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This toolkit arose from the need to provide a recipe book or a blueprint for the pilot schools of the UNESCO project to establish or strengthen schoolnets in Southeast Asia at the national and sub-regional levels. The project entitled, "Strengthening Use of ICTs in Schools and Schoolnet in Southeast Asian Countries", funded by the Japanese Funds in Trust and the ASEAN Foundation, is aimed at: a) exploring and demonstrating how ICT can be used in schools to improve the quality of education and better prepare youth for the demands of the Knowledge Society; b) testing innovative models of ICT use in schools and in other places of learning; and c) improving connectivity and access to the wealth of educational resources through the establishment of a SchoolNets in Southeast Asia. It will establish or strengthen national schoolnet in eight countries (Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Thailand, Vietnam) as well as connect them to a sub-regional schoolnet hub.

In Asia and the Pacific, a number of countries that includes Australia, India, Indonesia, Malaysia, the Philippines, South Korea, and Thailand, have established national schoolnets . Experts from several of these countries were commissioned to document their experiences in school networking. The cornucopia of experiences, tested strategies, best practices, and lessons learned arising from these case studies provide information which can be translated into a handy and practical set of do's and don'ts useful to those about to embark on a similar initiative or in the process of upgrading their existing SchoolNets. The UNESCO Asia and Pacific Regional Bureau for Education and the Commonwealth of Learning have seized this opportunity of turning these experiences and lessons learned into do-able and practical toolkit for establishing viable SchoolNets. This toolkit is meant for countries at various stages of development. Regardless of the stage of development, all will benefit from the toolkit as it offers guidelines tailor-made for those in different stages with different needs.

This toolkit is the first of its kind and a trailblazer not only in Asia and the Pacific but also throughout the world. It is a convergence of all that is good in school networking. SchoolNets have accelerated technology-based modernization of the education systems and schools. They have helped address the digital divide by mobilizing the telecommunication and IT sector to reduce telecommunications costs and offer free Internet connections through various arrangements. This has led in expanding the number of schools which can make telephone calls and connect to Internet; lowering student-computer and teacher-computer ratios; and enhancing the accessibility of teachers and students to computers through more open access areas and local- area and wide-area networking. Schoolnets have also networked educators and communities that otherwise have neither the tools nor the time and money to get together to connect for dynamic partnerships. They have therefore strengthened skills in collaborating and working in teams through their various telecollaboration activities and projects both at the national and global levels.

More information about the toolkit is given in the Introduction. I wish here to give credit to a number of people and institutions who have contributed to the completion of this toolkit. First and foremost, I would like to thank the Commonwealth of Learning which has contributed to the birth of this toolkit through its valuable support as a co-publisher and as a funder for its preparation and editing.

The primary author is Stephen Marquard, an ICT consultant specialising in applications of ICT in education and online learning and collaboration, with over a decade of experience in school networking and the educational application of ICT. Since starting the first school network in South Africa in 1993, he has subsequently worked with other national and regional Schoolnets in Africa in areas such as connectivity and network solutions for schools, e-learning programmes for teachers, projects addressing the digital divide in disadvantaged schools, the design of school intranets, online collaborative learning, and national educational ICT programmes and policies.

As mentioned, the toolkit derives from a collection of lessons learned and best practices from selected countries in the region which provides the basis for the principles, theories and guidelines presented in the toolkit. For this, we are grateful to the following authors:

- Okhwa Lee, Okhwa. *ICT Integration in Education in South Korea.*
- Cher Ping Lim, *ICT Integration into Education and Schoolnet Operations: A Case Study of Singapore.*
- Chan Foong Mae, *Case Study of ICT Integration into Education.*
- Chan Foong Mae, *Schoolnet Operations in Malaysia: The Malaysian Smart School Project.*
- Victoria Tinio, *ICT Integration in Education in the Philippines.*
- Victoria Tinio, *Ed.venture – the Pilipinas SchoolNet Pilot: A Case Study.*
- Pornpun Witayangkoon, *Case Study of ICT Integration into Education in Thailand.*
- Harina Yuhety, *Case Study of ICT in Schools and Schoolnet in Indonesia.*

The development and publication of the toolkit was coordinated by Carmelita Villanueva, Chief of the UNESCO's Information Programmes and Services and Coordinator of the Project. She also gave valuable comments for its improvement. Thanks also go to Vis Naidoo, Education Specialist, Educational Technology, Commonwealth of Learning; Shafika Isaacs, Executive Director of Schoolnet Africa; Tinsiri Sribodhi, Project Assistant of the UNESCO ICT for Education Team, who all contributed their comments and suggestions that led to the refinement of the toolkit. Last but not least, thanks goes to Ruth Wilson from Commonwealth of Learning who edited the document.

For the value added offered by schoolnets to educational systems, we hope you find the toolkit useful.

Sheldon Shaeffer
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UNESCO Asia-Pacific Regional Office for Education

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Introduction

Welcome to the **Schoolnet Toolkit**. The **Toolkit** is designed to help education planners and practitioners integrate information and communication technologies (ICTs) into education systems.

Education systems are under the spotlight worldwide today. Many countries are grappling with significant development challenges, such as meeting UNESCO's Education for All goals, as well as other social objectives. The information age is creating economic pressure for countries to develop into knowledge societies in order to become or remain internationally competitive in a global economy.

ICTs can help address these challenges. They are an important catalyst for transforming education, creating exciting new possibilities for teaching and learning, and facilitating shifts towards new pedagogies.

A number of Southeast Asian countries have contributed their experiences to this *Toolkit,* which is a practical resource about ICTs in education, and more specifically about setting up and operating schoolnet programmes and projects. A schoolnet programme is an organised set of activities that expands the use of ICTs and promotes sharing of educational resources by teachers and students at schools. Schoolnet programmes may be located inside or outside government, may be large initiatives with substantial funding, or smaller innovative projects without big budgets.

