound value judgments.

- *Generate innovations in education*: The integration of ICT-based teaching and learning approaches engenders innovations and encourages new curricula and new assessment methods to meet the objectives of education. In addition, MP1 provides schools with autonomy to use ICT resources flexibly to meet the needs of students. ICT also enhances learning and school administration.

- *Promote administrative and management excellence in the education system*: ICT promotes efficient communication within the school, among schools and between them and the MOE. It also enhances school administration and effective decision-making at all levels.

d. ***Thailand***: The e-Education component of the 2001-2010 National ICT Master Plan in education is fully supportive of the vision of lifelong learning. It aims to develop mechanisms for effective educational policy and management, improve and develop the ICT infrastructure to provide education for all, promote and develop human resources at all levels, accelerate the development of knowledge and information, and provide more access to knowledge and information.

lesson*learned*2

A holistic approach to ICT in education policy goes beyond a technological dimension

Although ICT infrastructure may be a necessary condition for successful ICT integration in education, it is not an end in itself. The ICT in education policy should consider other aspects, such as the curriculum, assessment, ICT resources, professional development of teachers, research and development and fund generation.

a. ***Philippines***: The ICT Plan for Basic Education focuses on seven key areas: infrastructure development; technical support; teacher training in the design, production and use of ICT-based instructional materials; research and development; technology integration in the curriculum; use of innovative technologies in education and training; and fund generation, particularly through non-traditional funding schemes.

b. ***Singapore***: Four key areas are covered in MP1: curriculum and assessment, learning resources, teacher development, and physical and technological infrastructure.

c. ***Thailand***: MOE's ICT Plan focuses on ICT use in four areas: improving the quality of teaching and learning, developing the educational management and administration system, building the capacity of education personnel, and developing educational ICT infrastructure.

lesson*learned*3

Adequate physical and technological infrastructures are necessary conditions for effective ICT integration

According to many researchers, the most frequently mentioned problem in integrating ICT in education is the insufficient number of computers (Cheung, 1997; Williams, Coles, Wilson, Richardson, & Tuson, 2000; Pelgrum, 2001). Countries with adequate budgets for ICT in education tend to have good physical and technological infrastructures. Other countries have successfully overcome budget constraints and are able to provide necessary infrastructure based on the needs of the school or region. Some other countries that have large budgets for ICT in education lack the expertise to identify appropriate hardware and software to purchase and, as a result, ICT integration is not well-supported by adequate infrastructure.

a. ***Indonesia***: Some programmes have been launched to provide ICT infrastructure in schools. Among the programmes are OSOL (One School One Computer Laboratory) and WAN Kota. OSOL is a programme of the Ministry of Communication and Information under Ministerial Decree 17/KEP/M.KOMINFO/4/2003, through which the Government encourages all concerned parties to assist in providing good computers for schools at low prices. Many members of the private sector are collaborating among themselves to produce low-priced computers (US$170–180 each) as well as software for teaching purposes. Through their efforts, it is hoped that every school will have its own computer laboratory facility. In addition, other members of the private sector are helping to solve the country's ICT infrastructure problem. Microsoft Indonesia, for example, is cooperating with many concerned parties. For every used computer donated to a school, Microsoft Company has provided Microsoft Office for free. Microsoft Windows and Microsoft Office to be used for education purposes are offered at a reduced price of about 2.5 USD/license for MS Windows 98 and MS Office. Another example is Cisco's assistance to the Directorate of Vocational Secondary Education in developing local area network for some vocational secondary schools.

Another good example is WANKota (City Wide Area Network of Schools) that is managed by Directorate of Vocational Secondary Education. This programme was developed to connect vocational schools in one district through the use of wireless technology. Each school is connected to the centre (server school) utilising radio frequency. In other words, WANKota serves as:

1. a means for information and communication among schools within a specific district, including junior high school, vocational secondary school and senior secondary school;
2. a server for learning materials (especially modules) in all subjects required by students;
3. a centre for information technology training;
4. a centre for distance learning.
5. a digital library centre that can be accessed by all schools in a specific district.

b. ***Malaysia***: Various types of schools are equipped based on their needs, location and region. Three models of ICT infrastructure are found in pilot schools under the Smart Schools Project.

- Level B provides 37 computers. 21 are placed in a computer laboratory and the rest are in the resource centre and administrative office. There are two notebooks and three servers per school. The computers are connected to the Internet by Fast Ethernet backbone with 128/64 kbps leased line.

- Level B+ provides the computer laboratory with 81 computers, two notebooks and three servers. Six computers are placed in each of the 15 classrooms and science laboratories. Computers in the resource centre and the administrative office are supported by 128/64 kbps leased line.

- Level A provides computers in full classrooms. The schools are located in urban areas and are equipped with 520 computers, five notebooks and six servers with 512/256 kbps leased line. 35 computers are placed in each of the four computer laboratories, seven computers in each of the 40 classrooms, seven computers in each science laboratory, and the rest are in the resource centre, the teachers' room, and the administrative office.

Countries that face budget constraints could adapt these models.

c. ***Singapore***: As a guideline for schools, MP1 set out national standards for ICT infrastructure by the year 2002, which envisaged that students would spend up to 30% of their study time using ICT. A student-computer ratio of 2:1 was targeted for every school by 2002. All primary schools were initially provided with a student-computer ratio of 6.6:1, while secondary schools and junior colleges had an initial student-computer ratio of 5:1. Students were also provided access to ICT facilities in all learning areas in the school, including classrooms, libraries and special rooms, besides computer laboratories. This encouraged effective integration of ICT in the curriculum.

MP1 provided school-wide networking in every school and allowed access to courseware, the Internet and digitized media resources in all classrooms and learning areas. Networking also allowed sharing of teaching resources within and between schools. All schools were linked through a Wide Area Network (WAN), which was eventually connected to the high-speed backbone of Singapore ONE. Teachers and students from primary four and above were given email accounts. Additional physical infrastructure, with respect to power, space and furniture required for an ICT-enriched school environment, were incorporated into future school building specifications.

d. ***South Korea:*** Construction of an infrastructure to facilitate ICT use in education was initiated under the Three-Year Plan for the Construction of ICT Infrastructure (1997-99).This was revised under the Comprehensive Plan for ICT Use in Elementary and Secondary Schools (1998-2002) and again modified in 1999. The current policy is the Five-Year Plan for Education Development (1999-2003). In January 2000, President Kim Dae Jung, announced his goal to complete the Comprehensive Plan for ICT Use in Education by the end of 2000 and ordered the construction of infrastructure to facilitate ICT use in education, in preparation for the 21st century knowledge-based society and in accordance with the Seventh School Curriculum. In April 2000, the Ministry of Education and Human Resources Development passed a new budget for the Comprehensive Plan for ICT Use in Education.

The Comprehensive Plan was completed with cooperation from the Ministry of Planning and Budget and the Ministry of Information and Communication and the infrastructure for ICT use in education was constructed. As a result, every elementary and secondary school in the country has installed a LAN and is connected to the Internet, marking the first time that this has been achieved on a national scale anywhere in the world. More than 13,000 computer laboratories are now in use by teachers and students in these schools. Each of the 222,000 classrooms has PCs and multimedia equipment. PCs have also been distributed to every member of the 340,000 teaching staff. Thus, all elementary and secondary schoolteachers are able to use the Internet as a teaching-learning resource.

e. ***Thailand***: There are several projects in which educators and researchers employ innovative strategies to combine old and new technologies, exploiting the potential of both, and making decisions about the best medium to convey information and to improve

learning. One notable example is Sukhothai Thammathirat Open University's School of Education (STOU) that offers in-service programmes (two-year and four-year degree programmes and one-year teaching certificates) for the professional upgrading of teachers. A six-credit course in STOU may consist of 15 units of printed text and workbooks, 15 twenty-minute radio programmes, 3-5 half-hour TV programmes, 1-3 audio-cassettes and 10-25 hours of face-to-face tutorials.

A more recent example is the development of a Linux School Internet Server (Linux SIS) by the National Electronics and Computer Technology Centre (NECTEC), offering the Government a cheaper alternative to move schools beyond the first phase of Internet implementation and eliminating the need to invest on expensive server software. It also overcame the language barrier since documentation is in the Thai language.

Issue 3

Economic and Social/Cultural Context

lesson*learned* 1

A well-developed ICT infrastructure in the economic sector facilitates successful implementation of ICT in education policy

There should be a national ICT plan to develop basic ICT infrastructure in the country. This plan should provide a foundation for ICT in education policy.

a. ***Malaysia***: The Multimedia Super Corridor (MSC), launched in August 1996, is a regional launch site for companies developing or using leading multimedia technology. It has facilitated successful implementation of ICT in education policy. It brings together four key elements:

- Best possible physical infrastructure, including Kuala Lumpur City Centre, the new Kuala Lumpur International Airport, rapid rail links to Kuala Lumpur, a smart highway, and two intelligent garden cities (Cyberjaya and Putrajaya).
- New laws, policies, and practices designed to enable and encourage electronic commerce, facilitate the development of multimedia applications, and position Malaysia as a regional leader in intellectual property protection.
- High capacity global communications infrastructure built on the MSC's 2.5 – 10 gigabit digital optical fibre backbone and using Asynchronous Transfer Mode (ATM) switches to provide fibre to the buildings. This network has a 5-gigabit international gateway with direct links to the United States, Europe, and Japan, as well as other countries in Southeast Asia.
- The Multimedia Development Corporation (MDC), a one-stop shop that manages and markets the MSC. The MDC's mission is to create the best environment for private sector companies to use multimedia and to promote investments in the MSC.

b. ***Singapore***: The Civil Service Computerization Programme launched in 1982 paved the way for nationwide computerization and set the pace for ICT application in Singapore. This was followed by the National IT Plan (NITP) in which the National Computer Board (NCB) made improvements to the ICT infrastructure as part of a seven-pronged ICT strategy. The current phase of ICT initiatives began in 1991 with the launch of the IT 2000 Master Plan. Singapore will be transformed into an intelligent island, where ICT permeates every aspect of life – at home, work and play. These initiatives in infrastructure development provide the basic foundation for the introduction of ICT in education.

lesson*learned*2

ICT in education policy is one of several key economic strategies to ensure sustained economic development of any country

ICT in education policy should not be formulated in isolation but should be planned and implemented to complement and support other development strategies. In the face of intense competition, countries can no longer rely on the accumulation of capital and labour to sustain economic growth. Each country has to redefine itself to remain competitive and this requiresit to move towards more value-added industries that produce high-tech and knowledge-intensive products.

a. ***Malaysia***: Consistent with Vision 2020, seven flagship applications were introduced in 1997 as part of the overall plan to develop the MSC and to jumpstart the country's leapfrog into the ICT Age. Vision 2020 calls for sustained, productivity-driven growth that can be achieved only with a technologically literate workforce that is capable of critical thinking and is prepared to participate fully in the global economy. One flagship application is the ICT-enabled Smart School. The others are Electronic Government, Telemedicine (later renamed Telehealth), Multipurpose Card, Research and Development Clusters, Worldwide Manufacturing Web, and Borderless Marketing.

b. ***Singapore***: National policies to nurture the country's knowledge-based economy and to work towards becoming the knowledge hub in the region and beyond have been formulated. Efforts in support of these policies include enhancing the national innovative system and entrepreneurship and education capability (Toh, Tang, & Choo, 2002). The capacity of the workforce to generate new knowledge is continuously being upgraded. A three-tier system suggested by the ERC Working Group on Education for the short- to medium-term includes universities (to provide a broader tertiary education base as well as cater to specialized niches), a core of quality commercial schools (to foster on-the-job upgrading), and multi-national corporations (to set up regional training facilities in Singapore). (Toh et. al, 2002).

c. ***Thailand***: MOE's ICT in Education Master Plan focuses on the use of ICT as a major tool for education reform, consistent with ICT strategies in the ICT Master Plan of the Ministry of Information and Communications Technology (MICT) in the e-Education, e-Society and e-Government components. The e-Education and e-Society strategies provide for the use of ICT infrastructure in accessing information and knowledge to upgrade the basic capacity of the Thai society, reduce the digital divide and promote learning in the Thai society. The country's telecommunications network has to be developed and improved to provide services at affordable costs.

ICT will be utilized for educational development and services (e.g. content development, curriculum resources and media development, distance learning via satellite or Internet). These strategies support the MOE 2004-2006 mission to improve the quality and effectiveness of student learning, the development and production of ICT personnel, and the distribution of ICT infrastructure for education. The e-Government strategy, utilizing ICT for good governance, emphasizes improvement and development of the administration and management systems in all government organizations. This strategy supports the decentralization of the MOE administration and management, from the ministerial level to the level of schools and educational service areas.

Component

2

Policy and Regulatory Environment

Overview

The importance placed on developing ICT policy in education varies from country to country. Some countries piloted ICT use in schools and trained teachers without an ICT in education policy. Others found it important to have a policy to serve as a framework and guide. From a cultural-historical perspective, the launch and implementation of an ICT in education policy are only a part of the development of an overall policy with respect to ICT in education. Malaysia and Singapore carried out pilot studies prior to launching ICT in education policies.

This component includes an account of how ICT policies are transformed into action, driven by a vision and supported by a blueprint and a roadmap. The enabling and inhibiting regulations (e.g. censorship laws) dealing with ICT use in education are examined. ICT in education inevitably has macro-economic impacts on a country, including narrowing the digital divide. Finally, this component ends with examples of inter-ministerial collaborations and how to obtain support from policy makers for the effective implementation of ICT in education programmes and/or policies.

The purpose of this component is to identify strengths, weaknesses and gaps in the development of ICT in education policy. Six issues are discussed: (i) policy development (focus on pre-launch of an ICT in education policy), (ii) transforming policy into action, (iii) legal and regulatory framework, (iv) macro-economic impact, (v) inter-ministerial collaboration, and (vi) advocacy and obtaining support of policy makers and other stakeholders.

Lessons learned

Based on the experiences of the six countries with respect to the six issues above, the lessons learned are the following:

1. Policy Development (focus on pre-launch of an ICT in education policy)

- *To ensure that ICT in education policy is integrated in the national ICT policy, Ministries of Education (MOE) should work closely with other government organizations, especially those in charge of implementing national policies on ICT and telecommunications.*
- *Lessons learned from pilot projects and studies in education that are carried out at different levels of the school system provide the basis for further policy expansion.*
- *Harmonized implementation of ICT in education programmes can be achieved by defining clearly the roles and responsibilities of all departments (within the MOE and other relevant ministerial departments) in the implementation of ICT master plans, showing clearly the different components of project activities, including budget allocations, manpower requirements and timetables.*

2. Transforming Policy into Action

- *Phased implementation of ICT in education policy ensures that the implementation process is manageable and the development of best practices and lessons learned is gradual. It also provides opportunities for evaluations so that the policy can be revised and fine-tuned.*
- *Central support from the MOE to pursue a clear and measurable vision helps in developing and implementing a comprehensive programme for the capacity building of schools in using ICT in education.*

3. Legal and Regulatory Framework

- *Initial filtering of the Internet from undesirable websites is necessary in order to prevent their harmful influence on younger students who may not be able to discern the veracity and reliability of information.*
- *More than any software or hardware device, better protection is ensured by making education on safety issues pertaining to the Internet an integral part of parenting as well as of teaching and learning activities at home and in the school*

4. Macro-Economic Impact

- *To narrow the digital divide, ICT in education policy should complement other government initiatives, such as public education in ICT, donation of computers and provision of free Internet access.*

5. Inter-Ministerial Collaboration

- *Sharing expertise, experiences and infrastructures among ministries and government agencies helps to coordinate and harmonise implementation of ICT in education programmes.*
- *Creating a national policymaking, regulatory and implementing agency for ICT development systematizes inter-ministerial cooperation on ICT in general, including education.*
- *Beyond ministries and government agencies, inter-ministerial collaborations could involve private sector participation.*

6. Advocacy and Obtaining Support from Policymakers and Other Stakeholders.

- *By linking the objectives of ICT in education policy with national education objectives, support from policymakers and other MOE stakeholders, including human capacity building, could be more forthcoming.*
- *By making policymakers and stakeholders regularly aware of and updated on the benefits of ICT to education, based on research results and documentation of experiences, advocacy for the acceptance of ICT use in education is further strengthened.*
- *By making all decisions taken or amended by the MOE's highest steering committee known to all members of the committee and heads of departments, their sense of ownership and involvement is enhanced.*

Synthesis of Experiences

Issue 1

Policy Development

lesson*learned* 1

To ensure that ICT in education policy is integrated in the national ICT policy, Ministries of Education (MOE) should work closely with other government organizations, especially those in charge of implementing national policies on ICT and telecommunications

As ICT in education policy is an integral part of the national ICT policy, the MOE has to work closely with relevant organizations in the country.

a. ***Indonesia***: The first attempt to wire schools was undertaken by the Indonesian Internet Service Providers (ISP) Association with its Sekolah 2000 Project that was aimed at connecting 2000 secondary schools by the year 2000. The Ministry of National Education, together with other organisations like ISP and telecom operators, and private sponsors such as CISCO and ORACLE, APJII, worked to develop a portal. By the end of the year 2000, the project had connected 1,180 schools translating into half a million new Internet users from high schools.

b. ***South Korea***: Collaboration at different levels, including inter-ministerial, was made possible through wide understanding of the first national plan for ICT use in education, when it was established in 1988, and mutual agreement to a national vision that ICT is the basis for future national growth. The Korea Telecommunication Company presented PCs and hardware infrastructure to primary schools throughout the country, while mass media companies and other organizations conducted the pilot project. This type of collaboration in the provision of hardware and software support made the national plan a success.

c. ***Thailand***: MOE collaborated with different government agencies on the ICT in Education Master Plan. These included NECTEC, Institute for the Promotion of Teaching Science and Technology (IPST), and Ministry of Information and Communications Technology (MICT). The partnership model is demonstrated by the cooperation among the Faculties of Science of 24 government universities, IPST and MOE to improve science and mathematics teaching and learning in schools. IPST signed an MoU with the Deans of Science Faculties in 2001 to develop schools under the supervision of universities. Under the MoU, IPST would provide financial support to a university that is undertaking such development. The Science in School Project and the GLOBE Programme are other activities conducted in schools under the financial and academic support of universities and IPST.

d. ***Singapore***: The National IT Plan provides a seven-pronged approach to the ICT strategy: developing ICT professionals and experts; improving the information and communication infrastructure; promoting the ICT industry; promoting co-ordination and collaboration among ICT-promoting organizations;

establishing a culture that welcomes ICT; encouraging creativity and entrepreneurship; and increasing ICT applications in the workplace (National Computer Board, 1986). To further support these approaches, the education system underwent some major changes. At the tertiary level, polytechnics and universities were oriented towards ICT-related training; and at the secondary and primary levels, the system was restructured away from the British system to incorporate features of a German system, such as training in mathematical and technical competencies. Computer awareness programmes were introduced in schools (Low, Soon, & Toh, 1991). MOE worked closely with the National Computer Board before the launch of MP1.

e. ***Indonesia***: The first attempt by the Indonesian Internet Service Providers (ISP) Association's to wire schools was undertaken through its Schools 2000 Project, aimed at connecting 2000 secondary schools by 2000. The Ministry of National Education collaborated in developing a portal with ISPs, telecom operators and private sponsors, such as CISCO and ORACLE. By the end of 2000, the project had connected 1,180 schools, translating into half a million new Internet users in high schools.

lesson*learned*2

Lessons learned from pilot projects and studies in education that are carried out at different levels of the school system provide the basis for further policy expansion

Pilot studies provide a good basis for the successful implementation of ICT in education policy. Through formative and summative evaluations of pilot studies, best practices and lessons learned can be integrated in the ICT in education policy. The policy should be able to refine and expand the scope of the pilot initiatives. Without follow-up action, it will be difficult to integrate pilot studies in ICT in education policy.

a. ***Malaysia***: A joint Ministry-Industry task force drew up in July 1997 a blueprint on the key components of the Smart School, based on a concept document, "Smart Schools in Malaysia: A Quantum Leap", which was produced by the MOE in January 1997. The Smart School blueprint is open to further refinements, including advances in pedagogy and improvements in ICT. The Smart School Pilot Project was launched in 1999. The schools served as nucleus for nationwide promotion of the Smart School concepts, materials, skills and technologies. The pilot project tested the Smart School Integrated Solution, which had the following main components:

- Browser-based teaching-learning materials (and related print materials) for Bahasa Melayu, English Language, Science and Mathematics
- A computerized Smart School Management System (SSMS)
- A Smart School Technology Infrastructure involving the use of IT and non-IT equipment, local area networks for pilot schools, and a virtual private network that connects the pilot schools, the Ministry's Data Centre and the Ministry's Help Desk
- Support services in the form of a centralized Help Desk and service centres throughout the country to provide maintenance and support
- Specialized services such as systems integration, project management, business process re-engineering, and change management.

At the end of the Smart School Pilot Project in December 2002, there were 87 networked schools (83 secondary and 4 primary) in all states throughout the country, 1494 courseware titles for Bahasa Melayu, English Language, Science,

Mathematics, a computerized and integrated Smart School Management System, a Help Desk, and a Data Centre, and trained administrators, teachers and IT coordinators from all the pilot schools.

b. ***Singapore***: Three pilot studies were conducted targeting primary schools, secondary schools and junior colleges, taking into account that operations, teaching and learning are different at these three levels. ICT was first piloted by the MOE as a tool to assist students' learning with the introduction of a project, "Accelerating the Use of ICT in Primary Schools (AICTP)". The AICTP, implemented in six pilot schools in mid-1995, introduced multimedia teaching in key subjects at the primary level. Students in pilot schools spent about 10% of curriculum time using ICT. The evaluation found the programme helpful to most pupils in their learning. Academically inclined students using ICT have become more independent learners, while others, encouraged by hands-on lessons, showed greater interest in their studies and reached the curriculum objectives.

The Student's and Teacher's Workbench (STW) implemented in six pilot secondary schools in 1996 with a fully ICT-based science curriculum, provided a central repository for educational resources and lesson packages for teachers.

The JCNet, a Research and Development project on Internet use, was implemented in two junior colleges in 1997. The AICTP, STW and JCNet projects were ntegrated and expanded in scope in the ICT in education master plan, launched in April 1997. Several features of the STW were incorporated in the MP1, such as the development of Digital Media Repositories (DMRs), resources used by teachers and involvement of private sector content providers. In the course of implementing MP1, further lessons were drawn from the STW project on extending it to other schools.

lesson*learned*3

Harmonized implementation of ICT in education programmes can be achieved by defining clearly the roles and responsibilities of all departments (within the MOE and other relevant ministerial departments) in the implementation of the ICT master plan, showing clearly the different components of project activities, including budget allocations, manpower requirements and timetables.

a. ***Malaysia***: Although the specific roles of concerned agencies were not clearly defined when the Multimedia Super Corridor (MSC) Flagship Applications were launched in 1997, the following general roles were designated:

- MOE as lead agency of the Smart School, one of the flagship applications
- MDC as coordinator of the MSC Flagship Applications
- A company or a consortium short-listed by the lead agency to deliver the solution requested through the Concept Requests for Proposals Process
- Central agencies with responsibility for procurement and legal aspects, such as the Treasury and the Attorney-General's Chambers.