Schoolnet projects usually adopt a multifaceted approach, addressing technology issues (connectivity and infrastructure), curriculum integration processes, assessment and pedagogy, the professional development of teachers, identifying and developing suitable content and software, and creating online communities of practice using ICTs. Schoolnets may also be involved in reshaping the policy environment through advocacy, research, or support of policy processes underway.

The exact form of schoolnet programmes varies from country to country. Nevertheless, the case studies on which the Toolkit is based show substantial convergence towards a body of best practice in ICT integration in education.

The *Toolkit* distils these experiences into a clear and simple format, of use to both start-up and mature schoolnet programmes.

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Who is the Toolkit for?

The **Toolkit** is for:

▶ **Policymakers and high-level managers** who need to understand the policy and macro issues involved in planning and establishing schoolnets and educational ICT programmes.

▶ **Schoolnet builders and managers** who are involved in starting and running schoolnet programmes and projects

▶ **Practitioners** such as teachers, school principals and content developers who work with ICTs in an educational context and participate in schoolnet activities

How to Use the Toolkit

The **Toolkit** is structured into four main sections, designed with different readerships in mind:

▶ *Guidebook***1: ICTs in Education and Schoolnets** is intended for *everyone*. It describes the value proposition for ICTs in education, and the broad processes that need to be integrated to ensure sustainable impact. It looks at the characteristics of schoolnet programmes, different organisational and leadership models for schoolnets, and outlines a variety of functions that schoolnets perform and services that they can deliver. Lastly, it presents ways of assessing the effectiveness of schoolnet programmes, and gives some examples of active schoolnets.

▶ *Guidebook***2: Planning Schoolnet Programmes** is intended for *policymakers and high-level managers*, and for s*choolnet programme managers*. It examines the policy and planning implications of schoolnet programmes, such as relating ICT programmes to broader economic and education development goals; understanding the financial and other resources that will be required and working within a range of constraints; establishing appropriate partnerships; and change management strategies. It describes ways in which the education system should respond to the introduction of ICTs, such as changes in curriculum structure, assessment strategies and professional development programmes for teachers. Lastly, it looks at factors that influence sustainability at various levels, broadening and extending the impact of schoolnet programmes and methods of evaluating and assessing impact.

▸ *Guidebook*3**: Implementing Schoolnet Programmes** is a practical and operational guide for *managers of schoolnet programmes*, covering project planning and implementation and the key elements involved in an ICT project; choosing appropriate technologies; putting in place support, maintenance and troubleshooting systems; models of training provision; creating and operating online services; creating schoolnet communities; and indicators for measuring participation and impact.

▸ *Guidebook*4**: Practitioner's Guide** provides pointers on ICT integration for *educators, school management, and others* directly involved in producing or using educational ICT resources in a school context. It covers the ICT integration process, changing ways of assessing learning outcomes, selecting, using and adapting ICT software and resources, collaborating with other educators in online communities, and skills and competencies that teachers should build through professional development programmes.

Finally, there are two appendices which may be consulted for further detail and references to source and follow-up material:

▸ Abbreviations, Acronyms and Glossary

▸ References

The toolkit and additional resources are available on CD, and can also be accessed online at the URL: http://wwwunescobkk.org/education/ict/resource/JFIT/schoolnet/toolkit.html

Country Case Studies

The ***Toolkit*** has been compiled based on the following case studies:

▸ **Korea**: Review of ICTs in education, documenting the development of Korea's infrastructure for ICT use from 1997 to the construction and operation of EDUNET run by the Korea Educational Research Information System.

▸ **Indonesia:** Review of ICTs in education and three different schoolnet initiatives: e-dukasi.net (an online content resource site), WAN Kota (a wide-area network for schools) and Sekolah2000 (a private-sector initiative).

▸ **Malaysia**: Review of ICTs in education and schoolnet operations, focusing on the Smart School Pilot Project implemented in 87 schools from 1999 to 2002 by the Ministry of Education in collaboration with the Multimedia Super Corridor initiative.

▸ **Philippines**: Review of ICTs in education and a case study of the ongoing Coca-Cola Ed.venture project, launched in 2001 and implemented in 15 schools by the Foundation for IT Education and Development.

▸ **Singapore**: Review of developments from the first Singapore Masterplan for ICTs in Education in 1997 (MP1) to the transition to the second Masterplan (MP2) in 2002, including a range of multilateral support programmes, and the teachers' portal and resource site edu.MALL.

▸ **Thailand**: Review of ICTs in education, documenting the progress made by multiple agencies such as NECTEC and the Ministry of Education, the establishment and evolution of Thailand's SchoolNet from 1995 to 2003, and the role of organisations such as IPST in generating online content resources.

Abbreviations, Acronyms and Glossary

Abbreviations and Acronyms

APEC	Asia-Pacific Economic Cooperation
ASEAN	Association of Southeast Asian Nations
BECTA	British Educational Communications and Technology Agency
COL	Commonwealth of Learning
EMIS	Education management information systems
ICT	Information and communication technology
IPR	Intellectual property rights
ITU	International Telecommunication Union
JFIT	Japanese Funds in Trust
K–12	Kindergarten to grade 12
LoTI	Levels of Technology Integration (Framework)
NCREL	North Central Regional Educational Laboratory (USA)
NGO	Non-governmental organisation
NETS-T	National Educational Technology Standards for Teachers
OECD	Organisation for Economic Co-operation and Development
SEAMEO	Southeast Asian Ministers of Education Organization
STaR Chart	School Technology and Readiness Chart
SWOT	Strengths, weaknesses, opportunities and threats (analysis)
UNESCO	United Nations Education, Scientific and Cultural Organization

Indonesia

Pustekkom	Center for Information and Communication Technology for Education

Korea, South

EDUNET	Korean Educational Network
KERIS	Korea Education and Research Information Service