In 1999, the MDC invited all government agencies and consortia involved in the MSC to help clarify and delineate roles and responsibilities. As a result of this exercise, many of the implementation problems identified by the lead agencies and the consortia, such as manpower shortage, unclear government

procedures and processes, and cross-flagship integration requirements, were resolved.

b. ***Thailand***: The MOE appointed four sub-committees responsible for specific areas in the ICT in education master plan. To ensure effective policy implementation, the sub-committees were supervised and directed by the MOE Deputy Director-Generals, serving as Chief Information Officers of relevant departments. However, policy implementation depended on the ICT vision of the Director-Generals, with some of them not fully appreciating the value and importance of ICT use. Frequent transfers of senior executives between departments also affected the continuity of the work plan. The recent establishment of ICT Operation Centres at all levels, from ministerial to national, could address this setback. The centres are expected to be in operation by the end of 2003.

Issue 2

Transforming ICT for Education Policy into Action

lesson*learned*1

Phased implementation of ICT in education policy ensures that the implementation process is manageable and the development of best practices and lessons learned is gradual. It also provides opportunities for evaluations so that the policy can be revised and fine-tuned

Demonstration schools (from the first phase) could serve as models for ICT integration. These schools could encourage the staff to share their experiences and expertise with staff from other schools, or they could post their teachers to other schools that wish to start ICT integration. Alternatively, staff from other schools could be attached to these demonstration schools to observe best practices and immerse themselves in a culture that supports ICT integration.

a. ***Singapore***: MP1 consisted of three phases: Phase I (1997), Phase II (1998), and Phase III (1999). Schools with a history of effective ICT integration were chosen as demonstration schools, also known as Phase I schools. There were 22 Phase I schools: 10 primary schools, 10 secondary schools and two junior colleges/ centralized institutes (JC/CIs).

In Phase II and III schools, implementation of the ICT in education master plan started in 1998 and 1999, respectively. Phase II schools were identified based on the school principals' evaluation of staff readiness for the new initiative. There were 106 Phase II schools and 268 Phase III schools. Schools were given the flexibility to decide on the pace of ICT integration.

ICT core training for all schools was completed by May 2001. The teachers were trained in basic ICT use, including word processing, spreadsheets and the Internet. A four tier-fan training model was put in place to acquaint teachers with ICT integration. This started with 60 senior ICT instructors from the Education Technology Division (ETD) who trained before visiting the schools to train, team-teach teachers and work with them. Together with teachers and heads of departments from Phase I schools, these instructors went to Phase II schools. Together with Phase II schools teachers, they went to Phase III schools.

lesson*learned* 2

Central support from the MOE to pursue a clear and measurable vision helps in developing and implementing a comprehensive programme for the capacity building of schools in using ICT in education

a. ***Indonesia:*** Most departments within the Ministry of National Education administer programmes on ICT use in education in their chosen manner. The same situation also occurs at the school level, with schools running their ICT in education programmes in their own way, without any special directives/regulations follow. The MOE may need to set up a special working team (national commission) that will be fully responsible for developing and implementing ICT use in education. This national commission may be responsible for:

- establishing a five or ten-year strategic plan with a clear and measurable vision;
- creating an institutional mechanism for effective and efficient implementation of the plan;
- planning the budget needed to implement the plan;
- planning the infrastructure and connectivity needed to implement the plan;
- developing and implementing clear regulations and guidelines (from national to school levels) on ICT use in education;
- developing and implementing a comprehensive programme for building the capacity of schools (teachers and administrators) for ICT use in education. This would include ICT literacy skills, use of ICT for instructional and/or non-instructional purposes; ICT-based learning materials and development of skills; and
- planning and implementing evaluation and monitoring to make sure that ICT use in education is in accordance with the plan.

b. ***Malaysia***: To monitor and guide the progress of the Smart School Pilot Project, the following committees were set up:

- Ministry of Education Smart School Steering Committee, chaired by the Secretary-General of Education. Members included all heads of departments and divisions in MOE and representatives from central agencies and the MDC.
- Smart School Pilot Project Steering Committee, chaired by the Deputy Director-General of Education. This committee ceased to function upon completion of the pilot project in December 2002. Members included the Pilot Project Director, senior officers from the Pilot Project Team, the Ministry's Legal Adviser, a representative from the Ministry's Supply, Privatization and Development Division, a representative from the Treasury, a representative from MDC, and representatives from the senior management of the shortlisted consortium.

c. ***Philippines***: While there is no national government agency dedicated to ICT, policy and regulatory functions are shared by the Department of Transportation and Communications and the National Telecommunications Commission. Responsibility for policymaking and coordination of national ICT plans and initiatives is held by the Information Technology and Electronic Commerce Council (ITECC), a joint private-public sector body constituted in 2000 and currently chaired by the President of the Philippines. Within ITECC is a Committee on Human Resource Development, which in turn has a Subcommittee on Basic Education. There are plans to create an ICT Commission that would supersede ITECC and will be the precursor to a Department of ICT. The plans

were announced in August 2003. The ICT Commission, to be established in 2003 (Oliva, 2003), will be empowered to implement ICT projects.

However, at the time of writing, the ICT Plan for Basic Education is still a draft document and has not been circulated widely in the Department of Education, leading to some confusion at the sub-national and school levels concerning its implementation. Moreover, implementing guidelines have not yet been formulated and schools are not aware of what is expected of them, in relation to the curriculum and the management of their ICT resources.

d. ***Singapore***: Responsibility for facilitating the conceptualization and implementation of the five-year MP1 and the follow-up MP2 is held by the Education Technology Division (ETD) at MOE. Different branches and offices at ETD work together and share responsibilities to achieve the objectives of the Division. These branches include ICT Planning, ICT Curriculum and ICT Training.

e. ***South Korea***: The Ministry of Education and Human Resources Development set up a commission to manage the ICT in education policy, coordinate projects involving educational reform and human resources, implement basic plans, mobilize and allocate resources, and provide administrative and financial support for the promotion of ICT use in education. The commission consists of specialists and officials from various ministries. As South Korea is highly centralized, policies from the national level (ministerial level) are disseminated throughout the country through 16 boards of education, 200 regional boards of education and about 10,000 primary and secondary schools. The ICT policies cover hardware instalment, educational software development and teacher training. A new body with responsibility for the policies was established at the Korea Educational Development Institute in 1988, later becoming KERIS. By 2001, all primary and secondary level schools were provided multimedia laboratories, network, software, educational contents, teacher training and support for educational administration.

f. ***Thailand***: The ICT Planning Team was formed with representatives from departments in the MOE to determine the scope of work and to plan tasks in accordance with established policies. Generally speaking, the master plan is quite clear and useful in guiding and supporting existing projects and initiatives. The only weakness in implementing the plan is the lack of standards and models for teaching and learning, hardware and software requirements, and staff development. Research studies on standards and models have been subsequently conducted and made available as references for setting target outcomes and as benchmarks for evaluating accomplishments.

For example, the MOE Staff Development Sub-Committee has been working on a master plan to guide the organization and development of professional personnel in education, including school administrators, ICT teachers, non-ICT teachers, technology coordinators, and other education personnel.

Issue 3

Legal and Regulatory Framework

lesson*learned* 1

Initial filtering of the Internet from undesirable websites is necessary in order to prevent their harmful influence on younger students who may not be able to discern the veracity and reliability of information.

Two common filtering techniques are human analysis and software analysis. Human analysis is labour intensive as websites are reviewed one by one and those with objectionable contents are put in a "blocked list". Software analysis can be carried out with a database of content that should be blocked, such as vulgar images and texts. When somebody attempts to access a website, the software checks whether the site contains any block-worthy content, and performs a block accordingly. Filtering is particularly crucial for young students who are not be able to discern the veracity and reliability of information. Although an excellent idea, filtering is not foolproof and Internet-savvy children can still get around it. Some schools have adopted extreme measures, such as keeping the students off the Internet entirely unless supervised by teachers. However, such measures deprive students of essential tools for survival in the 21st century.

a. ***Singapore***: The framework for the Internet developed by the Media Development Authority (MDA) emphasizes public education, industry self-regulation, and minimum regulation through a transparent licensing framework. One of MDA's main concerns is access to pornography on the Internet, especially by children and minors. Its regulatory focus is on mass impact websites that distribute pornography. The Internet Code of Practice identifies what the community regards as offensive, that is, pornography, violence and materials that may undermine Singapore's racial and religious harmony. It also spells out the obligations of Internet Service Providers (ISPs) and Content Providers (MDA, 2003). The three ISPs, Pacific Internet, SingNet and StabHub have launched their own Family Access Networks (FAN) that offer services to filter out most undesirable or pornographic sites. They are the Cyber Guard Family Access, Family Online and Infinity Family Access, respectively.

Apart from filters provided by ISPs, there are commercially available software programmes that help to block out unsuitable websites. Software filters block harmful websites, such as those on pornography, drug abuse and hate. It is important to note that no filter offers a foolproof way of blocking all child-corrupting sites.

lesson*learned*2

More than any software or hardware device, better protection is ensured by making education concerning safety issues pertaining to the Internet an integral part of parenting as well as of teaching and learning activities at home and in the school

Education concerning the dangers of the Internet offers better protection than any software or hardware device (Aftab, 2000). Therefore, schools and parents should guide students in surfing the Internet and discuss Internet issues with them (Turow & Nir, 2000). Schools should also allow children to share experiences online and give them opportunities to show teachers and parents what they know. Teachers and parents also need to be trained and supported so that they can educate students and children about Internet safety. Government organizations, volunteer organizations and schools can provide training and support.

a. ***Indonesia***: To ensure safe surfing, ICT WATCH, a private institution, has introduced a programme known as "Internet Sehat" or "Healthy Internet". The programme provides guidance and issues guidelines concerning safe and appropriate use of Internet such as:

1. To be careful when using e-banking in public service areas, e.g. in Internet kiosks,
2. To refrain from giving any passwords to others through the Internet, and
3. To refrain from opening any attachment file from unknown senders.

b. ***Malaysia***: In order to promote Internet use for education, business and entertainment, the Government has decided against censorship of the Internet. Instead, education is the main tool to prevent misuse and abuse of the Internet.

c. ***Singapore***: Teenagers generally favour educational strategies over control measures, as revealed in a survey conducted by the National Institute of Education (NIE) in 2001. The items 'discuss with children dangers on the Internet' and 'learning more about the Internet' (two educational strategies) were rated as most desirable by teenagers, and the items 'stop child from using the computer' and 'complain to Internet Service Provider' (two control measures) were rated as the least desirable (Lim, Khoo, & Williams, In Press). A volunteer organization that supports parents, teachers and students is the Parents' Advisory Group for the Internet (PAGi) (http://www.pagi.org.sg/). Volunteers assist in various activities, such as exhibitions, workshops, talks, and production of useful references on online safety, including handbooks and VCDs. These activities are usually carried out in public libraries, community centres and schools.

d. ***Thailand***: There is no long-term policy on censorship and, for the time being, censorship is just an experiment, a response to social criticism. As there is no censorship regulation, on-line games and adult entertainment material that inhibit the use of ICT for learning have become a big issue for parents. MICT has passed some measures to restrict access to such material. More serious action has yet to be taken. Teachers and parents should be more involved with students to guide and direct them.

Issue 4

Macro-economic Impact

lesson*learned* 1

To narrow the digital divide, ICT in education policy should complement other government initiatives, such as public education in ICT, donation of computers and provision of free Internet access

Investments in ICT facilities in schools will increase access to computers and the Internet, particularly for students from poor socio-economic backgrounds.

a. ***Malaysia***: The digital gap between rural and urban schools was reduced through the Universal Service Provision Project that had a budget allocation of RM 50 million in year 2002. The project, involving 220 schools in Sabah and Sarawak, provided basic infrastructure, including electricity, telephone lines, Internet access, computers, telephones and other related equipment. The project will be expanded into a nationwide SchoolNet, benefiting 10,000 schools in the country.

b. ***Singapore***: In 2001, PC ownership and Internet penetration for private housing were 81.2% and 73.9%, and 59.6% and 52.4% for public housing; compared with the 1996 figures for PC ownership and Internet penetration of 64.8% and 23.1% for private housing, and 31% and 6.1% for public housing. (IDA, 2002). The Government has committed S$25 million to promote PC and Internet awareness and use in collaboration with community groups and volunteer welfare organizations. In 1999 six hardware and software providers and one ISP funded a key initiative to provide 30,000 low-income households with used PCs bundled with free Internet access and basic training (Choi & Toh, 2000). MOE gave the largest number of used computers.

The ICT in Education Master Plan helps to narrow the digital divide by increasing ICT use in the curriculum, lowering the student-computer ratio, enhancing student access to computers by providing more open access areas, and providing cheaper access to the Internet as a result of school-industry partnerships. All students, regardless of socio-economic backgrounds, have equal access to ICT facilities in the schools.

c. ***South Korea***: The Government recognizes the importance of equal access to information and information sharing in a knowledge-based society. Carrying out a promise made by President Kim Dae Jung in 2000, the Government has provided PCs and financial support to students from poor families, enabling them to learn how to use computers and the Internet. In January 2001, the Government enacted a law to further reduce the information gap.

Following the President's leadership and the policy concerns of Government ministries, the Ministry of Education and Human Resources Development established in April 2001 the Plan for Promoting ICT Use and Distributing PCs to Children from Low-Income Families.

500,000 children from low-income families were given opportunities for computer lessons and practice. In addition, outstanding students received free PCs and financial rewards. 50,000 PCs were distributed. PC distribution and

support for learning fees for the students will continue until 2005. About 27.4 billion Won (US$23 million) was allocated in 2001, with another 70.9 billion Won (US$60 million) allocated for 2002 to 2005.

Issue 5

Inter-ministerial Collaboration

lesson*learned* 1

Sharing expertise, experiences and infrastructures among ministries and government agencies helps to coordinate and harmonise implementation of ICT in education programmes

The MOE needs to make its vision of ICT in education explicit and clear when working with other ministries or government agencies. This vision can then be translated into action plans to be carried out collaboratively. Collaborations between the MOE and other ministries should be encouraged and should be subsumed under an overarching framework for ICT in education.

a. ***Philippines***: Inter-ministerial collaboration on ICT in Education has taken at least two general forms. The first is exemplified by the cooperation between the Department of Trade and Industry (DTI) and DepEd on a computerization project called "PCs for Public Schools". In 2001-2003, DTI facilitated a grant from the Japanese Government in the amount of US$12 million dollars to provide 1,000 public high schools with 20 computers each. DepEd, for its part, was responsible for the selection of the school beneficiaries, ensuring that each school was able to meet counterpart requirements. It also supervised actual deployment of the technology package and created mechanisms for proper monitoring and evaluation.

Another form of inter-ministerial collaboration is found in many ICT-related programmes spearheaded by the DOST in DepEd-run schools. Whereas the collaboration with DTI was primarily at the national level, DOST's dialogue with DepEd is oftentimes at the sub-national and school levels, with minimal interface at the programme (national) level.

b. ***Singapore***: The MOE and Infocom Development Authority (IDA) worked closely on projects that drew upon IDA's technical and connectivity expertise and experiences, as well as IDA's database of industry partners. MOE also worked with IDA to tap the Singapore ONE national broadband network for interactive, multimedia applications and services. A major collaboration between MOE and IDA is the *FastTrack@School* project (http://schools.s-one.net.sg/index.html), launched in September 1999 to make Singapore ONE (S-ONE) relevant and useful to schools so that teachers and students could use it for teaching and learning activities. Singapore ONE is the world's first national broadband network. Over 300 interactive, multimedia applications and services have been developed in Singapore for delivery to offices, homes and schools.

The Fast Track@School encompasses 3 initiatives: (i) create relevant and useful broadband content for schools on S-ONE, (ii) help schools to have wide access to S-ONE; and (iii) help students to have S-ONE access from their homes at an affordable rate. These

initiatives are open to all schools. Schools are invited to submit an initial project proposal to outline their plans. MOE and IDA assess proposals that are received from schools and industry. Twenty-seven schools took part in the pilot project in 2000.

c. ***Thailand***: Active collaboration between the MOE and other ministries and the private sector include the EdNet Project (carried out by MOE, the Ministry of Science and Technology and MICT); and the Computer Donation Project (carried out by MOE and the private sector with support from MICT). MOE also collaborated with NECTEC in a project called SchoolNet, launched in 1995 and to be handed over to MOE in 2003. During the period 1998 to 2000, NECTEC collaborated with the Telephone Organization of Thailand (TOT) and the Communications Authority of Thailand (CAT) to set up SchoolNet@1509, a low-cost Internet for schools.

Other examples of cooperation in ICT-related initiatives are the Software Industry Promotion Agency (SIPA), the Multi-application Smart ID Card, e-Procurement, the Government Data Exchange (GDX), personnel development in software industries, development of instructors and R&D researchers for software development, and establishment of institutions for software professional training.

lesson*learned* 2

Creating a national policymaking, regulatory and implementing agency for ICT development systematizes inter-ministerial cooperation in ICT in general, including education

a. ***Malaysia***: When the MSC Flagship Applications were launched in 1997, the roles of various agencies involved were not clearly defined. In 1999, the MDC invited government agencies and consortia to help clarify and delineate roles and responsibilities. As a result, many implementation problems, such as manpower shortage, unclear government procedures and processes, and cross-flagship integration requirements, were addressed.

b. ***Thailand***: The strength of inter-ministerial collaboration is reflected in the unity and determination of all sectors to use ICT in the country's further development. However, inter-ministerial collaboration is time-consuming as, prior to their launch, projects must undergo a series of consultations between ministerial representatives and their superiors. Because cooperation is carried out on a project-to-project basis, there is no one agency that is willing to be solely liable for implementation and such reluctance frequently causes project delays.

In response the Government is gathering senior officers from related agencies to form a matrix organization or ad-hoc committee. This set up must be recognized by top ranking administrators, including the Prime Minister who has to clearly set up the national agenda and provide more resources for the implementation of the project.

At the same time, MICT is tasked to bring together ICT needs of various ministries. The Ministry's Office of Policy and Planning works with the Office of the Budget Bureau to consider ICT budgets from various ministries to prevent budget overlap. The budget is then appropriated in accordance with the framework and priority based on the National ICT Master Plan.

lesson*learned*3

Beyond ministries and government agencies, inter-ministerial collaborations could involve private sector participation

When developing ICT-based resources, industry partners and government agencies should work closely with schools, especially teachers and students. This will ensure that the design and development of ICT-based resources are pedagogically sound and meet the teaching and learning needs of teachers and students.

a. ***Indonesia***: The Government encourages the participation of the private sector in ICT programmes, such as the WAN Kota and OSOL. PT Indosat and Microsoft Indonesia provide affordable infrastructure service and software. Some mining corporations are also encouraged to donate their used computers to schools.

b. ***Philippines***: The Adopt-a-School Act of 1998 complements direct assistance packages from the Government. The Act gives tax incentives to private entities that donate ICT facilities to public schools. Among the Adopt-a-School partners are Intel Philippines, Citibank, Coca-Cola Export Corporation, Philips Electronics and Lighting Co., and various corporate foundations and NGOs.

c. ***Singapore***: In order to encourage industry/school partnerships, IDA initiated the Adopt-a-School Project, with help from industry partners to develop and provide a wide range of innovative services suitable for schools using Interactive Broadband Multimedia (IBBMM) technologies. The partners also assisted the schools to create and acquire the necessary content for Singapore ONE, developed tools and platforms for teachers and students, provided training for teachers and students to familiarize them with the tools and the content, and extended technical assistance to maintain and update the content for teachers and students. In many instances, the partners worked with teams of teachers and students to improve the pedagogical aspects of IBBMM in the school curriculum.

Some examples from the Adopt-a-School Project include the Physics experiments at St. Andrew's Junior College, and the Falling in Love with Raffles Museum of Biodiversity Research (RMBR) at Crescent Girls' School. The project in St. Andrew's Junior College (http://onezine.s-one.net.sg/@School/Standrew/) consisted of 30 Physics experiments with video illustrations and online technical notes, explaining basic physics principles and concepts and encouraging the students to reflect on them. The Falling in Love with RMBR (http://onezine.s-one.net.sg/@School/RMBR/index.html) was about students in Crescent Girls' School getting to know RMBR and the exciting things they found there.

Issue 6

Advocacy and Obtaining Support from Policymakers and other Stakeholders

lesson*learned*1

By linking the objectives of ICT in education policy with national education objectives, support from policymakers and other MOE stakeholders, including human capacity building, could be more forthcoming

ICT in education objectives are linked to economic growth and sustainability. Policymakers and stakeholders should be convinced of the urgency of implementing ICT in education policy. The ideal pace for technological change and paradigm shifts in society should be highlighted and explained.

a. ***Singapore***: At the launch of MP1 in 1997, the Minister of Education called on all Singaporeans to "think beyond the obvious, to think creatively, to search for new knowledge, to come up with new ideas to exploit new technologies to venture beyond current boundaries and open up new frontiers of knowledge." ICT has changed the way people communicate and do business and is now poised to bring about a paradigm shift in the way people learn. Such changes are seen in the way educational materials are designed, developed and delivered. Policymakers and other stakeholders from the MOE are aware of these changes.

lesson*learned* 2

By making policymakers and stakeholders regularly aware of and updated on the benefits of ICT to education, based on research results and documentation of experiences, advocacy for the acceptance of ICT use in education is further strengthened

Policymakers and stakeholders are more likely to support ICT in education policy when real-life examples are identified, documented and presented.

a. ***Singapore***: Policymakers and stakeholders are aware of ICT in education blueprints from other countries, some of which are as follows: (i) the United States' $200 million Technology Literacy Challenge Fund to give American students access to computers. Over 6000 schools will be linked; (ii) Major programmes for ICT in education in Germany, France, Britain and Italy, including a programme in Italy to install multimedia workstations and Internet connections in 15,000 schools by the year 2000, with an investment of about S$850 million. Finland, with the highest connections to the Internet in the world, has launched a five-year strategy in "Education, Training and Research in the Information Society"

lesson*learned*3

By making all decisions taken or amended by the MOE's highest steering committee known to all members of the committee and heads of departments, their sense of ownership and involvement is enhanced

This facilitates continuity and encourages common understanding at all stages of the project. It also keeps all heads of MOE departments and divisions informed and involved in the project.

a. ***Malaysia***: It is important to retain the membership of important ICT-related committees and to update new members on decisions that have been taken. For example, at the start of the Smart School Project, the then Minister of Education, the Director-General of Education and the Secretary-General of Education were enthusiastic supporters. At that time, the Smart School Steering Committee had a tripartite chairmanship, including the Director-General of Education, the Secretary-General of Education, and the Chairman of the Multimedia Development Corporation. The Minister of Education chaired regular meetings.However, the Smart School Project lost two champions when the Minister was transferred to another Ministry and the Director-General retired. The composition of the Smart School Steering Committee kept changing as members retired or were transferred. Decisions made at steering committee meetings were not always brought to the attention of new members.