Malaysia

COINS	Corporate Information Superhighway
MDC	Multimedia Development Corporation
MSC	Multimedia Super Corridor
SSIS	Smart School Integrated Solution

SSMS   Smart School Management System

Philippines

DepEd   Department of Education
FIT-ED   Foundation for IT Education and Development

Singapore

EDB   Economic Development Board
ETD   Educational Technology Division (MOE)
ETRC   Educational Technology Resource Centre
IDA   Infocomm Development Authority
KRDL   Kent Ridge Digital Labs
MOE   Ministry of Education
MP1   Masterplan for ICT 1
MP2   Masterplan for ICT 2
NCB   National Computing Board
NCS   National Computer Systems
NIE   National Institute of Education

Thailand

CAT   Communications Authority of Thailand
IPST   Institute for the Promotion of Teaching Science and Technology
Linux-SIS   Linux Schools Internet Server
Linux-TLE   Linux Thai Language Edition
MICT   Ministry for ICT
MOE   Ministry of Education
NECTEC   National Electronics and Computer Technology Center
TOT   Telephone Organization of Thailand (now TOT Corporation)

Glossary of Terms

ADSL   Asynchronous digital subscriber line, Fast, always-on broadband Internet connection.
AUP   Acceptable use policy.
Bluetooth   A short range wireless connectivity standard used by mobile and handheld devices such as cell phones, PDAs, headsets and notebook computers.
Broadband   Internet connection faster than 200 Kbps (kilobits per second).
ccTLD   Country-code top level domain. Internet country domain code, such as .th for Thailand.

CD(-ROM)	Compact disk (read only memory).
CD-R	Writeable CD format.
CMS	Content management system.
Digital divide	Divide between those who and do not have access to the Internet.
DNS	Domain name system, which translates Internet domain names to IP addresses.
DSL	Digital subscriber line. See ADSL.
DVD	Digital video disk. High-capacity storage medium for digital video and data.
DVD-R	Writeable DVD format.
E-rate	Education rate. Discounted rates for telecommunications and/or Internet services for educational institutions.
Fat client	Workstation where applications are stored and run locally rather than on a server.
Firewall	System which provides protection against unauthorised intrusion, worms and viruses by blocking certain types of network traffic.
Free software	Software provided with source code and a licence which permits users to modify and redistribute the software under the same licence.
HTML	Hypertext markup language.
IANA	Internet Assigned Numbers Authority.
ICANN	Internet Corporation for Assigned Names and Numbers.
IM	Instant messaging.
IMAP	Internet message access protocol.
Information literacy	The ability to locate, evaluate, analyse and synthesise information from a variety of sources.
IP	Internet protocol. The underlying protocol used by systems on the Internet.
ISDN	Integrated Services Digital Network: telecommunications service providing fast digital dial-up connections to the Internet (up to 128 Kbps).
ISP	Internet service provider.
Kbps	Kilobits-per-second.
LAN	Local area network, connecting computers within a building or campus.
LMS	Learning management system.
Metadata	Structured information that describes an item of content or software.
MP3	A popular format for digital sound files.
Open source software	Software provided with source code and a licence which permits users to modify and redistribute the software (similar to free software).
Operating system	Underlying software layer which allows application software to be run on a computer or other device.
PC	Personal computer.

PDA	Portable or personal digital assistant
PDF	Portable document format. A platform-independent format for distributing documents.
POP(3)	Post office protocol. Popular method of accessing Internet e-mail from a server.
Proprietary software	Software which restricts access to source code and does not allow users to freely copy or modify the software.
RAM	Random access memory.
Server	Computer which provides file, printing or other services to other computers on a network.
SMS	Short message service used for text messages on GSM mobile phones.
SMTP	Simple mail transfer protocol. Internet protocol for sending e-mail between systems.
TCO	Total cost of ownership. All costs associated with deploying, operating and maintaining a computer network and applications.
Thin client	Workstation model which allows users to run applications on a server, rather than on the workstation itself.
TV	Television.
Unicode	System for representing language characters in international character sets.
URL	Uniform resource locator. Internet address format used for Web sites and other information services (e.g., www.unesco.org).
VCD	Video compact disc. A CD which contains digital video material.
VCR	Video cassette recorder.
VPN	Virtual private network. Network which runs on top of an existing network, providing additional security, addressing or management features.
W3C	World Wide Web consortium, which defines the standards used on the World Wide Web.
WAN	Wide area network, connecting networks over a large geographical area.
WiFi	Wireless fidelity, generic term for wireless networks using the 802.11 protocols.
workstation	Computer used by users to run applications and access network services (see server).
WWW	World Wide Web.

The Knowledge Society

Digital technologies have fuelled exponential growth in society's ability to generate, exchange and consume information. This has had far-reaching effects on economic and social organisation. The "knowledge society" is one where growth, development and innovation are driven by the optimal use of information and information products. In knowledge societies:

▸ The agricultural and manufacturing sectors become less significant, in favour of service and knowledge-based industries.

▸ Individual opportunity is greatly increased, with mobility being determined largely by education.

▸ Competition is greater, with enterprises being exposed to global competition and global markets.

▸ Co-operation is an important strategy for organisations and enterprises, in markets and societies with high levels of integration and interdependence.

The transition to knowledge-based economies is being driven by globalisation and the changing world economy. Developing countries in particular need knowledge-based economies not only to build more efficient domestic economies, but to take advantage of economic opportunities outside their own borders.

In the social sphere, the knowledge society brings greater access to information and new forms of social interaction and cultural expression. Individuals therefore have more opportunities to participate in and influence the development of their societies.

A knowledge-based economy [is] one in which the production, distribution, and use of knowledge is the main driver of growth, wealth creation and employment across all industries.[1]

What are ICTs

Information and communications technologies (ICTs) are technologies used to communicate and to create, manage and distribute information. A broad definition of ICTs includes computers, the Internet, telephones, television, radio and audiovisual equipment.

The ability for users to communicate, collaborate and exchange information online is especially important for schoolnets, and in this context ICTs typically refer to computers, computer networks and the Internet, and increasingly other devices that can be used as network or Internet access devices (such as hand-held PDAs and mobile phones).

ICTs and the Knowledge Society

Information and communications technologies (ICTs) are technologies used to communicate and to create, manage and distribute information. A broad definition of ICTs includes computers, the Internet, telephones, television, radio and audiovisual equipment.

The development of ICT will build an environment in which most knowledge is shared and more knowledge and information is created as the distribution of such knowledge increases.[2]

The ability for users to communicate, collaborate and exchange information online is especially important for schoolnets, and in this context ICTs typically refer to computers, computer networks and the Internet, and increasingly other devices that can be used as network or Internet access devices (such as hand-held PDAs and mobile phones).

ICTs are the key enabler of the knowledge society. Those who have easy and affordable access to ICTs and communication networks can participate fully, while those without have fewer opportunities, and remain trapped in pre-knowledge economy forms of economic activity.

The phenomenon of differential access to ICTs is often labelled the "digital divide." This is often assumed to be about the presence of ICT infrastructure and equipment. However, the ITU has identified three further drivers of ICT usage: language (ability to use

When the first national plan for ICT use in education was established [in Korea] in 1998, support was forthcoming from ministries due to the broad and mutually agreed understanding of the national vision, which was that ICT would be the basis for national growth in the future.[3]

Fifty per cent of Indonesians with a college degree are online compared to 0.5 per cent [of those] without.[5]

languages in widespread use on the Internet), literacy (specifically a culture of reading) and learning (level of educational attainment).[4]

Education is, therefore, one of the most important components in creating knowledge societies, economic growth and prosperity. Education is not only the means by which individuals become skilled participants in society and the economy, it is also one of the key drivers in expanding ICT usage.

ICTs in Education

Seen within the context of the transition to the knowledge society, the following are the broad reasons for developing the pervasive use of ICTs within education systems:

▸ **To develop knowledge-society attributes in students.** This includes the development of higher order thinking skills, life-long learning habits, and the ability to think critically, communicate and collaborate, access, evaluate and synthesise information.

▸ **To develop ICT skills and competencies in students**, as preparation for operating in an ICT-rich workplace and society.

Schooling traditionally stopped when work began. In the knowledge society it never stops.[6]

▸ **To address structural problems and deficits in education systems.** This can include using ICTs to enhance administrative and teaching efficiency, alleviate under-resourcing in specific areas (e.g., a lack of textbooks or learning support materials), address equity issues through enabling equality of access to knowledge, resources and expertise, or support teachers who may be under-equipped to deal with new teaching challenges.

Because of the wide-ranging potential impact of ICTs, they are often associated with radical rather than incremental transformation processes. ICT-in-education programmes benefit from a strong association with curriculum change processes and other system-wide changes such as moves towards decentralisation, school-based management and learner-centred philosophies.

What Countries Say About ICTs in Education

Malaysia
Malaysians [need] to make the shift towards a more technologically literate, thinking workforce, able to perform in a global work environment and use the tools available in the ICT age.

Korea
The demand for workers to develop an ability to innovate is increasing, and a lifelong education will be required as the average duration of an individual's working life increases. The demand for high-quality education is on the increase.

The goal of adapting education to the information age is to foster a competent person who possesses the professionalism, creativity and problem-solving abilities necessary for a knowledge-based society.

Thailand
E-education...aims to develop the mechanisms for effective educational policy and management, improve and develop the ICT infrastructure of the nation to enable education for all, promote and develop the potential of human resources at all levels, accelerate the construction of educational knowledge and information and provide more access to the knowledge and information.

ICT should be integrated across curriculum subjects as a tool for developing decision-making, higher-ordered thinking and communication skills.

Singapore
The drive towards the knowledge-based economy calls for a responsive education system that will prepare the workforce for creating, acquiring, disseminating and applying knowledge.

[The main role of the ICT Masterplan is to]...lay the basic foundation and disposition among students to learn how to seek out new information, think critically and show initiative to meet the challenges of a fast-changing world.

The primary motivation for integrating ICT in schools is the belief that it supports students in their own constructive thinking, allows them to transcend their cognitive limitations and engages them in cognitive operations that they may not have been capable of otherwise.

The Value Chain for Educational ICTs

For ICTs to deliver meaningful results in an educational context, a number of related elements need to be in place. These can be thought of as interlocking pieces in a jigsaw puzzle, or as a value chain. One description of these elements as a value chain is:

ICT education in elementary and secondary education involves a revamping of curricula, the development and dissemination of educational content, staff education and the creating of infrastructure conducive to ICT.[7]

▸ Preparing all sectors of the education system to understand the investment in and value of technology

▸ Preparing schools to accept the technology

▸ Procuring and installing the technology

▸ Training teachers to use ICTs

▸ Developing and managing digital content

▸ Integrating ICTs into the curriculum

▸ Providing ongoing technical support

▸ Providing ongoing curriculum support

▸ Undertaking continuous evaluation and research[8]

In essence, this means that implementing ICTs in education calls for a holistic, system-wide approach with investment balanced appropriately in different areas, and implementation elements smoothly integrated. If too many elements are missing or under-resourced, the investment is unlikely to be successful and cost-effective.

Some non-government organisations, corporations and corporate foundations prefer to simply parachute computers into schools and not worry about whether the ICT facilities they help build in the schools are instructionally effective and sustainable.[9]

What is a Schoolnet

Schoolnets promote the development of knowledge societies by connecting schools to the Internet, building connections among students, teachers and schools, sharing information and resources and supporting e-learning in online, networked environments.

Schoolnet initiatives operate at the interface between ICTs and education. This is how one of the first country schoolnets to be created, Canada's SchoolNet, defines itself: "SchoolNet readies learners for the knowledge-based society. It champions lifelong learning and the creation of world-class educational resources through information and communication technology (ICT) and partnerships."[10]

This is a characteristically broad definition. Schoolnet initiatives can in some ways be seen as vision-based initiatives, with ICTs and connected schools being the common means to an end.