Component

3

Management and Financing

Overview

Sound management and financing of ICT in education policy are necessary conditions for the effective integration of ICT in schools. All countries face the technological challenges of buying appropriate hardware and courseware, getting adequate bandwidth for online learning, and obtaining state-of-the-art ICT learning and teaching tools. However, successful ICT integration also depends on the quality of the rest of the tools, the learning environment and the participants themselves. Management and financial strategies for effective ICT integration in education must take into account a wide range of factors, including events, activities, contents, and interpersonal processes that are within the context under which ICT is used. This component focuses on the following issues of management and financing: (i) harmonization of ICT in education policies with other policies, (ii) leadership and management, (iii) dichotomy between educators and technologists; (iv) resources at the ministerial and school levels, (v) resources from donor agencies and the private sector, and (vi) strategies to ensure sustainability.

Lessons learned

Based on the experiences of the six countries with respect to management and financing, the following are the lessons learned:

1. Leadership and Management

- *Having a champion at all levels in the education system promotes ICT acceptance.*
- *Including 'ICT in Education' as an important component in the administrator development programme supports the introduction of innovative uses of ICT in schools.*

2. Harmonizing ICT in Education Programme with Other ICT and/or Education Initiatives/ Projects

- *To avoid duplication of work and dilution of funds, there should be coordination of ICT in education projects and sharing of information on ICT .*

3. Dichotomy between Educators and Technologists

- *To ensure that ICT in education projects are not just technology-driven, they should be managed by a team composed of educators and technologists.*

4. Resources at Ministerial and School Levels

- *To ensure the site readiness of all schools, there must be an initial financial investment by the government at the national level, especially in basic ICT infrastructure and resources.*
- *Every school is different and each one should be given some autonomy to select ICT resources that are most suitable to the needs of teachers and students.*
- *Investments in ICT infrastructure and resources in schools create an environment that is conducive to learning.*
- *The MOE should be encouraged to establish a standard budget based on school size and existing resources rather than to apply one formula for all schools.*

5. Resources from Donor Agencies and the Private Sector

- *Financial and resource support for the implementation of ICT in education policy is mobilized if school-industry partnership is an integral part of such policy. In addition, schools are able to explore and experience emerging technologies and pedagogies.*

6. Strategies to Ensure Sustainability

- *Preparing and disseminating guidelines on how to source funds empower schools to look for their own funds and to identify expertise to promote sustainability.*

Synthesis of Experiences

Issue 1

Leadership and Management

lesson*learned* 1

Having a champion at all levels in the education system promotes ICT acceptance

Champions are dedicated persons who are motivated by the satisfaction of contributing to the enhancement of student learning. They build a culture of innovation and encourage ICT use in teaching and learning. Champions should be identified at all levels and appointed officially and their roles and responsibilities should be clearly stated. The role of champions in ICT in education programmes is important and they should have the support of their superiors and peers. However, there is also a need to ensure that the long-term success of a programme does not depend solely on the abilities and actions of a few individuals. Care must be taken to ensure continuity in leadership.

a. ***Malaysia***: Champions are found at different levels. At the ministerial level, the Minister is kept informed on a regular basis about the progress of the Smart School project. The other champions are the Secretary-General of Education, in his capacity as Chairman of the Smart School Steering Committee; the Director of the Ministry's Educational Technology Division, who served as Project Director during the pilot phase; and the Deputy Director of the Educational Technology Division, who is a champion at the operational level.

At the state level, the champions are the Deputy Director of the State Education Department (the second highest ranking officer after the Director) who is Head of the Smart School Strategic Support Team; and his deputy, the Principal Assistant Director who is head of the State Education Resource Centre. Members of the Strategic Support Team represent State Education Departments and the State Education Resource Centres. The State Strategic Support Teams meet with the Ministry's Smart School Team on a regular basis.

At the school level, champions hold the position of head of school. The head is the prime change motivator and change manager and, as head of the school change management team, is responsible for developing both short-term and long-term change management plans and activities for all key stakeholders in the school. The other team members are deputy school heads, resource teachers for Bahasa Melayu, English Language, Science and Mathematics, school IT coordinators, and school IT technicians. They meet at least once a year at change management coordination meetings conducted by the Smart School Team.

b. ***Thailand***: In many cases, champions at the provincial, regional and national levels are identified through contests and competitions on ICT in education. These include the Outstanding Teachers Search, Software Contest, Website Competition, and Model

Teachers Search. However, many champions are not sufficiently supported in their schools or provinces. For example, while teacher champions are invited to contribute to other schools or educational institutions to demonstrate their innovative projects, their routine workload remains relatively heavy. Their contribution outside the school is not considered as part of their workload. In this case, some champions may not be willing to share their best practices and projects with other schools. Sometimes even the transfer of innovations to other classrooms within the same school encounters resistance, especially when it lacks the support of the principal or peer teachers.

lesson*learned* 2

Including 'ICT in Education' as an important component in the development programme for administrator supports the introduction of innovative uses of ICT in schools

Research studies, such as the Second Information Technology in Education Study or SITES M1 and M2, suggest that in some cases, the school administrator's ICT vision is not always supportive of classroom innovations using ICT.

a. ***Thailand***: At the school level, the principals or principal-to-be have to undergo training provided by the Institute of School Administrator Development. The training courses cover all matters related to school administration and management, including general use of ICT. However, the courses do not focus on teaching and learning using ICT.

Issue 2

Harmonizing ICT in Education Programme with Other ICT and/or Education Initiatives/Projects

lesson*learned* 1

To avoid duplication of work and dilution of funds, there should be coordination of ICT in education projects and sharing of information on ICT

a. ***Malaysia***: Major projects in the Smart School Master Roll-out Plan have been properly coordinated. In addition, the plan gives due consideration to current trends and needs, such as Open Source Software, Open Standards, computer aids, mobile phones and Internet access by means of satellite and microwave.

Current educational programmes involving ICT include the Smart School Project, the teaching of Science and Mathematics in English, the school computerization programme, and the Universal Service Provision Project, all of which are part of MOE's goal to "provide equal access to quality education to every child, irrespective of background, religion or ethnicity". The Teaching of Science and Mathematics in English Programme was introduced in 2002 and implemented in 2003 in all schools in the country. The Government recognizes that English is the language of the Internet and that students need to be able to access materials from the Internet competently in order to keep pace with developments in science and technology. The School Computerization Programme is meant to provide every school with one to three computer laboratories (20 computers per laboratory), depending on the student population. The goal is to have every school run ICT literacy classes.

The Universal Service Provision Project helps to bridge the digital gap between rural and urban schools. The pilot project, involving 220 schools in Sabah and Sarawak, includes the provision of basic infrastructure, including electricity, telephone lines and Internet access, computers, telephones and other related equipment. The project will be expanded into a nationwide SchoolNet for the 10,000 schools in the country.

Issue 3

Dichotomy between Educators and Technologists

lesson*learned*1

To ensure that ICT in education projects are not just technology-driven, they should be managed by a team composed of educators and technologists

Ideally, ICT in education projects should be conceptualized by a mixed group of educators and ICT experts, with the educators capitalizing on existing and cutting edge technology while the technologists take into account teaching and learning issues concerned with ICT use in the classroom. ICT in education projects should be education-driven, not technology-driven.

a. ***Malaysia***: A joint Ministry–Industry Task Force wrote the Smart School Conceptual Blueprint. The task force included MOE officials from various divisions (e.g. Curriculum Development Centre, Teacher Education Division, Examinations Syndicate and Educational Technology Division) and representatives from leading ICT companies (e.g. Microsoft, Oracle, IBM and Sun Microsystems). The Smart School Pilot Project Team was made up mostly of educators although several systems analysts were included to help monitor the technology infrastructure and support service components of the Smart School Integrated Solution. The Smart School Development Team, which will implement the roll-out of the Smart School, also has a mixed membership consisting of educators and systems analysts. The school IT Coordinator is usually a teacher with ICT experience. The Ministry has an on-going programme to upgrade ICT competency among teachers, when necessary. An IT technician assists the school IT Coordinator.

b. ***Thailand***: Based on IPST's experience in curriculum development and teacher professional development, the key personnel that have to be involved include subject content specialists at university level, experienced teachers in each subject area, science and mathematics educational supervisors, science equipment designers, and educational technologists. This can be seen in IPST's current teacher professional development programme that aims to train science and mathematics teachers in integrating ICT in their subject areas. The task of integrating ICT in the teaching and learning process requires knowledge of the subject matter, ICT skills, and pedagogical skills. It is difficult to find instructors who possess all these skills. IPST curriculum developers have to work in collaboration with science and mathematics trainers and educational technologists from universities and Rajabhat Institutes for effective delivery of training courses. ICT personnel are not suited to this kind of programme although they are able to work well on courses focusing on the use of ICT tools.

Issue 4

Resources at Ministerial and School Levels

lesson*learned* 1

To ensure the site readiness of all schools, there must be adequate initial financial investment by the government at the national level, especially on basic ICT infrastructure and resources

It is important to ensure the site readiness of schools, in terms of manpower, funds and technological infrastructure.

a. ***Indonesia***: To facilitate the integration of ICT in education, the Government has allocated funds in the form of block grants. However, block grants are made available to a small number of schools only. The recipient schools use their respective grants to purchase hardware and software, prepare ICT personnel through training workshops, and support the maintenance, care and management of ICT equipment. It would be more helpful if the Government will allocate a special fund for implementing ICT in education from the national budget.

b. ***Malaysia***: The Government provided funds for the Smart School Project, allocating RM400 million for the pilot project, of which RM100 million was for the training of administrators and teachers in the Smart School Concept, and RM300 million for the implementation of the Smart School Integrated Solution in 87 schools, under an agreement signed between the Government and the shortlisted consortium. The components of the Smart School Integrated Solution and are as follows: Teaching-Learning Materials; Smart School Management System; Technology Infrastructure (IT and non-IT Equipment, Local Area Network, Wide Area Network, Communications); Training in the Use of SSIS Components; Support Services (Help Desk, Preventive and Corrective Maintenance) and Project Management, Business Process Re-engineering, and Systems Integration.

c. ***Philippines***: The General Appropriations Act (GAA) is the primary financing instrument for the DepEd Computerization Programme, which began in 1996. To date, DepEd has deployed hardware, printers, office software and educational CD-ROMs and has conducted teacher training on basic computer literacy for 986 of the over 4,500 public secondary schools. In 2002, it received US$3.1 million to computerize an additional 258 schools. To date, 56.4% of public secondary schools have at least one computer. DepEd estimates that by the end of 2005, 75% of public secondary schools will have computers. Once this target has been reached, the computerization programme will focus on public primary schools.

The Science Education Institute (SEI) at DOST has also been instrumental in enhancing ICT resources of public schools. Beginning in 1994, it has computerized 303 public high schools and continues to allocate between US$400,000 and US$600,000 annually for ICT facilities and ICT skills enhancement. Other SEI-DOST programmes include the Mobile IT Classroom (targeted at public primary schools), the ICT-Mediated S&T Learning Programme (for public primary and secondary schools), the Mini Computer Laboratory (for public primary and secondary schools), and Computer-Based Teaching Modules Development (for public secondary schools). The last one consists of curriculum-

specific lessons in General Science, Biology, Chemistry and Physics, and has been distributed to 1,477 public secondary schools nationwide.

d. ***Singapore***: With a budget of S$2 billion, MP1 was implemented to network all schools, equip them with at least one computer for every five students and train all teachers in ICT integration. The networking enabled access to courseware, the Internet and digitized media resources in every classroom and in all learning areas in the school. It also allowed the sharing of teaching resources within and between schools in Singapore.

e. ***South Korea***: Although the ICT infrastructure was constructed in accordance with the plan for 2000, it caused financial difficulties in Provincial Offices of Education, some of which issued public loans or incurred debts in the process.

The Ministry of Education and Human Resources Development took necessary measures to reduce the financial strain on the Provincial Offices of Education and recommended that a substantial part of the central government's subsidy be used for infrastructure construction for ICT use in education. As this was not a compulsory guideline, the financial contributions for infrastructure construction were not even. For this reason, the Ministry of Education and Human Resources Development defined standard expenses for unit projects and revised the enforcement rules for the subsidy. The Ministry handed over 450 billion Won to the local governments as subsidy for local educational expenses in April 2001.

The Ministry also defined enforcement guidelines for subsidies to ensure the effective promotion of ICT use in education, as follows: 40% for infrastructure construction (based on the number of schools); 30% for reinforced education for ICT use (based on the number of students); 15% for maintenance and repair of PCs and other equipment (based on the number of PCs); and 15% for ICT use in educational administration (based on the number of schools).

lesson*learned*2

Every school is different and each one should be given some autonomy to select ICT resources that are most suitable to the needs of teachers and students

By recognizing that every school is different, better ICT integration in the school curriculum is ensured.

a. ***Malaysia***: Initially, the State Education Departments did not make specific financial allocations for pilot schools in the Smart School Pilot Project in their states and instead they utilized available funds. The Pilot Project Team helped out by requesting for specific allocations to be set aside for the states to use, for example, for replacing equipment not covered by the Smart School Pilot Project Agreement and for improving wiring and lightning detectors in the pilot schools. As the project proceeded, the Ministry's Finance Division assigned special status to all the pilot schools, thereby allowing them a certain level of autonomy in school expenditure.

b. ***Singapore***: Schools are provided with basic technological infrastructures and are given the autonomy to decide on the kind of ICT resources and tools that they should acquire, based on their own visions and analyses of their students' learning needs. This is particularly evident in MP2 that allows schools to have greater autonomy and flexibility in using ICT funds.

lesson*learned*3

Investments in ICT infrastructure and resources in schools create an environment that is conducive to learning

Larger classrooms can accommodate more computers and provide teachers with more possibilities for ICT-based learning activities.

a. ***Singapore***: Under the Programme for Rebuilding and Improving Existing Schools (PRIME), schools underwent redevelopment and re-equipment. The facilities included computer laboratories, media resource libraries, ICT learning resource rooms, larger classrooms, pastoral care rooms and health and fitness rooms. S$4.5 billion of the MOE budget was allocated for the programme that also included the construction of extension blocks, alteration of existing school buildings, and construction of new buildings. Construction was carried out in phases, determined by the age of the school, the state of existing facilities in the school, and the availability and suitability of the school site. .

lesson*learned*4

The MOE should be encouraged to establish a standard budget based on school size and existing resources rather than to apply one formula for all schools

In some countries, large and famous schools have fewer financial problems compared with small ones. Therefore, the allocation of budget to schools should move away from a one-size-fits-all formula.

a. ***Thailand***: Two types of budgets are allocated for schools: one is a fixed cost which is based on school projects and activities, and the other is a variable cost which is based on the number of students. Large schools receive more budget than smaller ones. However, most schools, regardless of size, do not receive adequate funding from the Government. It is the responsibility of the school administrators to manage their own financial resources and handle their budget constraints.

Several organizations, such as alumni associations, parent-teacher associations, local communities or political groups, have become supplementary sources of funds for the school budget. Large schools generally have advantages in obtaining outside funding. In many cases, the ICT infrastructure is dependent upon the volume of funding a school is able to secure and the amount allotted to different school activities, including administration, teaching and learning, and personnel development.

Issue 5

Resource/Financial Mobilization from Donor Agencies and the Private Sector

lesson*learned* 1

Financial and resource support for the implementation of ICT in education policy is mobilized if school-industry partnership is an integral part of such policy. In addition, schools are able to explore and experience emerging technologies and pedagogies.

Partnerships with the private sector, statutory boards and government bodies provide schools with opportunities and perspectives on how ICT can be integrated in the school curriculum to enhance the learning experiences of students. The signing of an MoU could be an important first step towards school-industry partnership. Support from individual industries could be financial or in kind.

a. ***Indonesia***: Since the national budget for education is not quite enough to support ICT integration in education, the Government encourages private sector involvement, with the MOE coordinating their participation. Examples of such companies are PT Indosat, PT Telkom Indonesia, Microsoft Indonesia and ISP of Indonesia.

b. ***Malaysia***: Funding models from the private sector, as discussed during negotiations for the MSC Flagship initiative, included "Build-Operate-Transfer", "Build-Operate-Own" and "Build-Operate-Jointly Own". In the case of the Smart School Project, after several negotiations, the Government finally settled for a straightforward direct purchase model. Seven local members of the consortium formed a joint venture company, with the three multinational companies becoming sub-contractors to the joint venture company. The IPR to the Smart School Integrated Solution and all its components will be passed on to the Government upon the Government's acceptance of the solution.

In the original Smart School Implementation Plan, the schools would be empowered to source their own funds and expertise to "smartize" their schools. The MOE would act as architect and motivator by providing guidelines to help schools become Smart Schools. Now that the pilot project has ended, there are indications that many non-pilot schools are able to become Smart Schools on their own initiative. Some schools have obtained support from federal and state departments, while others have relied on patronage from the private sector (e.g. banks). The parent-teacher associations have contributed enough hardware to enable their schools to apply to the Ministry for installation of the Smart School Applications Software.

c. ***Philippines***: The Government does not shoulder the total cost of integrating ICT in schools, although national budgetary support is in fact needed. The Government passed the Adopt-a-School Act in 1998 in which many MNCs participated. The Japanese Government, an Adopt-a-School partner, provided assistance totalling US$12 million dollars for hardware, software and basic computer literacy training to 1,000 public secondary schools in 2001.

The project "PCs for Public Schools", implemented through the DTI, began deployment in 2002 and was completed in 2003. Another 1,000 schools will be given computer laboratories in 2004-2005 through this project.

Under consideration by ITECC are alternative financing schemes, such as an Internet Caf Voucher System and a Service Contracting Scheme involving commercial ICT providers. Other proposed measures include legislation to institute tax incentives for ICT vendors and suppliers of electricity, and automatic appropriation to schools with ICT facilities from the Local School Board Fund and/or the City/Municipal/Provincial Fund. Various groups are also lobbying for the institutionalization of educational discounts on hardware, software, telephone service, and Internet access. Lobbying also continues for an increase in the national budgetary appropriation for education in general

d. ***Singapore***: The ICT in Education Master Plan mobilized financial and resource support from private organizations and statutory boards, such as the IDA which initiated the FastTrack@School Programme. The programme encouraged industry partners to work with schools to develop useful and relevant broadband education content for teaching and the curriculum. A total of S$7.5 million was allocated under the pilot project for broadband access at schools and homes, as well as content on Singapore ONE and Adopt-A-School initiatives.

The School-Industry Partnership Scheme (SCHIPS), signed between the MOE and industry and initiated under MP1 in 1997, aimed to promote the development of Singapore's educational technology industry. The first two MoUs were signed in 1998 with Singapore Technologies Computers Systems and Services Pte Ltd (STCS) and Educom Pte Ltd (Educom). STCS worked with two schools to provide technology solutions, while EduCom, worked with four primary schools on an integrated learning management system called SuccessMaker. Educom also provided innovative computer furniture for the classrooms and training and support for the teachers. These two projects were co-funded by MOE, IDA (the then National Computer Board) and the respective industry partners, and cost about S$3.67 million, with the two industry partners contributing a little less than a third of the total fund.

e. ***Thailand***: Non-governmental budget is relatively low, with support mostly provided in the form of technical assistance rather than in capital fund. The projects being funded by the private sector include "Think.com Programme" and "Intel Teach to the Future". However, following the recent announcement of cooperation between Microsoft and the Thai Government, contributions to ICT education in Thailand may increase. Microsoft is committed to partner MOE and MICT in supporting 38,000 schools nationwide. The first stage focuses on the pilot project, "One District One Dream School". The contribution includes learning grants, computer donations, and school agreements and will last for five years. Under this project, Microsoft will support and work closely with all institutions in the field of ICT in education to help improve teaching and learning in all schools.

In addition, there is the JICA-funded ITEd project aimed at developing effective curriculum using ICT and training 3000 teachers and local people who can implement the newly developed curriculum and tools in local model areas.

Issue 6

Strategy to Ensure Sustainability

lesson*learned* 1

Preparing and disseminating guidelines on how to source funds empower schools to look for their own funds and to identify expertise to promote sustainability

The preparation of guidelines will ensure that schools with adequate financial means can proceed on their own initiative, while complying with existing rules and regulations.

a. ***Malaysia***: The Smart School Project uses a variety of funding strategies. The pilot project was implemented using federal funds, while the phased roll-out of the Smart School Integrated Solution will also make use of federal funds. However, it was originally planned that the schools would be empowered to become smart schools using their own funds and expertise. Guidelines to enable schools to proceed with "smartization" have been prepared and will be disseminated to all State Education Departments.

Component

4

ICT in Schools – Policy, Vision and Strategy

Overview

Very often ICT is merely attached to existing classroom teaching and learning activities, leaving the traditional curriculum, learning objectives, teaching strategies and student learning activities more or less intact. While the learning medium may have changed, from textbooks to web-based books or from PowerPoint presentations in class to PowerPoint presentation via the Internet, the learning paradigm remains the same. For example, the learning paradigm adopted for PowerPoint presentations of certain concepts in the classroom is a cognitive one, where learning is associated with the transmission of knowledge. This paradigm may be adopted when the same concepts are taught via the Internet, with the same PowerPoint presentations made available online. Although ICT may facilitate independent self-paced learning, the potential of ICT may not be optimized if there is no shift in the learning paradigm. This component examines and explains how ICT vision, policy and strategy are formulated and implemented to integrate ICT in education. The focus is on (i) ICT in schools: vision and plan, (ii) supporting policies that facilitate uptake of ICT, (iii) management of ICT resources, (iv) translation of laws into acceptable school-level policies, and (v) parents and community involvement.