Organisationally, schoolnets exist in a wide variety of forms. A schoolnet could be a programme located within a government department or ministry, a multilateral government initiative or a non-government organisation (NGO) or project.

The term "schoolnet" has become an internationally recognisable generic brand name, and as such has been used in a variety of different contexts by for-profit companies (in the US, UK and India), international foundations and projects (such as the Global Schoolnet Foundation) and regional schoolnets (such as SchoolNet Europe and SchoolNet Africa), supporting school networking activities in defined geographic areas.

For the purposes of this *Toolkit*, schoolnets should be understood as country-level programmes, government or non-profit, that have the objective of developing and supporting the use of ICTs in schools in a developmental rather than market-driven way. Schoolnets also often have a strong focus on building a community of practitioners with a membership of connected schools and/or teachers.

Why have a Schoolnet

Schoolnet initiatives usually arise from the realisation that there is a common interest that is not being adequately addressed by existing institutional structures. As ICTs typically evolve far more rapidly than individual institutions and education systems as a whole, this is to be expected.

In the early stages of ICT adoption, existing public institutions are generally poorly equipped to bring to fruition the advantage that ICTs can provide for

education. There may also be roadblocks of various forms, such as high connectivity costs, a need for more resources than are available or equity concerns such as a possible digital divide in public education.

Co-operation between ministries is essential when ICT use in education requires national support. One ministry is not good enough to implement the policy because developing the infrastructure requires not only the public sector, but also the whole power of private industrial support.[11]

Over and above the strong arguments for integrating ICTs into education generally, it is therefore often accepted that there should be a special, co-operative effort to develop ICTs in education in a structured way. This is important because ICTs in education:

▸ Have far-reaching impacts (e.g., on physical infrastructure, curriculum, teacher training, assessment and content development)

▸ Are complex and expensive, requiring the services and resources of multiple agencies for successful deployment and use (telecommunications companies, ISPs, content providers, school leadership, etc.).

ICT-in-education initiatives therefore work best when they are well-resourced and have a multilateral approach with the participation of a wide range of stakeholders and partners.

A schoolnet initiative becomes a recognisable focus and identity for such efforts, is an easily-marketable concept and reinforces the idea that ICTs have a transforming role to play, rather than being another "business as usual" process. Schoolnets can facilitate system-wide changes, broader than the mandate of any individual agency.

At a semantic level, the model of a network applies in several ways, from connectivity (networking computers) to fostering connections between schools, teachers and students (networking people). Schoolnets therefore also encourage the development of communities of practice and orient participants towards collaboration and co-operation.

[Canada's] SchoolNet, Computers for Schools and LibraryNet programs...have been important catalysts and facilitators, bringing together the complementary needs and resources of federal, provincial,

Schoolnets also make excellent sense as a reactive strategy to increasing ICT adoption at the school level. The risks arising from unco-ordinated and unplanned investment in ICTs are substantial. These include increased cost and lower efficiency, unsustainable solutions, educationally unsound implementation and vendor-driven solutions that may not be appropriate for the environment or may increase the total cost of ownership. A schoolnet programme can provide best practices, appropriate standards and strong, visible direction for ICT implementation, while not impeding grassroots innovation.

Where are Schoolnets Located

Schoolnet programmes exist in a number of different organisational forms, depending on a number of country-specific factors. Where schoolnets are located can be a function of the following factors:

‣ What funding and resources are available for ICTs in education

‣ The extent of support for ICTs in education by political and education leadership

‣ The political and government structure (the levels of government involved in education delivery and degree of centralisation)

‣ The extent and nature of grassroots activity

‣ Any particular opportunities and/or obstacles present

‣ Other initiatives underway related to ICTs in education

Schoolnets typically have slightly different roles and can achieve different things depending on their location and the extent of government involvement. The most common forms of schoolnet programmes are these:

‣ Educational technology units located within the Ministry or Department of Education (e.g., Malaysia and Singapore)

‣ Initiatives within other government departments or government-owned organisations (such as the original schoolnet programme in Thailand housed by NECTEC)

‣ Non-government organisations (such as the Pilipinas SchoolNet project run by FIT-ED in the Philippines).

In some cases, connectivity and educational services are separate (as in Indonesia where WAN Kota is a connectivity service, and edukasi.net is an online portal and educational content service). Schoolnet programmes that have large operational and service components also often provide these in conjunction with private sector companies. Table 1.1 outlines some of the characteristics of schoolnet programmes emerging from their location:

In practice, Schoolnet programmes typically evolve over time, in the best case leading to increased institutionalisation of educational ICT competencies and practices and different organisational structures as needs evolve.

Table 1.1: Schoolnet characteristics

	Advantages	**Disdvantages**
Schoolnet programmes within government	Can set policy, curriculum frameworks and make changes requiring official or legislative backing Can establish ICT vision and goals across entire education system Best prospects for long-term financial backing and sustainability	Slower to set up and slower to change Risk averse Can be impeded by cumbersome procurement processes and other government overheads Political requirements promote breadth over depth and all-or-nothing approaches
Schoolnet programmes outside government	Easy to set up on a small scale Innovative and can react quickly Grassroots, bottom-up approach responds directly to needs Easier to develop different types of partnerships and relationships with multiple players Advocacy role through small-scale pilots and demonstrations	Sometimes fewer resources available Can be dependent on donor agendas Process of institutionalisation within government can take longer Prospects for long-term sustainability uncertain

Schoolnets in Some Southeast Asian Countries

Korea
Korea established the Korea Educational Development Institute in 1988, which was later turned into the Korea Education and Research Information Service (KERIS). KERIS runs the country's EDUNET, which connects all of the country's schools through broadband Internet access, and provides information and portal services. EDUNET aims to:

▸ Provide an effective educational information network by integrating disparate educational information
▸ Construct the foundation for cyber education
▸ Construct an educational information database for ICT use
▸ Promote the utilisation of the Internet for effective educational services

Within the Ministry of Education, the Department of Educational Information Planning and the Department of Educational Information Operation oversee the development of ICTs in education.

Malaysia
In Malaysia, the Ministry of Education established the Smart School Pilot Project with the Multimedia Development Corporation and a consortium of private sector companies. The ministry's Educational Technology Division is responsible for ongoing development of ICTs in education, working with other divisions such as the Curriculum Development Centre.

Philippines
The Department of Education (DepEd) has an Education Technology Unit. There is a draft ICT Plan for Basic Education, which has not yet been formally approved. A number of different government departments have been involved in equipping computers with schools, including Education, Trade and Industry, and Science and Technology.

The non-profit Foundation for IT Education and Development (FIT-ED) runs Pilipinas SchoolNet, which has been piloted through the Coca-Cola funded Ed.venture project. The vision of Pilipinas SchoolNet is to build a network of schools throughout the Philippines that will leverage the Internet and related technologies to improve teaching and learning and to better prepare Filipino youth to meet the demands of the knowledge economy.

Singapore
In Singapore, the edu.MALL portal is one of the schoolnet initiatives established through the ICT Masterplan. Edu.MALL is an online network that connects educators, communities and resources in the use of ICT in education. It includes a learning resource centre, forum and professional development area, organised around the metaphor of a shopping mall.

Thailand
SchoolNet Thailand was initiated by the National Electronics and Computer Technology Center (NECTEC) in 1995, as a dial-up connectivity network. Content providers such as Kasetsart University and later schools and teachers contributed to the development of the Digital Library. SchoolNet Thailand is becoming part of EdNet, which is a national educational network set up by the Ministries of Education, Science and Technology and ICT with the objective of connecting all schools by 2005. The Educational Technology Center within the Ministry of Education is scheduled to form part of a new National Institute of Technology for Education.

What Enabling Conditions are Required

These are some of the enabling conditions for a successful schoolnet programme:

▸ **A supportive policy environment**. In the best case, there should be a clearly articulated rationale for the use of ICTs in education, linked to national economic and social development frameworks.

▸ **A multilateral approach**, with a willingness by all role-players to create working partnerships where required.

▸ **A receptive educational environment**. The Ministry or Department of Education, school management and teachers should be open to new ways of teaching and learning with ICTs and prepared to invest time and effort in implementing potentially far-reaching changes.

▸ **Adequate infrastructure in schools**: sufficient computers with good Internet connectivity (in turn depending on electricity and telecommunications services).

▸ **Sustainable operating costs**: the ongoing costs for connectivity, equipment maintenance and support should be affordable for individual schools over a sustained period, or there should be provision to cover these costs centrally in the long term.

▸ **Technical support**: It should be possible for schools to have technical problems resolved within a reasonably short period of time. Technical support services should therefore be accessible, affordable, responsive and effective.

▸ **A critical mass of connected schools and teachers**. There should be a large enough existing or potential user base to build effective online communities, achieve economies of scale and justify investment in resources such as online content.

If not all of the enabling conditions are present, schoolnets are unlikely to be able to achieve their objectives on a large scale. However, pilot projects on a smaller scale are often able to work around constraints using strategies such as "selecting for success" or working in urban areas where there are fewer infrastructure and technical support problems.

Given sufficient resources, the use of ICTs in education also often develops through "virtuous cycles" (e.g., developing online content builds demand for connectivity and hardware), which increases the number of connected schools, which in turn creates more demand for online content. The enabling conditions listed above should, therefore, not be seen as prerequisites to any investment in schoolnet programmes, but rather as necessary components to be addressed in a broad strategy.

What do Schoolnets do?

As noted above, the range of activities undertaken by schoolnets is usually shaped by the organisational form of a particular schoolnet. It may also be determined by the range of ICT-related services available in the marketplace and the maturity of the education market, with Schoolnet programs seeking to provide services not otherwise catered for.

These are some of the functions, activities and services provided by Schoolnets:

Technology services

▸ Connectivity services, acting as an Internet service provider (ISP) for schools, or facilitating partnerships with ISPs to connect schools at preferential rates (Schoolnets that act as ISPs directly sometimes establish their own network infrastructure, and/or operate as virtual ISPs, using network infrastructure of commercial providers.)

▸ Supplying equipment to schools (purchased through government funding, sponsored through donor or corporate funding, or donations)

▸ Domain registration, allowing schools to register individual domain names under an appropriate umbrella domain for schools (such as the sc.kr domain for schools in Korea)

▸ Web site hosting for schools

▸ Developing appropriate software solutions for schools (such as bundled Internet servers like the Linux-SIS Linux server for schools in Thailand)

▸ Providing technical support and help desk services

▸ "Complete solution" implementation (connectivity, equipment, networking, software, training and support, such as in the Malaysia Smart School Pilot Project)

Content services

▸ Portal sites to direct teachers and learners to appropriate Internet content (ideally organised and searchable by grade and curriculum area or subject)

▸ Content repositories to host locally developed online content

▸ Content development at a professional level (developed by content specialists) or grassroots level (contributed by practising educators)

Fostering communities

▸ Facilitating the development of learning communities, where educators can interact with each other to share experiences and provide peer support

▸ Creating and supporting virtual communities that interact through e-mail (using mailing lists), Web sites (Web forums or blogs) or other Internet technologies (e.g., instant messaging and audio- or videoconferencing).

▸ Running periodic face-to-face workshops or conferences on ICTs in education (such as the schoolnet conference in Korea).