Lessons learned

Based on the six case studies, the following lessons learned are generated:

1. ICT in Schools: Vision and Plan

- *A clear vision of ICT integration in schools that is shared by all members of the school community promotes effective use of ICT in the classroom.*
- *An ICT master plan that is formulated according to a school's vision and its socio-cultural setting assures effective integration of ICT.*

2. Supporting Policies That Facilitate Uptake of ICT

- *To promote ICT uptake in schools, school leaders should initially adopt strategies that make ICT a part of the daily routine or tasks of the teachers.*
- *To promote use of ICT in schools, the MOE should set guidelines for schools on the integration of ICT in the curriculum, without necessarily imposing these as rules or regulations to be strictly adhered to.*
- *ICT use in schools is more likely to be facilitated if school leaders employ strategies that provide teachers with a platform and support for the integration of ICT in the school curriculum.*
- *Appointing an ICT coordinator or head of ICT department in each school helps to ensure administrative and pedagogical support for the teacher.*

3. Management of ICT Resources

- *Carrying out a SWOT analysis and applying its findings help to optimise use of ICT resources.*

4. Translation of Laws into Acceptable School-level Regulations

- *Translating ICT in education policy and laws into a set of school-level regulations and procedures provides a clearer blueprint for schools on the use of ICT.*

5. Parent and Community Involvement.

- *ICT bridges and strengthens the home-school connection and, if properly harnessed, promotes parents' activities and involvement in the school.*
- *When parents are encouraged to participate in and contribute to change management activities within a school's ICT master plan, change occurs more quickly.*
- *As ICT opens opportunities to collaborate with different organizations and people in local and international communities, schools should establish linkages with different communities to help in developing the overall character of students.*

Synthesis of Experiences

Issue 1

ICT in School: Vision and Plans

lesson*learned*1

A clear vision of ICT integration in schools that is shared by all members of the school community promotes effective use of ICT in the classroom

Teachers need to know exactly how ICT is used as a teaching and learning tool. Many researchers have pointed out that a school's ICT vision is essential to effective ICT integration (Kerr, 1996; Murphy & Gunter, 1997; Anderson & Dexter, 2000). Ertmer (1999) wrote, "A vision gives us a place to start, a goal to reach for, as well as a guidepost along the way" (p. 54). Means and Olson (1997) thus recommend that teachers and schools develop a vision before they make substantial investments in hardware and software. Moreover, the vision should not be created by a single person or through a top-down process starting from the MOE. It is crucial to involve those who have a stake in the outcomes, including teachers, parents, students, and the community, and allow them to assist in the creation of the vision by contributing their knowledge, skills, and positive attitudes. An ICT vision that is accepted by all becomes a shared vision, which is critical to successful implementation of ICT in a school setting (Costello, 1997).

a. ***Singapore***: In interviews conducted by IDA (http://schools.s-one.net.sg/findings1.html), respondent teachers, heads of departments and principals offered various perspectives of their respective schools' vision of ICT use in education. The respondents were aware of the importance of the schools' vision, which some used as a benchmark for becoming top academic and elite schools in the forefront of ICT integration. Others considered the vision as a guide to ensure effective deployment of ICT in teaching and learning. The Crescent Girls' School's vision is to deploy ICT to reach out to the community at large, that is, ICT must serve the community. The provision of a pervasive ICT environment to improve the quality of life of teachers and students is the vision of Victoria Junior College. Both infrastructural and innovative interactive multimedia courseware contents are planned to meet the college's objectives. The vision of Rosyth Primary School is to embrace ICT to achieve administrative and academic excellence and to help students appreciate the relevance and appropriate application of ICT. These visions of ICT are consistent with that of MP1 and MP2, where ICT is seen as an enabler to enhance teaching, learning and administration in the schools.

b. ***Thailand*:** Most schools do not have their own ICT vision and plan as the ICT infrastructure and training are generally directed and given by the Ministry. The school-level vision and plan (if any) are usually established by individual school principals who perceive ICT as a tool for improving the quality of education. The school board takes all decisions on the purchase of ICT tools, a procedure that is usually met with some resistance from the teachers as they do not always share the same vision as the principal or the ministry nor do they feel a sense of ownership of the plan.

lesson*learned* 2

An ICT master plan that is formulated according to a school's vision and its socio-cultural setting assures effective integration of ICT

Some issues that should be considered include staff and student development in ICT-related skills, curriculum and assessment, ICT facilities and resources and support teams (both technical, administrative and pedagogical). Once the vision has been successfully created and accepted, the next step is to articulate an ICT integration plan, spelling out how the teachers are expected to integrate technology in their lessons (Strudler & Wetzel, 1999). An ICT integration plan provides a detailed blueprint of the steps and methods needed to translate the school ICT vision into reality. Developing ICT integration plans is no doubt a complex and time-consuming task, but they are usually well worth the time required to put them together (Hoffman, 1996).

a. ***Malaysia***: Initially, the Smart School Pilot Project was perceived as "just another Ministry pilot project". None of the heads of the pilot schools planned any formal or non-formal change management programme for the staff and students. The Smart School Pilot Project Team had to ask the schools to develop their own change management plans, with activities for in-house training, dissemination of information, and coordination meetings. These change management plans that were part of the ICT integration master plans were to be incorporated into the schools' existing vision and mission.

b. ***Singapore***: Most schools have ICT integration master plans that have been customized for their own school culture and environment. These master plans address the following issues: (i) priorities for implementation of the ICT master plan (e.g. staff, students, content areas), (ii) evaluation standards and benchmarks to indicate effective integration of ICT, (iii) responsibility for successful implementation (e.g., ICT committees, administrative personnel, teachers, technical support staff), and (iv) funding requirements and time available to implement ICT integration efforts.

Issue 2

Supporting Policies that Facilitate Uptake of ICT in Schools

lesson*learned* 1

To promote ICT uptake in schools, school leaders should initially adopt strategies that make ICT a part of the daily routine or tasks of the teachers

These strategies may include using e-mail as the mode of communication among staff, accessing the Intranet to download forms and using a word-processor to complete lesson plans for submission. The school leader should be a role model and should make ICT a tool in his/her everyday life.

a. ***Singapore***: Some means by which school leaders have facilitated the uptake of ICT in the schools are as follows: (i) sending out school announcements via e-mails to all staff; (ii) requiring all teachers to submit their weekly lesson plans via e-mails to their heads of department; (iii) uploading all forms (such as transport claim, leave application, training development application, and medical claim) on the school intranet for teachers to download; (iv) encouraging staff to communicate and share via e-mail and other asynchronous and synchronous ICT tools; and (v) requiring teachers to submit their class daily attendance via the online portal.

These measures ensure that ICT gradually becomes part of the school culture and helps some "technophobic" teachers to overcome their initial fear of ICT.

lesson*learned*2

To promote use of ICT in schools, the MOE should set guidelines for schools on the integration of ICT in the curriculum, without necessarily imposing these as rules or regulations to be strictly adhered to

Rules may stifle creativity and may lead to a technologically-driven approach to ICT integration. School leaders should be given the autonomy to decide on how to implement rules and guidelines based on their analyses of their schools' readiness.

a. ***Philippines***: Respondents to the 2001-2002 survey on ICT utilization in secondary schools considered three main goals in using computers in the schools: preparing students to join the workforce, improving student achievement, and making the learning process more interesting. The promotion of active learning, individualizing the learning process, and encouraging cooperative learning, although not considered unimportant, were less of a priority, suggesting that technology intervention was still focused on the acquisition of basic technical skills and was still embedded in traditional pedagogy (Tinio, 2002). This is in contrast to the shift in emphasis in the new national curriculum - the Revitalized Basic Education Curriculum or RBEC - from technology literacy for its own sake, to the effective application of ICT across the curriculum, especially in Mathematics and Science. Indeed, it would seem that there is a gap between what is prescribed at the national level and what is being done at the school level. There seems to be some confusion over what ICT capabilities are prescribed at the national and sub-national levels, with 87% of the schools claiming to need more guidance on this matter. All of the schools surveyed have indicated that they lack information on how to use ICT to support the curriculum (Tinio, 2002).

b. ***Singapore***: Most school leaders consider MOE's recommendation that 30% of the curriculum time should involve ICT use, as a guideline rather than as a rule or regulation. An increasing number of school leaders have realized over the last three years that ICT should not be integrated in the curriculum for ICT's sake. Instead, they believe that teachers should explore ways by which to integrate ICT in the curriculum to enhance the learning experiences of students.

lesson*learned*3

ICT use in schools is more likely to be facilitated if school leaders employ strategies that provide teachers with a platform and support for the integration of ICT in the school curriculum

These strategies may include sharing sessions on ICT use among teachers, peer teaching and team-teaching based on an apprenticeship model, and employment of more technology assistants to support teachers.

a. ***Indonesia***: A number of schools have integrated ICT use in education. Most of them have one or two computer laboratories, each with ten to twenty computers. Five to 10 of these computers are connected to the Internet. School leaders encourage teachers and students to use the Internet to seek information related to their learning needs. Some schools even have their own websites.

b. ***Malaysia***: At the school level, the head of the school is the prime change motivator and change manager. He or she heads the school change management team and is responsible for developing both short and long-term change management plans and activities for all key stakeholders in the school. The school heads, senior assistants (deputy school heads), resource teachers for Bahasa Melayu, English Language, Science and Mathematics, School IT Coordinators, and School IT Technicians meet at least once a year at change management coordination meetings conducted by the Smart School Team.

c. ***Singapore***: Some school leaders have adopted the following strategies: (i) planning contact time for teachers to share their experiences in using ICT in their lessons; (ii) initiating industry-teacher partnerships to deliver just-in-time ICT training for students and to develop instructional ICT-based materials for teaching and learning; (iii) peer-teaching of ICT-related skills based on the apprenticeship model or just-in-time learning; (iv) collaboration with other schools to share expertise and experiences on ICT integration; (v) equipping teachers with a personal laptop each so that they would be able to make ICT use a part of their lives; (vi) employing more technology assistants to support teachers in ICT use; and (viii) purchasing more laptops so that teachers would not be constrained by the unavailability of ICT facilities (such as computer laboratories and media resource rooms).

lesson*learned*4

Appointing an ICT coordinator or head of the ICT department in each school helps to assure administrative and pedagogical support for the teachers.

This appointment should not be confused with that of a technology assistant. The ICT coordinator or head of department should advise teachers on ICT solutions to their teaching or learning problems, help teachers to acquire ICT resources, and conduct training needs assessment of teachers' ICT-related capacities and advise them on their professional development.

a. ***Indonesia***: A teacher with ICT competency is appointed ICT coordinator. He/she is responsible for the management of ICT use in

the school. As most ICT coordinators do not have ICT educational background. Therefore, training them in ICT-related skills is necessary. JIS (School Information Network), a program initiated by the Directorate of Vocational Secondary School intends to provide ICT training for teachers within the network.

b. ***Malaysia***: The School ICT Coordinator is usually a teacher with ICT experience. To upgrade his/her skills, the MOE has an on-going programme for upgrading ICT and pedagogical competencies, whenever necessary. An ICT technician who is not an educator usually assists and supports the School IT Coordinator.

c. ***Singapore***: The ICT coordinator or head of department provides teachers with administrative and pedagogical support. He or she is a staff specialist whose main duties are to help teachers to coordinate ICT planning and development, provide administrative support by supervising computer facilities, order supplies, maintain hardware and software, liaise with hardware and software vendors and service personnel, and collaborate with teachers and school leaders in preparing hardware/software budgets, reports, and proposals. The coordinator or head also assists teachers in evaluating and selecting hardware and software and conducts needs assessments to determine additional hardware or software needs among the teachers and students.

Issue 3

Management of ICT Resources

lesson*learned*1

Carrying out a SWOT analysis and applying its findings help to optimise use of ICT resources

Without the application phase, a SWOT analysis is useless.

a. ***Malaysia***: In the change management exercise conducted by the Smart School Pilot Project Team, the heads of the pilot schools analyzed their schools' strengths, weaknesses, priorities, and available skills and resources. This information together with the organizational structure of the schools and the schools' change management plans were documented and monitored by the Smart School Pilot Project Team with the help of the consortium. However, on-site monitoring of the schools' implementation and adherence to their change management plans indicated poor compliance. Most of the schools cited lack of leadership, time and resources as reasons for not carrying out change management activities.

b. ***Thailand***: SWOT analysis is generally undertaken at departmental level in the MOE prior to developing the ICT in education policy. However, such analysis is usually not applicable to school situations due to budget constraints and centralized national policy. Decentralization of educational management to the school level may encourage schools to do their own SWOT analysis in the next phase of the ICT in education policy.

Issue 4

Translation of Laws into Acceptable School-Level Policies

lesson*learned*1

Translating ICT in education policy and laws into a set of school-level regulations and procedures provides a clearer blueprint for schools on the use of ICT

These policies and procedures should be in line with existing laws governing ICT at the national level.

a. ***Malaysia***: One of the deliverables of the Smart School Integrated Solution was a set of school-level ICT policies and procedures. The Smart School Pilot Project Team reviewed these polices and procedures to ensure that they were in line with existing Ministry rules and regulations. The team also submitted the policies and procedures to the central agency responsible for all matters relating to ICT use in the country, i.e. the Malaysian Administrative Modernization and Management Planning Unit (MAMPU) in the Prime Minister's Office, for their comments. The critical security policies introduced covered authentication and passwords, backup procedures, installation of firewalls, and use of licensed software.

b. ***Thailand***: Sections 63-69 of the 1999 National Education Act, Chapter 9, support the use of technologies in reforming education. The Act serves as a regulatory framework for formulating major plans and policies, some of which are being implemented at both ministerial and school levels. They are the Plan for Development of Mass Communication and ICT for Human and Social Development (1999-2008); the MOE Master Plans for Educational Radio Broadcasting, Educational Television, and Educational Multimedia; Policy for the Production, Development and Usage of Materials and Other Technologies for Education; the National ICT Policy (2001-2010) by NECTEC; National ICT Master Plan (2002-2006) by MICT; MOE National ICT Master Plan for Education (2004-2006); and National Education Network Project (2002-2005). Some of these laws have not yet been translated to school-level policies and procedures. A recent ministerial regulation issued in late 2002 supports the policy for the production, development and usage of materials and other technologies for education. This regulation offers more freedom for schools to select quality educational materials of their choice.

Issue 5

Parent and Community Involvement

lesson*learned*1

ICT bridges and strengthens the home-school connection and, if properly harnessed, promotes parents' activities and involvement in the school

ICT facilitates linkages among schools, homes and communities, enabling teachers, peers, parents and members of the community to play a greater role in the students' learning experiences. These experiences include engaging in authentic problem solving, working with researchers and honing their entrepreneurial skills. The bonds between schools and homes and communities are also strengthened through increased interaction and communication.

a. ***Malaysia***: One of the deliverables of the Smart School Integrated Solution is a feature in the computerized SSMS that enables parents to remotely access their children's school records so that they can keep track of their progress. The feature became available in late 2002. It has yet to be fully utilized by parents, particularly those who have no Internet access.

b. ***Singapore***: A wide range of school activities involve parents and the community, due partly to school-industry partnerships and the autonomy given to schools in ICT in education master plans. Moreover, with better connectivity linking the school to the home and community, peers, teachers, and parents are able to play a more active role in the students' learning experiences. One example is the "Learning Village" project in Outram Secondary School under the MOE-IBM Collaboration, a School-Community Web Collaboration System using the Internet to foster home-school-community connection and partnership. By connecting various stakeholders of education, the Learning Village has strengthened the school's effort to achieve it mission: "An Intelligent School and a Caring Family". The Radin Mas Primary School has set up a Parent Link website to promote rapport among parents and between the parents and the school, as well as to foster mutual support in shaping the overall character of students.

lesson*learned*2

When parents are encouraged to participate in and contribute to change management activities within a school's ICT master plan, change occurs more quickly

a. ***Malaysia***: Pilot schools in the Smart School Project were encouraged to include parents and the community in their change management activities. Parent-teacher associations took a keen interest in the development of the Smart School Project and helped to sponsor trips to the MDC for an inside view of the MSC's work . Other PTAs sponsored talks by ICT personnel, and facilitated the schools' participation in ICT-related competitions. The Smart School Pilot Project Team also organized a national seminar for representatives of PTAs from non-pilot schools as part of the Smart School Outreach Programme. In addition, the team gave talks and presented papers at seminars,

conventions, and meetings to help disseminate information about the Smart School Project.

b. ***Thailand***: In most cases, parents, alumni and PTAs are great school supporters. School committees comprising students, parents and teachers are established across grade levels to work together on the students' learning and to prepare proposals to obtain support from the school board or PTA. Parents not only provide hardware and software, but have also become resource persons. Some private schools offer ICT training to parents so that they can guide their children in the use of technology or even learn together.

lesson*learned*3

As ICT opens opportunities to collaborate with different organizations and people in local and international communities, schools should establish linkages with different communities to help in developing the overall character of students.

With appropriate support and autonomy, schools are capable of innovative ICT-based projects to improve the bonds between them and communities.

a. ***Indonesia***: A number of schools were involved in a couple of projects under the Asia-Europe Classroom Programme. One of them, Ndolalak and Hambo – A Cultural Exchange between Sweden and Java, involved Senior High School 7 in Purworejo on Java (Indonesia) and Torsbergsgymnasiet in Bolln s (Sweden). Under the project, the students learned about cultural traditions in Java and Sweden. The aim was to encourage them to establish friendships and to develop understanding, respect and positive attitudes. The project title referred to the names of two dances that symbolizes culture in the two countries. The participating students were in the age group 18 to 19 years old. The Swedish students belonged to a culture class and were interested in cultural studies covering art, literature, music, dance, traditions and so on. They had personal pen friends. Through e-mail exchanges and online bulletin boards, the students designed websites and produced videos for one another.

b. ***Malaysia***: In the "Face 2 Face" project under the Asia-Europe Classroom Programme, students from Helsinki Business College in Finland and the Garden International School in Malaysia planned to visit each other during the course of the project (October to June). In preparation for these visits, they communicated with one another via e-mail and bulletin board and shared various aspects of their cultures through web pages that they designed. They also planned the itinerary for their visits using an online open forum. Another project, Multicultural Exchanger - A Newspaper On Line, involved Malaysia, Finland, Sweden, Indonesia, France, China, Singapore and Portugal. The students researched, planned and exchanged information before designing the website for the online newspaper.

c. ***Singapore*:** Parents, industry experts and academics are invited to work with schools to make meaningful contributions to the community (Soh, 2002). One example is the service-learning programme at Crescent Girls' School (www.crescent.edu.sg) in which students use ICT in an innovative way to make a difference in the lives of less fortunate members of the community. In 2000, a group of secondary three students set up an e-commerce project, "Very Special Bazaar", together with members of Peacehaven (Home for the Elderly), the Movement for the Intellectually Disabled of Singapore (MINDS) and The Very Special Arts Singapore. Art and craft pieces were put on sale via the web with an e-commerce engine and the proceeds went to the elderly and the physically and intellectually challenged in these organizations. Two other projects by the school involved the Singapore School for the Deaf (SSD), where hearing-impaired students and Crescent's students co-designed digital art cards to raise funds. They also wrote, illustrated and translated some works into sign language to enrich teaching and learning resources for the hearing-impaired members of the community.

Component

5

Technology Infrastructure and Connectivity

Overview

The type and standard of physical and technological infrastructures and affordable connectivity available in the six countries vary. At one end of the spectrum is Singapore where there is 100 percent connectivity to all schools through a WAN while also offering broadband connection. Schools in Indonesia are connected in a citywide wireless WAN through an intercity backbone connection using fibre optic and satellite connection. Malaysia, under its Smart Schools Project, has connected 187 Smart Schools using both broadband and ISDN and is now about to expand this further.

Thailand and the Philippines make use of dial-up access. Thailand has connected 5,000 schools out of approximately 34,000 schools nationwide to its SchoolNet, with free Internet dial-up access through a cheap local telephone call. The Philippines has also established SchoolNet to connect 15 pilot schools under a dial-up Internet access used in a decentralized way.

Pelgrum (2001), in a worldwide survey of schools from 26 countries, found that the most frequently mentioned problem in integrating ICT in education is the insufficient number of computers. Williams, Coles, Wilson, Richardson and Tuson (2000) cited limited availability of ICT resources as a major obstacle to classroom management and organization of resources. Cheung (1997) observed that pupils tended to lose concentration when groups working on a computer are too big. Given a large student group and a teacher's limited time for each lesson, there is not enough opportunity for each pupil to use the computer. Pelgrum (2001) also noted that insufficient peripherals and learning software is one of the ten major problems related to ICT integration in schools. When peripherals, such as earphones and microphones, and copies of learning software are insufficient, teachers have great difficulty in planning and conducting lessons even if there are enough computers (Cheung, 1997).

This component focuses on the following issues: (i) mobilizing support from telecommunications and ICT organisations and industries, (ii) choice and mode of deployment of technologies, (iii) connectivity options and alternatives, (iv) infrastructure that supports and delivers teaching and learning, (v) emerging technologies, (vi) donated computers, (vii) open source software, (viii) guidelines on information security, and (ix) integration of school management software with the learning management system (LMS).

Lessons learned

Based on the experiences of all six countries except Indonesia, the following are the lessons learned:

1. **Mobilizing Support from Telecommunications and ICT Organisations and Industries**
   - *Tapping local telephone companies and ICT industries for support has promoted affordable Internet connectivity and computer hardware and software.*

2. **Choice and Mode of Deployment of Technologies**
   - *When deploying technologies to schools throughout a country, establishing a balance between equity and effectiveness is necessary.*
   - *Deploying ICT in different types of pilot schools or demonstration schools will generate lessons on how to increase ICT use at different school levels and cull best practices.*

3. **Connectivity Options/Alternatives**
   - *Use of satellite and Internet schemes has enabled some countries to reach marginalised areas or economically disadvantaged groups.*
   - *Working closely with Internet Service Providers (ISPs) helps in determining appropriate bandwidth connection in schools and homes* .

4. **Infrastructure to Support and Deliver Teaching and Learning**
   - *There is no perfect combination of online and offline resources to promote effective teaching and learning.*
   - *Digital libraries for schools may be introduced as infrastructure to support and deliver teaching and learning.*

5. **Emerging Technologies: Dealing with Rapid Development of Technologies**
   - *ICT pilot projects should not take more than three years to complete since the obsolescence rate of present-day technologies is increasing.*
   - *Mobile computing offers schools many opportunities that include overcoming constraints of space and giving flexibility in anytime-anywhere utilization of ICT in schools.*
   - *Leasing equipment from private companies can be one solution to the problem of rapidly increasing obsolescence rate of present-day technologies.*

6. **Donation of Computers**
   - *Vocational colleges can be tapped to provide maintenance service for computers donated to schools.*
   - *Donated computers that have exceeded their lifespan may be redeployed for other uses or may be offered to needy students in other schools or some government and charity organizations*.