Collaborative projects

▸ Facilitating the involvement of schools and students in collaborative online projects such as ThinkQuest

▸ Designing and running collaborative projects on a country level, either original projects or localised international projects (such as ThinkQuest Singapore)

Professional development

▸ In-service training of teachers on ICT skills and using ICTs in teaching and learning (curriculum integration)

▸ School management training on implementing, managing and supporting ICTs in a school

▸ Training in participating in schoolnet activities such as Internet-based collaborative projects, sharing resources online and participating in virtual communities

Partnerships

▸ Acting as an intermediary or bridge between various role players and stakeholders who share a common interest

▸ Facilitating investment in ICTs in education by corporate partners and donor organisations.

▸ Promoting industry partnerships, especially with the ICT industry, to expose schools to new and emerging technologies.

Experimentation, innovation and advocacy

▸ Conducting pilot projects across a range of environments and circumstances

▸ Developing and disseminating best-practice guidelines

▸ Advocating policy changes at various levels based on experience with pilot projects and best-practice knowledge

▸ Promoting and supporting innovation in the application of educational technologies

Curriculum and policy development

▸ Effecting changes in the education system that arise as a result of the introduction of ICTs in schools

▸ Contributing to ICT in education policy processes

▸ Redesigning the curriculum to leverage new teaching methods made possible by technology and to integrate ICTs into the curriculum (e.g., Singapore's MP2 initiative)

▸ Updating assessment processes to assess more accurately ICT-enabled learning processes

▸ Establishing competency frameworks for use of ICTs by learners and teachers

▸ ncluding ICT competencies in appointment and promotion standards for teachers

▸ Ensuring that ICT competencies are adequately embedded in pre-service teacher training courses
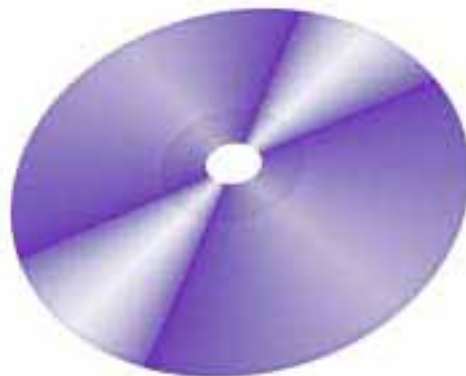
What is a Succesful Schoolnet

What are the key performance indicators for schoolnets? In some cases, quantitative measurements may be easy to apply. However, in many cases schoolnets perform the role of catalyst, helping to bring about change in a system. The results of such efforts are often indirect and seen in shifts of policy, improved understanding of ICTs, changes in budget allocations or revised curriculum frameworks.

In this sense, a successful schoolnet programme is one that has contributed to the transformation of a country and its education system towards a knowledge society. The categories below suggest some intermediate indicators that can be used to measure the progress of schoolnets.

Access and sustainable usage

▸ An increase in the connectedness of schools (i.e., the number of schools connected, the geographic spread of connectivity in urban and rural environments and the effective bandwidth available)

▸ Evidence of usage such as e-mail volumes and Internet traffic

▸ Sustainable usage: progressive increase of usage over time, extending beyond the lifespan of pilot projects

Institutionalisation

▸ ICTs in education are not seen as a special activity, but become integrated into all aspects of the core business of Ministries and Departments of Education and schools.

▸ ICT skills and competencies increase across the board.

▸ E-mail and Internet services are used to carry out official functions.

▸ Schools and teachers regard themselves as part of a broader network constituted by the schoolnet.

▸ Decision-makers are convinced of the value of ICTs, and there is high-level policy support.

▸ Curriculum revision processes are cognisant of new ways of teaching and learning with ICTs.

Content

▸ There is active use of digital content in classrooms and by learners, with ongoing development.

▸ Online content has been developed or adapted locally, with some content in local languages.

▸ Teachers and students contribute actively to expand the content database.

Community

▸ There are active online communities of teachers using ICTs. Educators provide peer support and derive professional benefit from their participation.

▸ Students establish and participate in online communities for both educational and social purposes.

Learning impact

▸ Learners show evidence of improved motivation and performance attributable to use of ICTs in learning programmes and participation in schoolnet activities.

Continuous improvement

▸ Periodic evaluation and feedback leads to continuous improvement in implementation practices.

Resources

▸ The development of multilateral and public–private sector partnerships, leading to greater resources being invested in ICTs in education from sources outside education line-function budgets

▸ The involvement of teachers, students, parents or the local community in supporting school ICT resources, through fees, fundraising or other activities, reflecting a sense of ownership and commitment

Examples of Schoolnets

Table 1.2 lists schoolnets in Southeast Asia, and Table 1.3 lists regional schoolnets.

Table 1.2: Schoolnets in Southeast Asia

Country	Schoolnet Name	Website
Indonesia	WAN Kota e-dukasi	www.wankota.org www.e-dukasi.net
Korea	KERIS EDUNET Schoolnet Conference	www.keris.or.kr/english/index-.jsp www.edunet4u.net www.schoolnet.or.kr
Malaysia	BESTARINet mySchoolnet	www.moe.edu.my myschoolnet.ppk.kpm.my
Philippines	Pilipinas Schoolnet at FIT-ED	www.pilipinasschoolnet.org www.fit-ed.org
Singapore	edu.MALLl	www.moe.gov.sg/edumall/
Thailand	SchoolNet@1509	www.school.net.th

Table 1.3: Regional schoolnets

Schoolnet	Website
Schoolnet Europe	www.eun.org
SchoolNet Africa	www.schoolnetafrica.net
ASEAN schoolnet	www.unescobkk.org/education/ict/v2/info.asp?id=10966

Further Resources

The Knowledge Society

"Towards Knowledge Based Economies in APEC"
November 2000, Report by Asian-Pacific Economic Cooperation (APEC) Economic Committee.
Available from *www.apecsec.org.sg/apec/publications/free_downloads/ 2000.html.*

Schoolnet Planning and Implementation

See Guidebooks 2, 3 and 4 for more detailed information on the topics in this Guidebook.