7. **Open Source Software**
   - *Although open source software (Linux-SIS, locally-developed word processor and digital toolkit for developing web content) is encouraged in the schools, there are limitations that must be taken into account before schools decide to use open source software.*

8. **Guidelines on Information Security**
   - *Preparing and disseminating guidelines on ICT security help in dealing with information security problems in schools.*

6. **Integrating School Management Software with Learning Management System (LMS)**
   - *Maintaining the inter-operability of a common school management system while ensuring that decoupling is built into the system is a need expressed by most countries. There should be adequate in-house training to help school staff and students in using LMS and in coping with the transition from manual to automated processes.*

Synthesis of Experiences

Issue 1

Mobilizing Support from Telecommunications and ICT Organisations and Industries

lesson*learned* 1

Tapping local telephone companies and ICT industries for support has promoted affordable Internet connectivity and computer hardware and software

SchoolNets in various countries have taken initiatives to obtain cost reductions for computer equipment and software and applications from private companies.

a. ***Indonesia***: PT Telkom, the main telecommunications company in Indonesia, signed an MOU with several schools in East Java. Under the MOU, PT Telkom willcharge schools a special rate for using telephone infrastructure. Another telecommunications company that has provided affordable rates is PT Indosat. PT Indosat actively participates in WAN Kota programmes initiated by the Ministry of National Education.

b. ***Malaysia***: Telekom Malaysia, the country's main telecommunications company, has proposed a special rate for telecommunications services to schools and the Ministry of Education (MOE). Another telecommunications company, Maxis, is collaborating with Telekom Malaysia to provide Internet access and telephones to 220 remote schools and their surrounding communities in Sabah and Sarawak.

The consortium that developed the Smart School Integrated Solution is helping the MOE to tap the resources of local and international hardware, software and applications companies in order to obtain cost reductions for the schools. Microsoft offers a special price for schools and other educational institutions. Currently, to address the high costs of long distance telephone calls, calls are made via a 1-300-xxx number and are levied local call charges. Calls can be made to this number from anywhere in Malaysia.

c. ***Philippines***: Leading telecommunications companies, including Globe/Islacom, PLDT, Bayantel, and Digitel, have provided over 100 public high schools with free telephone service and Internet access for one year and are extending a 50% discount for succeeding years to these schools. Numerous private companies, e.g., Intel, Microsoft, Sun Microsystems, Lucent Technologies, Cisco, etc., have also supported school networking through hardware/software donations and training grants

d. ***Thailand***: IT initiatives with NECTEC, TOT and CAT have brought benefits to the SchoolNet project, resulting in free Internet dial-up access from anywhere in Thailand at the cost of a local telephone, that is, three Baht. Compaq, Intel and Powell Computer have contributed as well. Powell Computer donated Pentium computers to 32 schools in rural areas. Microsoft donated 50 sets of Windows 95 and utilities to speed up schools' activities on the Net.

e. ***Singapore***: To reach households in the low-income bracket, six hardware and software providers and one ISP donated computers and other software. These households were provided with used PCs bundled with free Internet access and basic training..

Issue 2

Choice and Mode of Deployment of Technologies

lesson*learned* 1

When deploying technologies to schools throughout a country, establishing a balance between equity and effectiveness is necessary

ICT in education programmes must address the ever widening digital divide, taking into account geographical locations, socio-economic status, gender issues, ethnicity, and so on. These programmes must also recognize that while a tremendous amount of resources is needed, the levels of acceptance and utilization of computers and the Internet will vary from community to community.

a. ***Philippines***: Because of scarce resources, DepEd has had to choose whether to emphasize breadth (i.e., to provide facilities to as many schools as possible), or to emphasize depth (i.e., to provide a more comprehensive ICT package but to fewer schools). Political exigencies have tipped the balance in favour of nationwide roll-outs rather than more focused pilots. In some cases, such as the "PCs for Public Schools" programme, donors restrict the use of funds to purchase hardware and peripherals only. At the same time, some NGOs, corporations, and corporate foundations simply parachute computers to the schools and do not follow-up whether the ICT facilities that they help to build are instructionally effective and sustainable.

Predictably, the highest PC penetration rate in schools is in Metro Manila at 87%. A distant second and third are the highly industrialized regions of Central Luzon (25%) and Southern Luzon (22%). In the 13 remaining regions of the country, only 16% of the schools (or less) have computers. PC penetration rates of less than 5% are found in the poorest regions - Eastern Visayas (4.9%), Western Mindanao (3.4%), and the Autonomous Region of Muslim Mindanao (3.2%).

lesson*learned* 2

Deploying ICT in different types of pilot schools or demonstration schools will generate lessons on how to increase ICT use at different school levels and cull best practices

a. ***Malaysia***: Different types of schools were to be represented in the original Smart School Implementation Plan. The list was revised in 1999 to involve mostly existing secondary schools. Only five primary schools were chosen and these were schools that had yet to be constructed. By the end of the pilot project, only 83 secondary schools (including two newly constructed schools) and four primary schools (all newly constructed schools) were included. The other three schools (one primary and two secondary, all newly constructed) did not meet the contractual deadline for inclusion. Each of the fifteen States was allocated at least two pilot schools. States with larger student populations were allocated more pilot schools. The list included urban, semi-urban and rural schools.

b. ***Thailand***: In the next phase of operation of the SchoolNet, the responsibility to expand the connection to 34,000 schools in accordance with the National ICT Policy will be transferred to the MOE. SchoolNet will be merged with the newly established national network, EdNet. The decentralization of the ICT infrastructure through EdNet started in 2003, to connect all schools at all levels and educational institutions and enable them to integrate ICT for educational purposes. This will be accomplished by 2005. As part of the One District One-Dream School Project, there will be at least one school in each district that is equipped with one computer laboratory to facilitate ICT use in the curriculum. For schools in remote areas that lack electricity or telecommunications infrastructure, distance education through satellite broadcasting will be utilized. These technologies will help to ensure equal service to all schools and educational institutions.

Issue 3

Connectivity Options/Alternatives

lesson*learned* 1

Use of satellite and Internet schemes has enabled some countries to reach marginalised areas or economically disadvantaged groups

a. ***Malaysia***: Some pilot schools were given satellite and wireless connection to the Smart School Network because of problems with land-lines in their areas.

b. ***Indonesia***: Through WAN Kota, Indonesia has managed to connect its schools in a citywide wireless WAN with an intercity backbone connection using fibre optic and satellite connection.

c. ***Singapore***: To bridge the gap between those who are more economically well-off and those who are not, the Government is committing S$25

million to promote PC and Internet awareness through collaborations with community groups and volunteer welfare organizations. Households with a monthly income of less than S$2000 have been provided with used PCs bundled with free Internet access and basic tools.

lesson*learned*2

Working closely with Internet Service Providers (ISPs) helps in determining appropriate bandwidth connection in schools and homes

This collaboration may be in the form of subsidized subscriptions or discounted rates based on a long term contract. Although there are clear educational benefits to using broadband Internet access, the proportion of online learning activities that the school has designed and organized for the students must be taken into account. Otherwise, schools may be operating at excess capacity and students and teachers may end up using this connection for personal entertainment purposes.

a. ***Indonesia***: ISP of Indonesia has initiated a programme known as Sekolah2000. The goal of the programme is to make 2000 school in Indonesia connected to the Internet in the year of 2000. By the end of 2000, the project had connected 1,180 schools which translating into half a million new Internet users from high schools.

b. ***Malaysia***: Each pilot school in the Smart School Network was provided its own Local Area Network through a structured cabling system. The vertical cabling used fibre optics and UTP, while the horizontal cabling used UTP. All 87 pilot schools, the Ministry's Data Centre and Help Desk were connected to a Smart School Virtual Private Network provided by the Corporate Information Superhighway or COINS. Every computer in the Smart School System is Internet-enabled and connected to the Ministry's Virtual Private Network. The bandwidths chosen for the different models of technology were based on financial constraints at the time. During the pilot project, it was evident that a bandwidth of 128/64 kbps for Level B and Level B+ pilot schools was insufficient to support the Smart School Applications Software and communications requirements.

c. ***Philippines***: Internet access in the basic education system is limited, with only 14% percent of schools nationwide having Internet access. Of public secondary schools with Internet access, only 9% use the Internet for instructional purposes. Furthermore, 44.5% of public secondary schools that use the Internet for instructional purposes only have one computer that can access the Internet. Online time is also fairly limited. A little over half of the schools access the Internet at an average of less than an hour per day. Bandwidth limitations are also a factor. All but one of the schools has a dial-up connection with a maximum speed of 56.6kbps (SEAMEO-INNOTECH, 2002). This is not surprising since dial-up access is still the cheapest available. What is gained in affordability, however, is often lost in terms of speed and stability. Connection speed invariably decreases during peak hours - usually towards noon and in the early afternoon, especially when ISP use is near to or at full subscription. The number of computers in a school that are simultaneously accessing the Internet through one line slows down speed. Schools have also experienced difficulty in dialing up the ISP and/or being frequently disconnected especially during peak hours.

d. ***Singapore***: Although all schools are linked through a WAN, which is in turn connected to a high-speed backbone of Singapore ONE, student take-up rate of broadband subscription for their home varies; it is high for some schools (more than 75%) and low for others. In interviews

conducted by IDA in 2002 with school principals and teachers (http://schools.s-one.net.sg/findings2.html), it was highlighted that students in some schools are already subscribing to broadband access without the subsidies offered under FastTrack@School. Until 2002, the $10 subsidy for the broadband access standard packages for student home access was part of the S$150 million package announced in April 2000 under the Infocomm21, to jumpstart the development and growth of the interactive broadband multimedia industry. However, some students complained that the $10 subsidy was meagre and that they had difficulties in convincing their parents to subscribe to broadband services. Many respondents cautioned that prices must be kept affordable and competitive for students, especially those from low-income families.

Issue 4

Infrastructure that Supports and Delivers Teaching and Learning

lesson*learned* 1

There is no perfect combination of online and offline resources to promote effective teaching and learning

Any type of combination depends on the infrastructure of individual schools. In many countries, broadband connection is still very limited. A combination of online and offline mode seems most appropriate and flexible. The production of online resources should be repackaged in order to accommodate an offline mode.

a. ***Thailand***: As of August 2003, 70% of primary schools have no telephone lines, 4% no electricity, and 79% no computers for teaching and learning. All secondary level schools have computers at a ratio of 1 computer for every 54 students, 71% have Internet connection, and 17% have no telephone lines. The student population in these schools ranges from 300 to 500 to over 3,000 students. Considering the availability of ICT infrastructure and the size of these schools, ICT use for teaching and learning can be described as follows:

- Schools with insufficient infrastructure, normally use stand alone computers and printers and general office software bundled with word processors, spreadsheets and so on. Presentation or graphic software is used in many subject areas. If Internet dial-up connection is available, this is used for information search. Satellite TV is used in some remote areas or as a supplemental tool to ease the shortage of ICT infrastructure.

- Schools with average infrastructure availability have at least one computer laboratory that is connected to a LAN and Internet and can provide students an opportunity to use the Internet in the classroom for information search, collaborative projects, product creation, and on-line activities. Satellite Internet-link is used to provide such opportunities to schools without telephone lines.

- Schools with sufficient infrastructure are able to mix the modes of ICT use. On-line or off-line can be used to support the teaching and learning process, making it more flexible and extendable beyond the classrooms. Parents and communities can be involved in the student learning process.

lesson*learned*2

Digital libraries for schools may be introduced as infrastructure to support and deliver teaching and learning

While digital libraries are currently possible in more advanced countries, like Singapore and Korea, other countries should nevertheless plan for these in the future. Recognizing that the school library is a core facility for teaching and learning, UNESCO in 1998, along with the International Federation of Library Associations and Institutions (IFLA), adopted the UNESCO/ IFLA School Library Manifesto, which urges governments to formulate legislation and policies on school libraries, covering their principles, goals, staffing needs, budgets, operations and management.

a. ***South Korea***: Under the Government's Comprehensive Promotion Plan for ICT Use in Libraries, launched in March 2000, model digital data rooms were set up in school libraries with full-time librarians. In 2001, 96 elementary and secondary schools were selected for the installation of digital data rooms, followed by 123 schools in 2002, of which 119 were city or provincial schools and four were national schools. Each school received funds amounting to 42 million Won (US$35,500). In city or provincial schools, half of the funds were generated from the Information Society Promotion Fund and the other half from the local government. For national schools, the Information Society Promotion Fund provided the full amount. Of the total budget of 800 million Won (US$676,000), half was generated from the National Treasury for the development of software, and the other half from the local government for the purchase of servers and other equipment. Based on applications submitted by cities or provincial Offices of Education, KERIS selected the most appropriate Office of Education as site of the Digital Data Support Centre. In 2003 the digital data rooms will be further expanded following a review of the model rooms.

b. ***Thailand***: Digital Library, a SchoolNet Content Development project, was started in 1998 to encourage ICT use by teachers who are not competent in English. The project was carried out by Kasertsart University in conjunction with IPST. The Digital Library has become a repository of Thai-based teaching/ learning lessons contributed by a university and science centre-based team and by teachers and students. A website was opened in the Thai language for secondary school students in seven major academic subjects, namely, computer science, mathematics, physics, chemistry, biology, engineering and environment. The software in use, Digital Library Tool Kit, allows teachers, especially those with no knowledge of HTML, to develop Net-based lessons for students. The Digital Library offers opportunities to participate in international collaborative projects through the Global Learning and Observations to Benefit the Environment (GLOBE) Programme and the ThinkQuest Project. Apart from providing content and information resources on the web, the Digital Library also offers Internet and web page development training courses, seminars and other activities, for teachers and students from participating schools.

Issue 5

Emerging Technologies: Dealing with Rapid Development of Technologies

lesson*learned*1

ICT pilot projects should not take more than three years to complete since the obsolescence rate of present-day technologies is increasing

a. ***Malaysia***: When the Smart School Pilot Project Agreement was being finalized in 1999, the technologies selected were not all cutting-edge technologies, but they were deemed appropriate for the job. Specifications for ICT and non-ICT equipment, courseware, systems software, and the network were up-to-date at the time that the Agreement was formalized. By the time the pilot project ended in 2002, the specifications were no longer sufficient or up-to-date. For instance, the Microsoft NT platform used for the development of the SSMS had long been replaced by newer platforms.

lesson*learned*2

Mobile computing offers schools many opportunities that include overcoming constraints of space and giving flexibility in anytime-anywhere utilization of ICT in schools

With the emergence of new technologies and small devices, such as hand-held computers and mobile phones, the potential of these devices as teaching and learning tools (as well as for classroom management) should be explored.

a. ***Malaysia***: In 2001, the Ministry initiated a pilot project on the use of the electronic book or e-book to find out how this device could be used to improve teaching and learning in the classroom. The Ministry was also interested in studying the e-book to replace conventional textbooks and thus resolve the problem of heavy school bags. The pilot project was conducted in 35 schools over a period of five months. The company involved in the pilot project supplied 2491 e-books to the schools. More than 400 teachers and about 2000 students were involved in the project. Initial findings indicated that the device improved computer and technology knowledge, as well as engaged students in reading and learning.

b. ***Singapore***: Using notebook computers in classrooms, with size and portability as advantages, is an option that some schools have taken up. By using notebook computers, there is greater flexibility in arranging students for group learning and the problem of small space is resolved. Also, higher utilization of computers is encouraged.

lesson*learned* 3

Leasing equipment from private companies can be one solution to the problem of rapidly increasing obsolescence rate of present-day technologies

a. ***Thailand***: Technology changes very fast and schools have to cope with emerging technologies. Outdated computers cannot be discarded and replaced with new ones, unless they have been used for a certain period of time, usually five years, according to the Government's current procedures concerning hardware procurement. To cope with the rapid development of technologies, some schools have resorted to leasing ICT equipment from private companies.

Issue 6

Donation of Computers

lesson*learned* 1

Vocational colleges can be tapped to provide maintenance service for computers donated to schools

The burden of maintenance is a problem associated with donated computers. Old computers that have exceeded their lifespan will entail maintenance and support expenses. These must be taken into account in the cost-benefit analysis so that users can make informed decisions between new and used computers.

a. ***Thailand*:** Second hand computers or outdated ones that are in good conditions can still benefit some schools despite their limitations in running some application software. MOE collaborates with the private sector and the MICT to solicit computer donations. However, some schools have no technical staff to repair or change parts when these donated computers are out of order. The Ministry has requested vocational colleges to provide maintenance service for schools near them.

lesson*learned*2

Donated computers that have exceeded their lifespan may be redeployed for other uses or may be offered to needy students in other schools or some government and charity organizations.

The redeployment of old computers to needy students and households should be handled as a collaboration between schools, MOE, and other government agencies/organizations or self-help groups.

a. ***Singapore***: The PC Re-Use Scheme, managed by IDA and initiated in November 1999, provided for the donation by the MOE of some 10,000 used PCs over a five-year period, to underprivileged families. Recipients must be Singapore Citizens or Permanent Residents from a household with a gross income not exceeding $2000 per month. A member of the household should have attended the National IT Literacy Programme. The recipients pay a nominal fee for the refurbished PCs. The first batch of PCs went to families identified by the Singapore Indian Development Association (SINDA), the Council for the Development of the Singapore Muslim Community (MENDAKI) and the Northeast Community Development Council, in March 2000.

The MOE has been one of the largest donors of computers to the scheme, replacing PCs in schools every three to five years, averaging annually up to 12,000 PCs since 2002.

Issue 7

Open Source Software

lesson*learned*1

Although open source software (Linux-SIS, locally-developed word processor and digital toolkit for developing web content) is encouraged in the schools, there are limitations that must be taken into account before schools decide to use open source software

a. ***Thailand***: School use of software is usually limited to those bundled with the purchased computers, e.g. Windows operating system, MS office software, web browsers. Other software includes downloaded freeware or shareware or those that are illegally copied. The Government, particularly the Intellectual Property Department, encourages the use of legally obtained software and has requested software producers to reduce their price. Open source is preferred as this is better in terms of copyright-free problem. A recent government project to develop local application software for LINUX responds to the lack of Thai language software.

The Linux SIS (School Internet Server) was developed by NECTEC in 1996 to solve the problem of licensing the operating system for

servers. NECTEC later developed the Web-SIS in Thai Language, enabling teachers to manage the Internet server by using the web interface instead of the command line. This helped the teachers to overcome the difficulty of managing the network as well as the language barrier.

Issue 8

Guidelines on Information Security

lesson*learned* 1

Preparing and disseminating guidelines on ICT security help in dealing with information security problems in schools

There should be adequate on-site and remote monitoring of guidelines to prevent breaches of security.

a. ***Malaysia***: The Smart School Integrated Solution produced a set of school-level ICT policies and procedures, which were reviewed by the pilot project team to ensure that they were in line with existing Ministry rules and regulations, and later submitted to the Malaysian Administrative Modernization and Management Planning Unit (MAMPU) in the Prime Minister's Office, the central agency responsible for all matters relating to ICT use in the country. The security policies covered authentication and passwords, backup procedures, installation of firewalls, and use of licensed software.

   The Data Center and Help Desk personnel of the Smart School Development Team deal with problems of hacking and virus attacks on the Smart School System. At present, the team uses the Norton Antivirus Software for this purpose. The Smart School ICT Policies and Procedures, updated twice since its introduction in 2000, provide guidelines on how to deal with hacking and virus attacks.

b. ***Thailand***: Currently available anti-virus or filter software is used to solve the problem of computer viruses and hacking. However, most anti-virus software that run on servers are quite expensive and unaffordable for many schools where the cost of license per annum is relatively high. New computer viruses that attack users around the world also affect users in Thailand. Schools usually employ preventive measures that are economically affordable.

   Guidelines on information security are found in most websites of universities, and agencies, such as NECTEC. The websites feature guidelines to prevent security risks, warnings of new viruses and their file formats, and first aid to fix the problem.

Issue 9

Integrating of School Management Software with LMS

lesson*learned*1

Maintaining the inter-operability of a common school management system while ensuring that decoupling is built into the system is a need expressed by most countries

A major complaint by schoolteachers is the amount of time required to perform routine non-teaching tasks. There is a need to optimize the potential of ICT, automate administrative processes, and provide linkages with the teaching and learning processes, assessment and external MOE databases.

a. ***Malaysia***: The integrated management software, SSMS, covered nine areas of school management: Financial, Student Affairs, Educational Resources, External Resources, Human Resources, Facilities, School Governance, Security, and Technology. In addition to supporting the management functions of the Smart School, the SSMS also integrated the following systems: Teaching and Learning Materials, Assessment, IT Security Management, Network and System Management, User Support and Help Desk. The SSMS helped to integrate the different functions by acting as a common user front-end for access to all Smart School applications, consolidating database information across multiple applications, allowing access between certain applications and other databases and applications, and allowing access to existing databases within various divisions in the MOE.

The MOE wanted the following features for the SSMS: portability, flexibility, inter-operability, scalability, usability, and manageability. However, due to technological and financial constraints in 1999, the Ministry compromised on all the features. This resulted in an integrated SSMS with functionalities that could not be easily decoupled.

lesson*learned*2

Maintaining the inter-operability of a common school management system while ensuring that decoupling is built into the system is a need expressed by most countries

a. ***Malaysia***: The SSMS was not optimally used by most of the pilot schools, according to findings from monitoring exercises carried out in the pilot schools by the MOE. The common reasons given were that the system was not user-friendly, hung easily, and did not simplify the routine tasks of teachers and other school staff members. In most cases, the Ministry discovered that the schools had not completed the data entry necessary to prime the system, and that the staff and students were not using the system correctly. However, pilot schools with complete data entry and adequate in-house training found that the system supported the teaching and learning processes by managing resources and processes more efficiently and effectively.

Component

6

Curriculum, Pedagogy and Content Development

Overview

As ICT enters the socio-cultural setting of a school, it "weaves itself into the learning process in many more ways than its original promoters could possibly have anticipated" (Papert 1993, p.53). There is a context for ICT experiences that encompasses activities peripheral to the particular time and format of ICT interactions. Salomon (1993, p.189) proposes: "No tool is good or bad in itself; its effectiveness results from and contributes to the whole configuration of events, activities, contents, and interpersonal processes taking place in the context in which it is being used."

Therefore, a study of ICT in education cannot be isolated from the learning environment in which it is situated. ICT may trigger changes in the activities, curriculum and interpersonal relationships in the learning environment, and is reciprocally affected by the very changes it causes (Salomon, 1993). Experiences in the six countries have shown that ICT has not been radically incorporated in a systematic way into current curricular offerings and national textbooks, although there is a growing trend to gradually introduce ICT in selected subjects, such as science, mathematics and language.

In this component, the discussion focuses on six issues: (i) integrating technology in the curriculum and assessment, (ii) shift in pedagogy, (iii) content and services that support continuous improvement of curriculum practices, (iv) development and selection of culturally sensitive content, (v) ethical and political implications of using English as lingua franca, and (vi) intellectual property rights related to educational software.

Lessons learned

Based on the experiences of the six countries with respect to curriculum, pedagogy and content development in the integration of ICT in education, the following are the lessons learned:

1. Integrating Technology in the Curriculum and Assessment

- *When teachers perceive ICT as a tool to meet curricular goals, they are more likely to integrate ICT in their lessons.*
- *Equipping students with ICT skills facilitates the effective integration of ICT in schools.*
- *Teachers play a pivotal role in the integration of ICT in the school curriculum and assessment.*
- *When ICT is introduced into the assessment process, there is a need to reconsider the assessment approaches .*

2. Shift in Pedagogy as a Result of Integrating ICT in the Curriculum

- *Shifting pedagogical approaches to the use of ICT in education is time-consuming.*
- *Shifting pedagogies, redesigning the curriculum and assessment, and providing more autonomy to the schools help to optimize the use of ICT.*
- *Shifting pedagogical approaches is facilitated through appropriate professional development of teachers.*

3. Contents and Services that Support Continuous Improvement of Curriculum Practices

- *Attracting well-established foreign education software developers to work with local companies helps to develop high quality ICT-based resources.*
- *Establishing a clearing house or digital libraries of ready-to-use and customizable ICT-based resources promotes better use of ICT in teaching and facilitates quick and easy access to resources for making lesson plans and for teaching.*

4. Development and Selection of Culturally Sensitive Content

- *Having a mechanism in place for evaluating content developed for schools ensures political and cultural validity, reliability and correctness.*

5. Ethical and Political Implications of Using English as Lingua Franca

- *While local content in the local language promotes better use of ICT-based resources and materials, the use of English in schools optimizes the potential of ICT (especially the Internet) for teaching and for learning.*

6. Intellectual Property Rights Related to Educational Software

- *A cost-benefit analysis conducted before deciding on whether to acquire the intellectual property rights to educational materials, or to acquire a perpetual license to use the materials, prevents waste of resources.*

Synthesis of Experiences

Issue 1

Integrating Technology in the Curriculum and Assessment

lesson*learned* 1

When teachers perceive ICT as a tool to meet curricular goals, they are more likely to integrate ICT in their lessons

The instructional design for any courseware should conform to the curriculum specifications and pedagogical requirements of the national education system. The different types of ICT tools complement one another to meet curriculum goals. For example, the Internet may complement PowerPoint where students are first instructed to search for relevant information from the Internet and are subsequently asked to present their findings using PowerPoint.

a. ***Malaysia***: Teaching and learning materials for the Smart School Pilot Project were developed in four selected subjects: Bahasa Melayu, English Language, Science and Mathematics. The materials were in the form of browser-based courseware, teachers' guides, student worksheets, and sample lesson plans to guide the teachers in integrating the courseware in their lessons. The instructional design for each of the four Smart School subjects took into account the curriculum specifications and the pedagogical demands of the Smart School. The specifications stressed the need to cater to students' capabilities, learning styles, learning modalities; to respond to a variety of learning environments; to support students' self-paced, self-accessed, and self-directed learning; to build in assessment capabilities so that assessment records can be stored electronically; to promote values, skills (especially creative and critical thinking skills), knowledge and language ability; and to allow for horizontal integration between subjects, and vertical integration between learning areas in a subject.

b. ***Philippines***: The new interactive and integrative curriculum, Revitalized Basic Education Curriculum (RBEC), has changed the way ICT is used in schools. "What makes this curriculum interactive is the use of information technology and the greater emphasis on computer literacy in all the learning areas in every school where equipment is available." (DepEd, 2002).

ICT use is further articulated in terms of "skills in accessing, processing and applying information, and using educational software in solving mathematical problems and conducting experiments". At the secondary level, the RBEC does not provide direct teaching of ICT skills under Technology and Home Economics; instead basic ICT skills are integrated in different learning areas.

c. ***Singapore***: Under MP1, ICT has been integrated in all subject areas and software and other ICT resources consistent with the curriculum objectives have been made available. The initial focus at the primary level is on English, Mathematics, Science and Chinese Language, and on Geography, History, English Literature and Civics and Moral Education at the secondary level. Extensive use is made of

the Internet in many of these areas at the secondary level. Open tools, such as word-processing, spreadsheet, and presentation packages, are also used for all subjects, including mother tongue languages.

lesson*learned*2

Equipping students with ICT skills facilitates effective integration of ICT in schools

The skills may include keyboard skills, information search and evaluation skills, word-processing skills, web-authoring skills, and other more specific ICT skills (such as image and video editing and flash development).

a. ***Indonesia***: ICT is an essential part of the 2004 national curriculum. While it has also become a means for instruction, not all schools are able to use ICT because of infrastructure and financial constraints. Schools that make use of ICT have made ICT a subject. In these schools, students learn World Processor (MS Word), Spreadsheet (MS Excel), Creative Design (CorelDraw, Photoshop), and Internet (browsing, e-mail, and mailing list).

b. ***Philippines***: Grade 2 students at private primary schools are exposed to the background, functions and parts of computers; followed at Grade 3 onwards by lessons on basic computer operations. In public primary schools, however, computers are not introduced until Grade 4 under Home Economics and Livelihood Education. In public secondary education, the teaching of basic ICT skills is done in the fourth year under Technology and Home Economics. Schools with sufficient resources also offer the course to third year students. Some private secondary schools offer programming and website development courses.

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c. ***Singapore***: Students are expected to acquire specific ICT skills from primary school upwards, through just-in-time learning (prior to starting a project) or integrating ICT in different subject areas. By the end of secondary schooling, most students would have acquired minimum competencies in desk-top publishing, spreadsheet and database construction, and sourcing information from CD-ROMs and on-line resources. Respondents (i.e. teachers, principals and heads of departments) to a survey conducted by IDA in 2002 (http://schools.s-one.net.sg/findings1.html) agreed on the readiness and preparedness of students who grew up in the ICT era for the FastTrack@School initiative.

d. ***South Korea***: Training in ICT literacy provides equal access to information and reduces the information gap in public education. Since 2001 the Government has required mandatory ICT education for students from first grade to sixth grade, unlike in the past when ICT-related classes were elective subjects in secondary school and no other type of ICT training was available. Furthermore, in every subject, more than 10% of classroom activities are encouraged to make use of ICT. Training in ICT utilization should not be considered as a special subject or as a part of technical education.

e. ***Thailand***: There have been tremendous changes in ICT education since the introduction of educational reform. Firstly, the new ICT curriculum, despite being introduced separately, has been made compulsory from primary through upper secondary years. Secondly, ICT is one of several technologies included in the newly developed Design and Technology Curriculum. Thirdly, ICT will be integrated in the curriculum as a tool for developing decision-making, critical thinking and communication skills. The established ICT learning standards for the ICT curriculum focus on basic understanding and skills, value and ethics, and effective applications of ICT in handling information, communications, problem solving, and work and career. Before the implementation of the new curriculum standards in 2003, ICT was treated as a separate subject and offered as an elective course.

lesson*learned*3

Teachers play a pivotal role in the integration of ICT in the school curriculum and assessment

Lim *et al* (2002) stressed the importance of orientation activities in ICT-based lessons so that they support learner autonomy and help students to become more engaged in the learning process. These activities include introductory sessions to ICT tools, advance organizers and instructional objectives, activity sheet and checklist, and ICT and non-ICT tools for post instructional reflections. In order to carry out these activities effectively, they should be supported by socio-cultural factors in the learning environment, including supportive leadership, professional development (both formal and informal) and access to ICT-based resources.

a. ***Singapore***: ICT facilitates learning as it shifts from information receiving to searching, collating and synthesizing relevant information, and from applying information to problem-solving and communicating ideas effectively. ICT strengthens the teachers' skills and offer a wide array of learning resources for students, encouraging independent learning and the expansion of horizons beyond the standard curriculum.

Sharing their experience of ICT integration in a survey conducted by IDA in 2002 (http://schools.s-one.net.sg/findings1.html) in relation to the FastTrack@School, respondents from River Valley High School noted that teachers' training in ICT integration began with the implementation of the ICT in Education Master Plan. The teachers explored ICT as a learning tool and private vendors offered rigorous training programmes so that the teachers could conduct ICT-based lessons, enabling them to jumpstart ICT use at a faster pace than their contemporaries. School authorities reviewed the implementation of the ICT in Education Master Plan continuously to ensure that all the teachers were involved and were able to cope with the process.

lesson*learned*4

When ICT is introduced into the assessment process, there is a need to reconsider the assessment approaches

Effective ICT use should take into consideration integration issues in relation to the curriculum and assessment approaches. Curriculum and assessment are interdependent and mutually supportive and both should be considered. There may be a greater role for formative assessment when ICT is integrated in the assessment process.

a. ***Singapore***: An initiative on ICT integration covering both formative and summative assessments was the Enigma Project undertaken by the ITAL Unit (Interactive Technologies in Assessment and Learning) in UCLES (University of Cambridge Local Examinations Syndicate). It consisted of trial online examinations conducted in Singapore in September 1997 and October 1998, in line with the country's goal to move towards a more ICT-based assessment system. In the first trial, papers from a Physics examination were transferred directly into a computerized format to determine whether a traditional paper and pen test format (multiple choice and short questions) could be administered through a computer. The second trial had two components: conceptual and analytical. The conceptual component was similar to the first trial, but questions in the analytical component were similar to those in a practical examination in science that require students to carry out a simulation. Both trials demonstrated the feasibility of ICT-based assessment, but there were many technical, administrative and educational issues that needed to be addressed. Activities that interacted with the assessment process included the use of ICT in test administration, setting questions and manual and automated marking, and supporting teachers in using ICT-related materials in the classroom and in using electronic content (Harding & Raikes, 2002).

Other initiatives include exploring assessment modes in an ICT-based learning environment to measure students' skills in assessing and applying information, thinking and communicating. While current modes of assessment remain relevant, ICT could facilitate assessment of pupil competencies in more than one subject area and in several skills. Such modes of assessment include project work, simulation software to assess students' ability to formulate and test hypotheses and self-assessment software so that students can monitor their own learning.

Issue 2

Shift in Pedagogy as a Result of Integrating ICT in the Curriculum

lesson*learned* 1

Shifting pedagogical approaches to the use of ICT in education is time-consuming

A foundation may be needed to provide the necessary conditions (e.g., basic ICT infrastructure, ICT competent teachers, and clear vision) for a shift towards more student-centred approaches for ICT-based lessons.

a. ***Indonesia***: A shift in pedagogy as a result of integrating ICT in the curriculum has not happened yet due to several reasons: (i) lack of ICT literacy among teachers, (ii) limited support infrastructure (i.e. LCD Projector, PCs, etc.), and (iii) limited ability to develop ICT-based learning materials.

b. ***Singapore***: MP1 has provided a broad base for ICT integration in the curriculum and school activities. There have also been changes in pedagogical approaches. An IDA interview with principals, heads of departments and teachers in 2002 (http://schools.s-one.net.sg/findings1.html), noted a shift to more self-directed learning processes and learning environments. The shift in pedagogy is most noticeable when the goals of MP2 are compared to the present status of ICT use. The key differences between the present situation and the goals of MP2 are described as follows: (i) whereas ICT is used at present to support the curriculum, in the future there will be seamless integration of ICT right from the planning of curriculum design; (ii) from a largely static content in print form, there will be a repository of dynamic digital content; (iii) the one-size-fits-all approach will change to mass customization and an ability-driven approach; (iv) teachers' skills in the use of ICT for teaching will move from basic to a wider range of competencies; (v) from a phased approach to the integration of ICT, schools will move to a sense of greater ownership of and accountability for ICT implementation; (vi) ICT provision for all will become more flexible; and (vii) pedagogies will shift from being teacher-centred to being student-centred.

c. ***South Korea***: The pedagogical shift concerning ICT use in education has been gradual and is best reflected in the new educational environment. Descriptions of these environments vary, but they tend to include two important characteristics. First, there is greater freedom in the choice of time and place. Students can choose their preferred activities and the time to learn them. The freedom to choose time, place and activity means that education becomes more individualized. Second, knowledge is conceptualised as something generated or constructed by each individual. This changes the roles of the student and of the teacher in education. The student is no longer a passive recipient of knowledge. With the help of the teacher, knowledge is constructed in the minds of individual students.

lesson*learned* 2

Shifting pedagogies, redesigning the curriculum and assessment, and providing more autonomy to the schools help to optimize the use of ICT

When ICT enters the school environment, the environment has to change to maximize opportunities and address the limitations of ICT. A shift in pedagogical approaches could facilitate the building of a community of thinking and independent ICT-savvy students in schools.

a. ***Thailand***: Innovative practices in Science, Mathematics and Thai language teaching reflect a shift in pedagogical practices.

In teaching Mathematics and Information Technology, a series of web-based CAI programmes have been developed to make mathematical concepts more interesting and meaningful to grade seven students. The teacher facilitates the students' learning with questions and comments and provides explanations. Students submit their work and discuss with the teachers via e-mail and the web board. The quality of the students' questions and opinions is taken into account as part of the students' evaluation. Both teacher and students enjoy working together and modifying the pre-designed lesson plans, as necessary.

In teaching about electrical matters to ninth grade science class, the teacher uses Internet resources and services to enable the learners to develop basic knowledge and understanding of electrical equipment through website exploration and discussion. Both teachers and students utilize ICT as a teaching and learning tool and gradually develop their ICT skills. Students learn more with pleasure and they explore and update materials. Their thinking skills are developed as a result of the opportunity to select, analyze, and synthesize information.

b. ***Singapore:*** The MOE has incorporated ICT use in curriculum planning, design and delivery and is working with electronic publishers on a comprehensive repository of digital media content to complement existing resources like textbooks. This repository will allow teachers to use and customize content to meet the learning needs of students (Soh, 2002). Emerging technologies are being explored to increase the efficiency of summative assessments, and to expand the scope and nature of formative assessments. These changes will support the shift of pedagogy to a social constructivist paradigm, where teachers and students work together using ICT to carry out learning tasks and construct knowledge.

Under MP2, the Education Technology Division works with schools to explore the most effective use of ICT in learning and administrative programmes. Schools have more autonomy in the management of ICT-related resources than under MP1, and will have access to clear performance indicators for evaluating their ICT programmes. ICT consultancy teams in each school cluster are being formed to support these new initiatives to encourage greater diversity in creative approaches and processes in ICT integration (Soh, 2002).

lesson*learned*3

Shifting pedagogical approaches is facilitated through appropriate professional development of teachers

a. ***Malaysia***: The Smart School Pilot Project introduced electronic learning materials in four subjects in which the in-service and pre-service training conducted by the Teacher Education Division concentrated. As a result, other teachers and staff members in the pilot schools regarded themselves as non-Smart School teachers and maintained their usual methods of teaching. Fortunately, the MOE had emphasized learner-centred teaching, higher level of thinking skills, generic skills and co-operative learning long before the start of the Smart School Project. Therefore, the better teachers were already practicing "smart pedagogy" by using a variety of methods, strategies, tools and materials to cater to individual differences in their students, with or without the use of ICT.

b. ***Philippines***: Some attempts have been made to shift the emphasis of teacher professional development programmes from basic ICT skills training to pedagogies for effective integration of ICT in the school curriculum. One such attempt is the FIT-ED/Coca-Cola Ed.Venture pilot programme where teachers are taught pedagogy-based skills, such as learning theories, instructional planning models, and student-centred approaches in teaching and learning with ICT.

c. ***South Korea***: The focus of most professional development programmes is on how to effectively achieve teaching-learning goals by utilising existing educational content, rather than how to develop new educational content. There is a lot of emphasis on pedagogical approaches in integrating ICT in the curriculum. The plan for training in ICT use was undertaken in 2002, outlining teaching-learning goals in 10 common basic subjects in the Seventh school curriculum. Under this plan, a teaching-learning model for ICT use in a teaching-learning plan for each subject was developed, in accordance with subjects in the curricula and the high-tech learning environment in the classrooms, group study rooms and individual multimedia study rooms. The plan has been in progress for two years, from 2002 to 2003, and has been applied to training in ICT use for teachers.

d. ***Singapore***: The shift in pedagogy requires teachers to be equipped with a new set of skills, attitudes and knowledge to take on a pivotal role in the learning environment. Hence, there is a need for a sustained model for the professional development of teachers in the use of ICT in education. This model should have clear benchmarks for the beginning teacher, the trained classroom teacher, the peer leader and the organizational leader. This model may be mediated by network technologies where existing training initiatives are streamlined and integrated with existing and new ones into a single e-learning system (Shanmugaratnam, 2002).

Issue 3

Content and Services that Support Continuous Improvement of Curriculum and Assessment

lesson*learned* 1

Attracting well-established foreign education software developers to work with local companies helps to develop high quality ICT-based resources

Local development of ICT-based resources is crucial to support the curriculum as it enhances the relevance and authenticity of resources for students and teachers. This also promotes the transfer of skills and technologies.

a. ***Singapore***: Under the MOE-Local Industry Upgrading Programme, local partner companies established global software houses to develop educational software and to facilitate the transfer of skills and technologies. The focus was on developing high quality software, especially in areas where suitable titles were lacking. The NCB helped to develop the base of talent required to produce educational software, and encouraged software distributors to provide value-added services to schools, such as proactive sourcing of educational software to match their needs and provision of after-sales technical support.

Many locally developed educational software packages are now recognized internationally, including the Active Primary Mathematics CD-ROM series (comprising three titles) which features sound pedagogy, innovativeness and content-rich activities. The MOE, project development specialists, and Times Media Private Limited collaborated in producing this package.

lesson*learned* 2

Establishing a clearing house or digital libraries of ready-to-use and tailored ICT-based resources promotes better use of ICT in teaching and facilitates quick and easy access to resources for making lesson plans and teaching

Teachers who are provided with a recommended list of ICT-based resources (software and websites) spend less time to identify the most appropriate ICT-based resource for their lessons. In addition, the MOE could provide them suggestions on the use of particular websites or software products for particular lessons. This will be especially helpful for novice teachers or teachers who are new to ICT in education.

a. ***Malaysia***: Although good electronic materials are not easily available in Bahasa Melayu, Science and Mathematics teachers are happy to access the Internet for Science and Mathematics materials in English, such as GetCyberEd.com, a portal provided by the consortium that developed the Smart School Integrated Solution. Several other local companies have established e-learning portals to provide services and

materials to students and teachers. Most of these portals offer drill and practice materials to help students prepare for public examinations. Other portals offer a wide variety of services and materials to help teachers and students learn better. The Smart School Pilot Project established BESTARInet, the Smart School portal, to enable the pilot schools and parents of Smart School students to access their own schools remotely. The school's IT coordinator with approval from the School Head controls access.

b. ***Thailand***: Science, mathematics, and ICT education materials are mostly developed by IPST and are disseminated via the IPST Web Site and its e-library. NECTEC, in collaboration with IPST, has developed science, technology, and engineering content for the Digital Library, as a part of SchoolNet services to secondary school students. The Digital Library covers more than 7,100 subjects in 10 subject areas. The MOE has developed a database for over 3,689,744 catalogues and the work is continuing. Database development, in the form of e-Book, e-Journal and Courseware, is also ongoing. In addition, there is a reference database to store electronic data from various colleges and universities. A recent project, Developing an Educational Resources Clearing House initiated by the MOE, is a database of resources produced by all ministerial departments and organizations, including curriculum and supplementary materials in eight subject areas.

c. ***Singapore***: Respondents to an IDA survey cited various reasons for choosing courseware developed under the FastTrack@School Project (http://schools.s-one.net.sg/findings1.html). The reasons are as follows: (i) broadband interactive multimedia content for education (e.g. videos, simulation aids, and games) enhances students' understanding of subject areas; (ii) learning should be independent, fun, flexible and self-paced; (ii) the ICT tracking system for the auto-grading of quizzes could help students to reflect upon their efforts and to develop independent learning; and (iv) there is a value added dimension to the creative processes of teaching and learning in all subject areas.

The MOE has a compilation of recommended software that has been evaluated by the MOE Clearinghouse for IT Resources (http://www.moe.gov.sg/edumall/edu_library/rsl_englishl.html). Schools, however, have the autonomy to purchase software. Under the Educational Software Procurement Scheme (ESPS), schools could purchase any number of software titles in the ESPS list at a special educational price and directly from a locally appointed agent. The ESPS also allows teachers in primary or secondary school, JC or CI to purchase one personal copy of each software title at a special educational price.

The Digital Media Repositories (DMRs) provide media clips, web pages and courseware snippets for multimedia resource-based learning. The Internet serves as a platform for delivery of materials in the DMRs. There is also a database of Internet educational resources for use in the local curriculum (http://www3.moe.edu.sg/ier/).

Issue 4

Development and Selection of Culturally Sensitive Content

lesson*learned*1

Having a mechanism in place for evaluating content developed for schools ensures political and cultural validity, reliability and correctness

a. ***Malaysia***: All materials developed for the Smart School Pilot Project were stringently tested for technical and content accuracy. Some Ministry officials, teachers and teacher trainers were seconded to the short listed consortium to ensure that the materials were free of culturally and politically sensitive matter. The warranty for all the Smart School Applications Software runs for one year after the end of the pilot project. During the warranty period, all defects, errors and bugs in the software that are reported to the Ministry's Smart School Help Desk will be remedied.

Issue 5

Ethical and Political Implications of Using English as Lingua Franca

lesson*learned*1

While local content in the local language promotes better use of ICT-based resources and materials, the use of English in schools optimizes the potential of ICT (especially the Internet) for teaching and learning

a. ***Malaysia***: Following the Government's decision to leapfrog into the ICT Age and transform itself into a knowledge-based society, there has been general consensus that school-leavers do not have the necessary competence in the English language that will enable them to deal with challenges in the ICT Age. The ICT industry has regularly urged the Government to radically improve the standard of English competence in schools and universities. There has been much public debate on increasing the use of English in schools and universities. In 2002 the Cabinet finally made the decision to use English to teach Science and Mathematics. Intensive training courses are underway to ensure that all Science and Mathematics teachers are fully equipped to teach these two subjects in English. The provision of an allowance to all Science and Mathematics teachers teaching in the English Language is a welcome incentive to all the teachers involved.

b. ***Thailand***: Using English in ICT application is a great barrier for many Thais. Only those who are capable of understanding English can become self-directed learners in the Internet.

Those who are not are limited to Thai language programmes only. While developing SchoolNet, the NECTEC noted that one key element for the successful use of ICT is the opportunity for schoolchildren to become bilingual. It was proposed to the Cabinet on 17 September 2003 that if students were capable enough to master more than one language, it would move the country forward rapidly since they could take advantage of their technological knowledge and language skills

Issue 6

Intellectual Property Rights Related to Educational Software

lesson*learned*1

A cost-benefit analysis conducted before deciding on whether to acquire the intellectual property rights to educational materials, or to acquire a perpetual license to use the materials, prevents waste of resources

a. ***Malaysia***: The Intellectual Property Rights (IPR) to the Smart School Integrated Solution and its components, including the Applications Software, was passed on to the Government upon the MOE's acceptance of the Integrated Solution. An earlier proposal for the Government to acquire a perpetual license from the consortium instead of the IPR was not supported by the Attorney-General's Chambers, who felt that the Government's interest might be compromised if the IPR were not passed on to the Government. Therefore, all Government institutions and Government schools are allowed to use the Smart School Applications Software without having to pay license fees.

Component

7

Professional Development

Overview

The teacher has an important role to play in the teaching/learning paradigm shift, with ICT facilitating the development of a higher level of cognitive skills in evaluating arguments, analyzing problems and applying what is learnt. The teacher no longer monopolizes activities as the transmitter of subject matter since emphasis has shifted from lecture-oriented teaching and learning activities, to activities that are governed more by the learning needs of individual students, including more situation-specific ad-hoc instruction, small group instruction, and one-to-one tutoring.

While teachers play a pivotal role in the learning environment, they are oftentimes not consulted concerning changes to teaching-learning procedures. The teachers' needs under changing conditions have to be continuously assessed and activities to satisfy these have to be developed. Very often, teachers' training programmes focus more on basic literacy skills and less on the integrated use of ICT in teaching.

Teachers are more likely to integrate ICT in their courses, when professional training in the use of ICT provides them time to practice with the technology and to learn, share and collaborate with colleagues. Perkins (1993) argues that the best use of any physical support system, including ICT, is an art; and it is necessary to acquaint the teachers with this art. This component examines professional development in the use of ICT to address the design of the learning environment, taking into account opportunities and limitations. The following issues are discussed: (i) policy and management of teacher training on ICT, (ii) teacher training modalities, (iii) teacher competencies and standards, (iv) mindset change of teachers, (v) content focus of capacity building for teachers, (vi) capacity building of all education personnel, and (vii) incentive system and motivational strategies for teachers.

Lessons learned

Based on the case studies, the following lessons learned have been identified with regard to six issues:

1. **Policy and Management of Teacher Training on ICT**
- *To ensure continuous training of teachers from pre-service teacher education to induction to in-service professional development, other training agencies should be mobilized and labour divided among them, with the MOE providing central coordination.*
- *Professional development is more likely to succeed if continuous training of teachers is a built-in process and is offered as a benefit to them.*
- *A centralized training administration system for all teaching and non-teaching staff is crucial to document and monitor professional development.*

2. **Teacher Training Modalities**
- *Peer and school-based training of teachers by their more experienced peers from other schools or senior instructors from the MOE ensures that teachers are trained in the context of their workplace.*
- *Incorporating online learning into professional development on ICT enriches the teachers' experience and makes them comfortable with online learning.*
- *Needs-based just-in-time learning and peer coaching ensure further development of the teachers' ICT and pedagogical skills.*

3. **Teacher Competencies and Standards**
- *ICT competency standards serve as a benchmark for formulating and evaluating teacher training programmes and use of ICT in teaching.*
- *Customizing national-level ICT competency standards for each school, depending on its socio-cultural context, ensure ICT integration and acceptance .*

4. **Mindset Change of Teachers**
- *A buddy system approach where novice teachers work together with expert teachers in a classroom using ICT contributes towards changing prevailing mindsets.*

5. **Content Focus of Capacity Building for Teachers**
- *Training teachers on ICT-related skills within the context of classroom objectives and activities ensures development of skills in the integrated use of ICT in teaching.*
- *ICT professional development programme for teachers should be planned, taking into account the vision of ICT in education policy.*

6. **Capacity Building for All Education Personnel**
- *Training education personnel at all levels ensures that all aspects of ICT use in schools are implemented in an efficient, coherent and complementary way.*

7. **Incentive System and Motivational Strategies for Teachers**
- *Having a recognition system for innovative and effective use of ICT integration in schools will motivate teachers to use ICT in teaching.*
- *Formal certification of in-service professional development that leads to diplomas or degrees could provide an incentive for teachers to upgrade and update their skills in and knowledge of ICT integration.*
- *Teachers' interest in using ICT after their training is more likely to grow if they* are *provided with computers, training materials and software for classroom use.*

Synthesis of Experiences

Issue 1

Policy and Management of Teacher Training on ICT

lesson*learned* 1

To ensure continuous training of teachers from pre-service teacher education to induction to in-service professional development, training agencies should be mobilized and labour divided among them, with the MOE providing central coordination

It is not possible for the MOE and teacher education institutions to address all the ICT training needs of teachers. There is a need to sub-contract certain courses to private training agencies and institutes of higher learning. However, the MOE and the respective schools must work very closely with these training entities to design a training curriculum that is relevant to the needs of the teachers. The curriculum should focus on both the pedagogical and technological aspects of ICT integration.

a. ***Indonesia***: A number of teacher training institutions have introduced compulsory courses concerning computer use and the Internet. Teachers graduating from these institutions are expected to be able to use computers and the Internet in their teaching activities. Different computer literacy in-service training for teachers have also been conducted as an initiative by individual schools or by the MOE.

b. ***Philippines***: Most teacher training institutions have incorporated computer courses into their curriculum as a requirement for graduation. However, computer literacy is not yet a strict requirement for teacher certification. In general, there is a need to reform the pre-service teacher education system. For this to happen, teacher education institutions need to upgrade their facilities and faculty skills as well as to restructure their curriculum. The Intel Teach to the Future Programme and the Commission on Higher Education are currently discussing a programme for improving knowledge and skills in the use of ICT for teaching and learning, at the pre-service level.

In-service training opportunities for public school teachers, on the other hand, are being provided by various entities. DepEd's computerization programmes include a basic computing and Internet literacy-training component. The Intel Teach to the Future Programme also provides basic skills and technology integration training for public secondary school teachers. It has reached around 35,000 teachers via a cascade or echo scheme since it began in 2001. SEI-DOST, with its various partners, provides more specialized training to Science and Mathematics teachers, specifically in robotics, ICT application in Physics teaching, use of graphic calculators for Math and Calculus, electronics, and computer assembly. In the private basic education sector, commercial providers typically conduct in-service training (Department of Education, 2002).

In-service teacher training must also be given higher priority, particularly beyond basic skills training. A long-term, flexible, and teacher-

directed in-service programme must be designed and the necessary investments made. To ensure retention of skills, teachers must also be provided with sufficient access to ICT facilities post-training. Both the Intel Teach to the Future Programme and the Pilipinas SchoolNet are currently providing advanced ICT-based training, but these and other programmes need to be rationalized within an overarching framework for in-service training.

c. ***Singapore***: The ICT master plan encourages the involvement of 'academic coaches' from institutes of higher learning, ICT firms that have association with and expertise in education, and committed ICT professionals from the private and public sectors. Different approaches to ICT use provide a rich source of learning to both 'academic coaches' and stakeholders of the schools.

The NIE offers ICT training programmes and ICT has been integrated in the NIE curricula. The first priority has been to equip trainee teachers from the 1997/98 academic year with basic pedagogical and technical skills on ICT integration. ICT skill (e.g. PowerPoint, DreamWeaver, Excel) workshops were conducted on Saturdays by private ICT training consultants.

An induction programme is provided to supplement the NIE's basic training. The MOE's centralised induction programme, conducted by the Teachers' Network for New Teachers, provides vital information, survival tips, platforms for discussion and sharing among beginning teachers, and between beginning teachers and more experienced ones in face-to-face and electronic environments. This applies to both ICT- and non-ICT-based tasks carried out by teachers. Individual schools have their own induction training. New teachers are assigned to a personal mentor in their schools to guide them.

The transition from initial teacher education to induction, and from induction to continuous in-service professional development and networking is becoming seamless.

d. ***South Korea***: Training in ICT use is provided as training for prospective teachers and as in-service training for teachers. ICT training for prospective teachers is carried out by the departments of computer science and through relevant subjects in universities of education and teachers' colleges. Computer education provided by the departments of computer science tends to focus on computer literacy. Students enrolled in a university of education obtain six credits for general courses related to computer literacy and 20 credits for advanced courses that they select. Computer courses provided by other departments stress the use of computers, especially the improvement of teaching learning methods using computers.

In-service training consists of training for additional qualifications and professional job training. Training for qualifications is provided to secondary school teachers who teach computer science as part of their first-class or second-class teacher training qualifications and for teachers who apply for principal or vice-principal qualifications. From January 1, to December 31, 2001, 914 teachers, 213 middle school teachers and 701 high school teachers received computer qualifications.

Professional job training on ICT use dates back to 1972 when teachers received mandatory training at Doksu Vocational High School. Training was carried out through a connection between the high school computer and the mainframe computer at the Korea Institute of Science and Technology (KIST). The programme expanded as more computers were distributed to schools and teachers in 1984. It received increased emphasis especially after 1988 when personal computers (XT level) were distributed to every school. More than 730,000 teachers received professional job training in ICT use from 1998 to 2001.

e. ***Thailand***: The ICT master plan incorporates professional development programmes for teachers, administrators, and education personnel to support the use of ICT in their work. The MOE has delegated an ICT sub-committee to develop and design standard training programmes for these groups of personnel and to guide responsible departments within the Ministry on the provision of training. The training courses will be customized for school administrators, ICT teachers, non-ICT teachers

and school technology coordinators, based on both pedagogical and technological perspectives.

Recent cooperation between Thailand and Australia under the Capacity Building Facility for Thai Education Reform (CABTER) includes a pilot project for developing school-based ICT training centres using the Navigator School Model. Twenty-four primary and secondary schools have been selected as pilot schools for the design of practicum-based professional development programmes and trial for all staff, to support school and classroom-based practices in ICT use. To date, there is no linkage between pre-service and in-service professional development programmes.

Oracle's Think.com and Intel Teach to the Future Programmes have also focused on capacity building for teachers. While Think.com has emphasized utilization of its website both inside and outside the classrooms, Intel Teach to the Future Programme encourage teachers to address students' high order thinking skill in the integration of ICT in classroom activities. Moreover, the ITEd project funded by JICA aims to produce six WBT materials for six courses. Up to 3,000 teachers will be involved in three type of training courses: information literacy, information delivery, and information system management.

lesson*learned*2

Professional development is more likely to succeed if continuous training of teachers is a built-in process and is offered as a benefit to them

a. ***South Korea***: Between 1997 and 2000 all teachers had an opportunity to participate in the annual professional training programme. Beginning in 2001, one-third of all teachers had attended the annual professional plan job training, under the Promotion Plan for ICT Utilization in School Education, prepared by the Ministry of Education and Human Resources Development. Every teacher receives professional job training once every three years.

b. ***Singapore***: Teachers are entitled to 100 hours of in-service professional development each year. Teachers are also fully sponsored or highly subsidised for courses that are conducted by private training agencies. According to a survey by Soh (2002), all teachers have received 30 to 50 hours of ICT-related professional development. The majority (84%) have expressed their interest in further ICT training above the required minimum. 77% of the teachers are looking for other ways to integrate ICT in education. 68% feel that ICT has encouraged class participation. 65% have found the preparation for ICT-based lessons worthwhile. Given such positive perceptions of the teachers, the professional development programme seems to have been successful.

lesson*learned*3

A centralized training administration system for all teaching and non-teaching staff is crucial to document and monitor professional development

The system must be accessible to all staff via the Intranet or Internet so that they can track and monitor their own professional development, and plan and apply for courses that they need to attend. The system will help supervisors to monitor the professional development of staff, while also enabling the staff to plan their own professional development.

a. ***Singapore***: In order to document and monitor the professional development of education personnel under the MOE, the Training Administration System (TRAISI) was developed in 1999. It was designed and developed by Andersen Consulting in association with MOE's Staff Training Branch. TRAISI is an online system on the Intranet that enables both teaching and non-teaching MOE staff to document their individual training roadmaps. It allows staff to search online for training courses at the MOE and the Institute of Public Administration and Management (IPAM) and to apply for admission. The system then informs the staff of the outcome of their application via fax or e-mail depending on their preference. TRAISI also helps to track training status and generate training statistics.

Issue 2

Teacher Training Modalities

lesson*learned*1

Peer and school-based training of teachers by their more experienced peers from other schools or senior MOE instructors ensures that teachers are trained in the context of their workplace

a. ***Singapore***: An effective and continuous programme for training teachers in the use of ICT was central to the success of MP1. All teachers were trained to handle IT-based instruction and to support new learning strategies. A four tier-fan training model was put in place in every school in 1999. 60 senior ICT instructors from the ETD formed the first tier of training that was completed in late 1996. The senior ICT instructors then trained 22 demonstration schools in Phase 1 of implementation. In Phase 2, heads of departments in charge of ICT and selected teachers from each Phase 1 school co-trained teachers from three to four schools each, together with senior ICT instructors. In turn, selected heads of departments and teachers from these schools trained those in the final phase of implementation. The fan approach generated a multiplier effect, enabling the sharing of expertise and experiences among schools. The heads of departments and teachers from the earlier phases, who were selected as part-time instructors for other schools, had their teaching duties reduced by about one-third. Senior ICT instructors played the role of key trainers, mentors and coordinators for all schools during the phased implementation.

lesson*learned*2

Incorporating online learning into professional development on ICT enriches the teachers' experience and makes them comfortable with online learning

This type of training may include face-to-face tutorials with independent online learning. This allows teachers to experience different modes and strategies of instruction, especially online ones.

a. ***Singapore:*** The core module on ICT integration in the pre-service education programme focuses on the pedagogies of using ICT in the classrooms. Tutors employ a fully dynamic online learning environment to complement onsite activities. In 2002, the module had four major components: anywhere/anytime lecture, onsite laboratory tutorial, online independent hands-on session, and online asynchronous discussion. There was a shift in the mode of assessment from summative to more formative, and in the orientation of delivery from cognitivist to social-constructivist. (Lim, 2001a). The anywhere/anytime lectures were designed to complement textbook readings. The tutors co-authored a book 'Teaching and Learning with Technology' (Tan & Wong, 2003) to highlight and address key issues of ICT integration. The online lectures consisted of instructional objectives, dynamic guiding questions and reflective activities (such as, online quizzes and hyperlinks to case studies) to enhance task-orientation and encourage critical reflection among trainee teachers.

During onsite laboratory tutorials, there was no didactic teaching and less discussion of textbook concepts (these discussions were carried out through the online discussion board). Instead, the tutorials focused on collaborative activities among groups of trainee teachers working together on tasks. The tasks were always posted on the module website two weeks before each tutorial session. To encourage greater learner autonomy, there were independent online sessions that required trainees to work independently on challenging tasks. These included identifying learning opportunities and problems associated with the use of IT tools within the school context, critiquing visual aids posted by their fellow trainees or tutors, and reflecting and commenting on video clips of classroom management issues. They were asked to work with their partners and classmates, bounce off ideas and explore ICT resources.

Trainee teachers were expected to participate in intra- and inter-group online discussions. The online discussions allowed them to apply what they have learnt to their own learning and teaching experiences and to share their experiences and expertise in ICT integration in schools.

lesson*learned*3

Needs-based just-in-time learning and peer coaching ensure further development of teachers' ICT and pedagogical skills

a. ***Singapore***: At Serangoon Garden South School, (http://schools.moe.edu.sg/sgss), a needs training programme caters to teachers' further development of ICT and pedagogical skills. Teachers who want to know more about using any hardware or software in the school are requested to submit a needs training form to the head of the ICT department. An appointment is

set up between the trainer (head of the ICT department or ICT committee member) and the teacher. In this way, more personalized attention and time are devoted to the teacher. Peer coaching has been very effective as it focuses on the pedagogical and technological learning of teachers.

Issue 3

Teachers' Competencies and Standards

lesson*learned* 1

ICT competency standards serve as a benchmark for formulating and evaluating teacher training programmes and use of ICT in teaching

ICT extends learning beyond formal classroom settings and encourages lifelong learning. There is a need to set ICT competency standards for teachers and students. The standards should cover both technical and pedagogical ICT competencies that are tailored to the needs of each school. The standards should avoid software- or product-specific skills and should instead focus on generic skills of particular applications.

a. ***Thailand***: The National ICT in Education Master Plan states the following vision: "Teachers should have a high level of ICT knowledge and skills including an understanding of the development of learning and teaching media for instruction." This implies the need to develop a set of technology standards for teachers to serve as a benchmark for formulating and evaluating teacher training programmes.

As for science and mathematics teachers, the IPST has developed a set of teaching standards that includes communications skills to promote student learning through an inquiry process. Teachers are required to use technologies as a communications, research and productivity tools, in addition to verbal or written communication skills. This set of technology standards for Thai teachers is developed based on ISTE standards and existing learning standards for Thai students.

lesson*learned* 2

Customizing national-level ICT competency standards for each school, depending on its socio-cultural context, ensures ICT integration and acceptance

Setting ICT competency standards helps to ensure effective integration of ICT in schools. Nevertheless, these standards should not pose additional pressure on students and teachers.

a. ***Thailand***: According to some teachers, it is difficult to measure the level of ICT competency in the production of teaching and learning materials because of constraints in existing ICT infrastructure.

Issue 4

How to Change Mindset of Teachers

lesson*learned*1

A buddy system approach where novice teachers work together with expert teachers in a classroom using ICT helps to change the mindset of teachers

The existing mindset of teachers could prevent them from experimenting with approaches that are contrary to prevailing wisdom. It is therefore necessary to address current ways of doing things. However, the issue is not about replacing lectures or teachers with ICT packages, or about promoting ICT simulation as the best way to relate theories to the real world. If a non-ICT tool can address a learning need or objective successfully, it makes little sense to replace the non-ICT tool with an ICT tool.

a. ***Thailand***: An effective way to develop positive attitudes towards the use of ICT is a buddy system approach, whereby junior and senior teachers work together on classroom projects using ICT. The positive attitude is reinforced by the satisfaction of seeing the students' improvements and achievements. When the teachers' mindsets change, their behaviours also change. The IPST uses this approach in in-service training for teachers in the use of specific programmes in science and mathematics.

Issue 5

Content Focus of Capacity Building for Teachers

lesson*learned*1

Training teachers on ICT-related skills within the context of classroom objectives and activities ensures development of skills in the integrated use of ICT in teaching

This approach will ensure that the focus is on applying ICT skills to achieve pedagogical objectives, rather than on teaching ICT skills in isolation. One way of implementing this is by mobilising private or public ICT training agencies to equip trainee teachers with basic ICT skills, while teacher education institutions can focus on the pedagogical use of ICT for education. Private and commercial ICT training agencies are specialists in basic ICT training and may be more competent and effective for this type of ICT training. This will also allow the MOE to focus on the pedagogical aspects of ICT use. Teacher education institutions can work closely with these agencies to develop the curriculum, leaving the training to the latter.

a. ***South Korea***: The plan for training in ICT use was undertaken in 2002, outlining teaching-learning goals in 10 common basic subjects in the Seventh school curriculum. Under this plan, a

teaching-learning model for ICT use in a teaching-learning plan for each subject was developed, in accordance with subjects in the curricula and the high-tech learning environment in the classrooms, group study rooms and individual multimedia study rooms. The plan has been in progress for two years, from 2002 to 2003, and has been applied to training in ICT use for teachers.

b. ***Thailand***: The MOE and the ICT Unit in the Office of the Permanent Secretary of Education provides in-service teacher training courses at three levels: foundation, intermediate, and advance. The foundation level is a requirement for all teachers. It includes basic, general purpose software, such as word processing, databases, spreadsheets, and Internet use. The intermediate level courses, which are optional for teachers, focus on developing teaching materials that require higher levels of ICT knowledge skills. Examples include developing web materials using presentation programmes, web authoring tools, ready-made templates, and writing simple CAI programmes using authoring software. The advanced level courses are designed for teachers who seek specialization in ICT areas or who teach computer courses and/or work as technology coordinators in their own schools.

However, none of these courses is specific to any subject specialization. Many teachers are not able to apply what they have learned to their classroom teaching and learning. They are also constrained by their heavy workload and rigid class schedule. In addition, some schools do not have the budget to provide supportive environments for integrated use of technology.

There have been developments in the past three years to make the courses more subject-specific. IPST plays a key role in providing ICT training and train-the-trainer activities for science and mathematics teachers. Handheld devices, such as graphic calculators, probes and data loggers and special software are being introduced in science and mathematics classrooms of pilot schools by first training the teachers.

c. ***Singapore***: The foundation course focuses on hands-on ICT experience at the initial stage of pre-service teacher training and acquaints trainee teachers with the art of integrating ICT in schools. This course is supported by basic ICT skills training workshops that have been sub-contracted to private training agencies. The agencies conduct workshops during the term breaks and on Saturdays, using Powerpoint, Dreamweaver, Flash, Excel, Authorware, and other ICT applications. As elective courses, more advanced ICT-based pedagogical principles and skills are offered. Examples include "Constructivist Learning with the Internet" and "Instructional Multimedia Design".

An ICT component is integrated in all subject areas, such as Mathematics, Science, English, and Humanities. In all these courses, students have opportunities to design and develop ICT-based instructional plans and resources and share their ideas and products with their peers. Moreover, the trainee-teachers' practicum gives an opportunity to collaborate with schools to upgrade the trainee teachers' ICT-integrating skills. During the practicum, trainee teachers are encouraged to design ICT-based lessons and implement them under the close supervision of expert teachers and NIE lecturers.

lesson*learned*2

ICT professional development programme for teachers should be planned, taking into account the ICT vision in education policy

Various agencies involved in professional development programmes should work in close consultation. These agencies may include the MOE, teacher education institutions and private companies.

a. ***Singapore***: The NIE and ETD work very closely with schools to design the ICT component in pre-service teacher education programmes. They examine the vision, dimensions and strategies of MP1 and MP2 before developing ICT training plans for pre-service teachers. Four types of ICT courses for NIE trainee teachers are offered in the pre-service teacher education programme: basic skill ICT workshops, 30-hour ICT foundation course, 26-hour elective courses, and 6-12 hours of ICT integration in each curriculum subject class.

Issue 6

Capacity Building of Education Personnel at All Levels

lesson*learned*1

Training education personnel at all levels ensures that all aspects of ICT use in schools are implemented in an efficient, coherent and complementary way

Experience has shown that most professional development programmes cater only to teachers and heads or principals of schools. However, this should not be the case. MOE's non-teaching staff, for example, complement and support teachers in the integration of ICT in their schools.

a. ***Malaysia***: The ETD is finalizing a five-year training and professional development plan which takes into account all the personnel involved in the roll-out of the Smart School, namely, ETD officers, state level officers including those from the State Education Departments and the State Educational Resource Centres, and school support staff, such as clerks and technicians.

b. ***Philippines***: Continuing training for policymakers and school administrators in technology planning and management is essential. Many ICT-based programmes have been stalled because of tentative leadership. DepEd has begun to see the need for this and in 2003 brought together, through a series of meetings the administrators of schools that received computer donations through the "PCs for Public Schools" programme. Whether this represents the first step in establishing a long-term professional development programme for administrators remains to be seen.

The schools' capacity for autonomous technical maintenance must also be developed. The inherent complexity of ICT equipment and tools brings much pressure on school

personnel to operate and maintain ICT facilities efficiently. Hardware, software and network installation and maintenance, system administration, and network security are basic skills that must be available at or near the school. Various NGOs and technical training institutes provide technical support training and assistance to public high schools, but again these programmes must be rationalized and institutionalized at all levels of DepEd.

c. ***Thailand***: It is the MOE's policy that all education personnel should use ICT in their work and that all mid-level personnel should acquire basic skills in using general office software applications and the Internet and e-mail. The Office of the MOE Secretary General organizes training courses for all departmental personnel in a wide range of ICT uses. Training courses for high-level officials are organized by NECTEC and the MICT. In addition, the demand for data and information exchange between departments and ministries in electronic format, as well as on-line communication driven by the Prime Minister Operations Centre, necessitates extensive training to be undertaken by all department personnel.

Issue 7

Incentive System and Motivational Strategies for Teachers

lesson*learned* 1

Having a recognition system for innovative and effective use of ICT integration in schools will motivate teachers to use ICT in teaching

The scheme may be in the form of awards or grants for teachers, heads of departments or principals. It may be at the school level, cluster level or national level. The sponsors could be schools and higher education institutions, or private companies and organizations that work closely with the MOE.

a. ***Malaysia***: Other than those teachers who taught the four subjects included in the Smart School Pilot Project, the rest of the teachers in the project's pilot schools were generally not motivated to improve their ICT skills. However, since the Government implemented the new civil service scheme in 2001, encouraging and rewarding civil servants who acquire competencies in specific areas, there has been greater motivation on the part of teachers to acquire ICT skills and knowledge.

b. ***Singapore***: Hewlett-Packard (Singapore) has sponsored the HP INIT Award since 1999 to recognize teachers' creative use of ICT in teaching. This award encourages teacher to innovate in applying ICT to enhance learning and motivates them to move to higher levels of ICT use. In 2001, a new dimension was added – collaboration and networking among teachers and specialists. The new dimension provides teachers with a platform to reflect on their own learning experiences through the innovative use of ICT, backed by strong pedagogical considerations.

c. ***Thailand:*** National awards for outstanding teachers are a good strategy to encourage teachers' dedication. Support and recognition within and outside schools help to sustain their perseverance and enthusiasm. However, other incentives related to the merit system of promotion could be more sustainable in the

long run. An Act is being drafted to establish the Institute for the Development and Promotion of Teachers, Faculty Staff and Educational Personnel, to supervise a system for incentives and ensure the achievement of quality on a sustained basis.

lesson*learned*2

Formal certification of in-service professional development that leads to diplomas or degrees could provide an incentive for teachers to upgrade their skills in and knowledge of ICT integration

a. ***Malaysia***: The Smart School Development Team is experimenting with the "International Computer Driving License", which offers competency certification at the end of the course. The goal is to determine whether certification would motivate the teachers to sign up for training and to use ICT in their work after the training.

b. ***Singapore***: NIE has introduced the Advanced Diploma and Advanced Postgraduate Diploma in education programmes to enable teachers to upgrade and update their content knowledge of school subjects or state-of-the-art educational methodologies or technologies, guidance and counselling methods and educational administration courses. The Advanced Diploma in Information Technologies in Education has already taken in three cohorts of teachers. Advanced diplomas provide an alternative route for admission into the Institute's bachelor's and master's degree programmes. However, the teachers can opt to sign up for individual modules in the programme and hence have a wider choice of continuous in-service professional development. The advanced diplomas and their accreditation framework also ensure better articulated linkages between in-service training and the career paths of teachers by providing greater opportunities for teachers to upgrade to degree and postgraduate qualifications.

lesson*learned*3

Teachers' interest in using ICT after their training is more likely to grow if they are provided with computers, training materials and software for classroom use

a. ***Thailand***: Based on IPST's experience in the provision of in-service teacher training, it is necessary to provide training material or software for use in the classrooms. A written permission from the school principal is required to warrant the use of these materials in the school, stating further that the trained teachers are expected to provide training to other teachers in their schools and in other schools. A series of training courses will help to ensure that the courses are offered effectively.

Another good strategy is for schools that already have ICT tools to provide their teachers with training on the use of available resources and tools.

Component

8

Monitoring and Evaluation

Overview

Experience in the six countries except Singapore has shown that monitoring and evaluation are the weakest components in most ICT in education programmes. While a number of stocktaking research studies have been conducted on ICT infrastructure penetration and access in schools, there have been minimal monitoring and evaluation of ICT integration and its impact on teaching and learning. Evaluation is an important phase in the formulation and implementation of an ICT in education programme. Evaluation, both formative and summative, means that policies, practices, and activities are documented, interpreted and analyzed. Both qualitative and quantitative methods are used, including observations, interviews, focus group discussions, reflective journals, questionnaire surveys and assessments. The data collected and analyzed will then provide information on practices and policies to effectively integrate ICT in schools. Unfortunately, the findings of the few research and evaluations that have been conducted have not been widely shared with policy makers and practitioners. This component focuses on three issues of monitoring and evaluation: (i) documentation of the benefits of using ICT in education, (ii) evaluation methodologies, and (iii) programme evaluation.

Lessons learned

Based on the experiences of the countries except Indonesia, the following are the lessons learned with respect to three issues:

1. Documentation of the Benefits of ICT Use in Education

- *Proper use of ICT tools offers students and teachers learning and teaching opportunities and improves teaching and learning processes.*
- *Investment in research and development projects and centres has contributed towards examining existing pedagogical practices, revising and refining practices, and exploring new pedagogical approaches to ICT in education.*
- *Research has helped policymakers to formulate ICT targets and goals .*
- *Evaluation can demonstrate the reasons for the under-utilization of ICT resources and identify major obstacles to their full utilization in schools.*

2. Evaluation Methodologies

- *Action research is one of the best methodologies for documenting the process of effective ICT integration.*
- *Assessing the learning impact from ICT use is better measured through other means besides the paper-pencil test method.*
- *To gather the most meaningful data on the integrated use of ICT in schools, both quantitative and qualitative methodologies should be used, employing various data-gathering instruments, such as case studies, questionnaires, face-to-face interviews and focus groups.*

3. Programme Evaluation

- *Countries recognize that evaluation of ICT in education programme should be a continuous process, covering planning, implementation, reflection, refinement, effectiveness and user acceptance.*
- *Due to limited experience in ICT use in the region, better quality directions for the programme can be obtained by benchmarking the quality of ICT projects against international studies, standards and best practices.*

Synthesis of Experiences

Issue 1

Documentation of the Benefits of ICT Use in Education

lesson*learned*1

Proper use of ICT tools offers students and teachers learning and teaching opportunities and improves teaching and learning processes

Studies demonstrate that ICT tools have helped to improve greater autonomy in learning, stimulate students' sensory and cognitive curiosity, develop life skills, boost self-confidence and facilitate the learning of abstract ideas and theories. These can be achieved for as long as the ICT-based teaching and learning materials are interactive, engaging, multimedia, visually robust, and are integrated in classroom lessons. It is also important that sufficient time is given to ICT use in education. Thus, the teaching and learning benefits provided by ICT include learners' autonomy, visualization of abstract concepts and relationships, experimentations and conduct of inquiries with simulation packages and joint-construction of meanings between students and teachers. The learning benefits for teachers include collaboration and sharing of resources, expertise and experiences among teachers; anywhere-anytime professional development with teacher training colleges and universities; and learning beyond the boundaries of the teachers' subject specializations.

a. ***Singapore***: A research conducted by IDA in 2002 (http://schools.s-one.net.sg/findings1.html) cited the benefits resulting from implementation of FastTrack@School on the teachers' ICT integration capacity and on the students' learning process. The respondent teachers, heads of departments and principals described the ways by which ICT improved the teaching-learning process and engaged the students. These included the following: (i) interactive multimedia courseware facilitated teaching and learning of abstract ideas and theories; (ii) ICT encouraged self-directed and self-paced learning on the part of the students. There was no time constraint and students had greater autonomy in learning; (iii) ICT integration served as a catalyst to boost the students' self-confidence as seen, for example, in the benefits derived by students from use of ICT in the presentations - from preparation to the final delivery of the presentations; (iv) ICT facilitated discovery learning as it encouraged students to ask and address more in-depth questions; (v) ICT stimulated the students' sensory and cognitive curiosity. Most of the students were visual learners and the use of vibrant colours, interactive graphics and icons provided stimulation; (vi) the development of interactive courseware could involve students. When students are engaged in the design and development of multimedia, they acquire a set of life skills.

The respondents also cited how the ICT initiative by IDA and MOE has enhanced the ICT integration capacity of teachers, noting the following: (i) ICT use in training and teaching raises the teachers' ICT awareness and competency level; (ii) while ICT could never replace real-life teachers, ICT resources complement existing academic resource

materials to enhance learning; (iii) ICT, including both asynchronous and synchronous communication tools, facilitates the exchange of knowledge and resources among the teachers and ensures knowledge-based connectivity among them; (iv) as peer teaching and sharing are practiced in many schools, this fosters knowledge exchange on ICT; and (v) ICT provides opportunities to explore beyond the teachers' academic areas and to work with ICT vendors in developing instructional design and technical skills.

A survey conducted by the MOE in September 2001 highlights the impact of ICT integration (Soh, 2002) on students, teachers, schools and the community. 90% of the students noted that ICT has made learning more interesting. (82%) feel that ICT use has increased their knowledge, while some 77% believe that ICT has improved their learning and encouraged them to learn beyond their curriculum. 64% feel that ICT has stimulated interaction with their classmates. Teachers have attended 30 to 50 hours of ICT training each. 84% of the teachers express interest in further ICT training, while 77% want to find more ways to integrate ICT in education. 68% feel that ICT has encouraged greater class participation, while 65% find the preparation of ICT-based lessons worthwhile. In most of the schools, a supportive culture for ICT use has been cultivated and ICT applications are now found in various school procedures in administration, counselling and communications. Technology has been a prevalent feature in the schools. For the community as a whole, there is greater student participation in projects with foreign students. Parents, industry experts and academics have been approached to make meaningful contributions. Partnerships with industry have become common and the bonds between schools and the community have been strengthened.

lesson*learned*2

Investment in research and development projects and centres has contributed towards examining existing pedagogical practices, revising and refining practices, and exploring new pedagogical approaches to ICT in education

a. ***Thailand***: To showcase ICT research and development, researchers selected a poetry composition project at a large secondary school with a student population of 3,328 and 87 computers, most of which were networked and had Internet access. The students selected assignments of their preference from predefined websites and either paired or formed groups with classmates of their choice. One computer was shared by at least two students. The students helped one another to do the exercises and to answer the questions. In the process, they had to talk, discuss and agree on their views. Teacher-student communication took place on the Web Board developed by the teacher. It was here that the students chose a picture to compose a poem. The group members were the first to comment and score the work. The students used ICT to study verses at www.thai.net/bunga/poem.html, they then individually composed verses for submission to the teacher by e-mail. According to the teachers interviewed, ICT use not only contributed to the students' better understanding of the content but also enhanced their motivation. Seeing their works on the Internet (www.thai.net/greenpink/ep04.html) also gave them a sense of pride.

b. ***Singapore***: ETD and NIE have begun to conduct research on the use of ICT in education. Schools are encouraged to "generate research and development that will enhance the next generation of technology applications for teaching and learning" (Soh, 2002, p.32), and "teachers can look forward to R&D grants to help them experiment on novel teaching strategies and to develop new teaching and learning resources" (Shanmugaratnam, 2002).

lesson*learned*3

Research has helped policy makers to formulate ICT targets and goals

a. ***Thailand:*** IPST has been involved in several international research studies on ICT in education, the most recent ones being the Second Information Technology in Education Module 1 (1998) and Module 2 (2002), and the Australian-SEAMEO Project, Pre-service Teacher Training and Teacher Professional Development in the Use of ICT in the Teaching of Mathematics and Science in Participating SEAMEO Countries (2001). Findings from these studies are beneficial to current projects and initiatives at national and institutional levels. For example, SITES M1 and M2 provided policymakers and educational practitioners with information about ICT in the education system and the extent to which ICT contributes to educational reform. The MOE has established a computer/school ratio of 1:20 for secondary schools and 1:40 for primary schools, based on SITES M1 indicators. Documentation on these studies has been published and shared among the participating countries and concerned readers.

lesson*learned*4

Evaluation can demonstrate the reasons for the under-utilization of ICT resources and identify major obstacles to their full utilization in schools

a. ***Philippines***: A nationwide survey of public and private primary and secondary schools, in which 36,368 out of 46,440 schools participated, was conducted by SEAMEO-INNOTECH. The survey revealed that only 18% of the schools have computer literate teachers, the largest percentage of such schools being in Metro Manila (SEAMEO-INNOTECH, 2002). Only 7% of primary and secondary schools offer ICT-related instruction.

A 1998 study conducted by DOST-SEI to establish baseline data on ICT capabilities in public and private secondary schools revealed that 84% of secondary schools use computers for instruction The response rate for this survey was 66% or 4,310 out of 6,494 schools (DOST, 2001). Findings of the DOST-SEI study have been validated by a 2001-2002 survey conducted by the Foundation for IT Education and Development, a non-government organization.

A simple random sampling of 100 schools (from the 661 public secondary schools that received computer assistance packages from DepEd between 1996-1998) was carried out to determine levels of ICT utilization and to identify factors that affected utilization (Tinio, 2002). Student-computer ratios were in general quite poor, ranging from 12:1 to 1,098:1 with a mean ratio of 267:1. For schools planning to expand their ICT facilities, space was a limiting factor. In an education system where overcrowding is the norm, classrooms that can be converted into computer laboratories are hard to come by. In secondary schools where computers were available, only 15.2% of teachers claimed to have used them. Of these, only 56.5% used the computers for instructional purposes. In contrast, 92.1% of students in schools with computers reported that they have used the technology for learning activities (DOST, 2001).

Most of the learning activities are “learning the tool” and not “learning with the tool”. Of the total number of computer hours used, 80.4% have been for teaching basic ICT skills and productivity tools, such as word processing,

spreadsheets and presentation software, and the rest for computer-assisted instruction (CAI). While student access to the technology appears widespread, contact time is fairly limited. Significantly, what little ICT is present in the schools is generally underutilized, especially given that a large majority of the computers have fast processors, fairly new operating systems, and multimedia capability (Tinio, 2002).

Under-utilization is attributed to several factors: (i) lack of guidelines from DepEd on the integration of ICT in different learning areas; (ii) lack of educational software; (iii) lack of hardware peripherals, such as digital imaging devices, graphical tablets, etc.; (iv) low level of teacher competencies in basic computing and Internet use and ICT application in different learning areas and across the curriculum; and (v) lack of funds to pay for full operations (i.e., eight hours a day, five days a week), including the cost of electricity, supplies, telephone time, Internet access, repair and maintenance (Tinio, 2002).

Issue 2

Evaluation Methodologies

lesson*learned* 1

Action research is one of the best methodologies for documenting the process of effective ICT integration

One of the best methodologies for gathering data on the integrated use of ICT in education is action research as it enables practitioners to explore and integrate ICT in the school curriculum, reflect on the process and outcome, and amend and refine practices for future use.

a. ***Singapore***: edu.QUEST, an initiative of the MOE, showcased research projects on the use of ICT in education (http://www.moe.gov.sg/edumall/edu_quest/eduquester/default.htm). edu.QUEST projects focus on quality research on the impact of leading edge technologies on educational practices and achievements. Action research is ideal as it is responsive to unanticipated discoveries in the course of experimentation with emerging technologies.

   In one such project at Woodlands Primary School,"Turning the Science Garden into a Huge Classroom" (http://www.moe.gov.sg/edumall/edu_quest/eduquester/sciencegarden.html), the teacher turned the school science garden into a huge outdoor classroom with students studying plants in their natural environment and surfing the Web on the spot for further research on the plants. The teacher's evaluation noted that (i) students can easily relate what they observe in the science garden to what they read on the Internet, (ii) students ask relevant questions and compare observations/findings with their peers, (iii) the learning environment is more interactive and responsive and, as the teacher is able to work with individual students or groups, immediate feedback and adaptive instructions are possible, and (iv) the Network Assistant package permits better management of tasks and the students. For example, it is possible to monitor and freeze the students' screens.

lesson*learned*2

Assessing the learning impact from ICT use is better measured through other means besides the paper-pencil test method

There is a need for teachers to be trained on how to construct authentic assessment instruments and interpret the results, focusing on the development of student learning. Training should be a complete process of teaching and learning as well as curriculum development. Assessment methods are new to most teachers and they would have to be trained to select methods suited to specific learning activities

a. ***Thailand***: The new curriculum standards encourage the use of authentic assessment across the curriculum. The traditional paper-pencil test method is not responsive to an instructional process that focuses on students' learning, in which students are required to practice a higher level of thinking skills and to engage in hands-on activities to construct knowledge. Evaluation should be obtained from various sources of information and should make use of several methods (e.g. group or individual observation, report or product; interview; student's record; consulting between students and teachers; practical assessment; performance assessment; and portfolio assessment).

An authentic assessment better reflects what students have learned or performed than the paper-pencil test method, and provides realistic feedback to both teacher and learner. The result of assessment can be crosschecked using several sources of information. A good paper-pencil test method is only able to assess rote learning and gives no information on what a student has learned.

lesson*learned*3

To gather the most meaningful data on the integrated use of ICT in schools, both quantitative and qualitative methodologies should be used, employing various data-gathering instruments, such as case studies, questionnaires, face-to-face interviews and focus groups

To provide multiple perspectives to an evaluation, the findings should be interpreted and analyzed based on well-established literature on education research, learning theories, management theories and ICT research. The evaluation may be carried out in natural settings in schools of different types and levels, to provide a holistic picture of ICT integration in the schools. Qualitative and quantitative methods are employed to complement each other, enhance the validity and reliability of the evaluation and ensure that the depth and breath of the study are not compromised.

a. ***Singapore***: The NIE carried out a three-year research project under the Education Research Fund in 2000 entitled, "Effective Integration of ICT in Singapore Schools: Pedagogical and Policy Implications". Phase 1 was a questionnaire survey to explore the critical aspects of ICT integration, while Phase 2 was a collective case study of 10 schools.

Phase 1 had three main goals: (i) provide a descriptive and interpretive account of critical aspects of ICT integration in the schools; (ii) formulate recommendations to facilitate effective ICT integration, (iii) identify schools for the collective case study in Phase 2. Ten schools (five primary, three secondary and two JC/CIs) were chosen based on their high level of ICT integration.

The questionnaire consisted of five categories: school ICT culture, student use, teacher use, management of ICT resources and staff development. A five-point scale was used for the responses for all items in the five categories.

Case study method was appropriate for Phase 2, given the need to emphasize the context of use. To gather the accounts of various groups and individuals concerning the learning environment, both qualitative and quantitative methods were used, including observations of ICT and non-ICT based lessons, face-to-face interviews with principals and ICT coordinators, focus group interviews with students and teachers, questionnaires for teachers and students, and samples of students' work.

The project will be completed at the end of 2003. Readers may access the project website at http://eduweb.nie.edu.sg/projects/itintegration for updates.

Issue 3

Programme Evaluation

lesson*learned* 1

Evaluation of ICT in education programme should be a continuous process, covering planning, implementation, reflection, refinement, effectiveness and user acceptance

In the planning and implementation of programme and initiatives, the evaluation phase is very important. This includes both formative and summative evaluations, involving a continuous cycle of planning, implementation, reflection and refinement.

a. ***Malaysia***: The ETD in cooperation with the MDC has commissioned two evaluation studies on the Smart School Integrated Solution. Researchers from five local universities conducted one study to evaluate user acceptance and effectiveness of the Smart School Integrated Solution. The final draft of the report, written in Bahasa Melayu, will be available before the end of 2003.

b. ***South Korea***: In spite of great success in adapting education to the information age and the heavy investments made in ICT use in education, the effectiveness of ICT integration in education at the national level has not yet been evaluated and the level of integration compared with other countries cannot be ascertained. In the second stage of the ICT Use in Education Plan, the Ministry of Education and Human Resources Development is developing indicators to measure the effectiveness of ICT use in education. The development of such indicators has been divided into four stages: elementary and secondary school education in 2001, higher education in 2002, special education in 2003 and lifelong education and vocational education in 2004. To develop these standardized indicators, the Government is also promoting cooperation among ICT research institutes and strengthening collaboration with international organizations, such as the INES project of the OECD, the Knowledge and Human Resources Development Bureaus of APEC and UNESCO.

c. ***Thailand***: Whereas in the past, evaluation was not a part of the ICT programme, the new strategy and master plan now require a phase-by-phase evaluation to obtain feedback and information for monitoring ongoing activities. The long-term evaluation programme is now under consideration at the policy level, not only for local or national

use but also for comparison purposes at the international level. MOE's ICT in Education Master Plan (2004-2006) includes a monitoring and evaluation system that involves developing a database for key success indicators for monitoring the effectiveness and efficiency of the implementation of the master plan, at both ministerial and departmental levels. The information system of all departments will be linked to facilitate and follow-up project operations. Monitoring will be taken every three months, focusing on budget implementation and the progress of project operation. The project result for each fiscal year will be used for adjusting and improving the following year's plan. Both external and internal evaluators will prepare the final evaluation. The findings will be used as feedback for the next phase of the master plan.

lesson*learned*2

Due to limited experience in ICT use in the region, better quality directions for the programme can be obtained by benchmarking the quality of ICT projects against international studies, standards and best practices

a. ***Singapore***: One of the first international studies on ICT integration was the first module of SITES by the International Association for the Evaluation of Educational Achievement (IEA) in November 1998 (http://www1.moe.edu.sg/press/1999/pr991122.htm). The main objective of the study was to assess the status of ICT in schools for instructional activities by teachers and students in 27 countries. Singapore, a leader in the provision of computers and associated peripherals to schools, has a well-planned and implemented staff development programme. Other avenues opened to teachers to learn ICT knowledge and skills and knowledge include ICT courses, training given by heads of departments and peers and sharing sessions. The findings also indicated that in formulating policies, school principals prefer to address 'emerging' ICT-related objectives over 'traditional' objectives.

b. ***Malaysia***: The first study, conducted by Frost and Sullivan, benchmarked the Smart School Integrated Solution against international practices. The report is written in English and is available on request from ETD. It is also available on BESTARInet, the Smart School Portal, www.moe.edu.my.