Planning Schoolnet Programmes

Introduction

This guidebook is for policymakers and high-level managers. It is written for readers in both government and non-government contexts.

The guidebook presents a set of planning recommendations and issues to consider in four implementation areas: curriculum integration, online content, teacher training and ICT infrastructure. It then looks at what to do next once a schoolnet pilot project is up and running, and then examines evaluation and assessment in more detail.

Assessing the Environment

Policy content

The policy context for information and communications technologies (ICTs) in education sets the stage for schoolnet programmes and determines how easy or difficult it may be to achieve results and how far-reaching those results may be.

Ask the following questions:

▸ Is there a national vision statement about becoming a knowledge-based economy or knowledge-society?

▸ Is there a national economic development framework?

▸ Is there a national policy or framework on ICTs for economic and social development?

▸ Is there a national policy supporting the use of ICTs in education?

It is also necessary to look at the integration between policy and planning:

▸ Is policy backed up by appropriate funding, capacity and resources?

▸ Are there any discontinuities between policy and implementation?

▸ Is national policy easily implemented by lower levels of government?

In the best case, there is supportive policy backed by funding commitment. If there is supportive policy without appropriate funding, or no relevant policy but an openness to ICTs, the policy context can be considered neutral. If the policy environment takes no account of ICTs and its application is inflexible, this may be an impeding factor.

The lack of a supportive policy environment could be a result of policy being somewhat reactive by nature, or it could be because there is still insufficient consensus among policymakers on the relative benefits of ICTs in relation to other basic priorities in education. Depending on the policy context, schoolnet programmes may need advocacy components to promote policy change. This could include proof-of-concept, prototype or pilot projects and research activities to establish baseline information, such as an audit of ICT facilities in schools or developing a set of ICT indicators to measure progress.

Schoolnet programmes should also clearly articulate their role in relation to national policy goals and broader development frameworks such as the Education for All and Millennium Development Goals.

Some Educational ICT Policy Frameworks in Southeast Asian Countries

Singapore
Singapore developed two successive Masterplans for ICTs in Education: MP1 and MP2. MP1 was launched in the same year as the vision for education, "Thinking Schools, Learning Nation." MP1 and MP2 were comprehensive plans which covered all aspects of ICTs in Education. As a country, Singapore had already institutionalised the drive towards universal access to ICTs, with the establishment of statutory agencies such as the Infocomm Development Authority.

Thailand
Thailand has a set of inter-related policies on ICTs in education and the broader economy. The 2001–2010 National ICT Master Plan includes an e-education component, supported by four other e-components: e-commerce, e-government, e-society and e-industry. The Ministry of Education's ICT for Education Master Plan focuses on the use of ICT as a major tool for education reform, consistent with the ICT strategies of the Ministry of ICT's ICT Master Plan.

Korea
The construction of an infrastructure to facilitate ICT use began in 1997 with the Three-Year Plan for the Construction of ICT Infrastructure (1997–1999). This was revised under the Comprehensive Plan for ICT Use in Elementary and Secondary Schools (1998–2002) in 1998, and followed by the Five-Year Plan for Education Development (1999–2003).

Following the provision of universal Internet access to schools by the end 2000, ICTs have been further developed in schools under the Second Stage Comprehensive Plan for Developing ICT Use in Education.

ICT infrastructure

At the most basic level, schoolnet programmes can only be operational insofar as the available infrastructure supports ICT-enabled activities. The essential ICT infrastructure components are electricity, computer and network hardware and software, telecommunications services, Internet connectivity and technical support.

Ask the following questions:

▸ What types of Internet connectivity are available to schools (e.g., DSL, satellite, wireless, fixed-line, ISDN or analogue dial-up)?

▸ How many schools have broadband Internet access?

▸ How many schools have dial-up Internet access?

▸ How many schools have computer labs?

▸ How many schools have telephone lines and electricity?

▸ Is Internet connectivity affordable enough to permit extensive use by schools?

▸ Are there any significant disparities in Internet connectivity (e.g., differences between urban and rural environments)?

▸ What are the major obstacles to greater Internet connectivity in schools (e.g., availability of service, operating costs or availability of computer equipment)?

Schoolnet programmes need to make strategic decisions in relation to ICT infrastructure in schools. For example, for which aspects of ICT infrastructure should the schoolnet be responsible, and what approaches will be most effective in increasing the spread of Internet connectivity?

The parameters of a schoolnet programme should be shaped by the extent of existing infrastructure and informed estimates of growth rates over three to five years.

Education environment

Schoolnet programmes may be easy or difficult to establish and institutionalise depending on the educational environment and openness to change.

Ask the following questions:

▸ How often does the education system undertake curriculum review processes, and are these processes open to incorporating new cross-cutting elements such as ICTs into all subject areas?

▸ Is there an openness to integrating ICT training components into existing or future in-service and pre-service training curricula?

▸ Does an existing organisational restructuring lend itself to providing for an ICT-based programme or unit, or can ICT-related responsibilities be integrated within all divisions within the ministry or department?

▸ In what ways can ICTs contribute to addressing existing problems in the education system?

▸ Are there existing problems in the education system or at schools that could obstruct the introduction of ICTs?

▸ Are leaders and senior managers in the ministry or department open to ICT integration?

▸ To what extent is decision-making decentralised?

▸ How much autonomy do school managers and teachers have to introduce and manage ICTs and integrate them into teaching and learning processes?

▸ Are school managers (principals and heads of department) open to introducing and leading the adoption of ICTs in schools?

▸ Are teachers receptive to new ideas and motivated to spend additional time and effort on ICTs?

Wherever possible, schoolnet programmes should be integrated or aligned with existing or new change processes. This will provide the best opportunities for ICTs to be used in a meaningful way in the education system, rather than simply being added on to a pre-ICT model of education. Where the education system is not already changing in response to new needs, schoolnets should consider promoting a broader education system change as a component of the programme.

Programme Design and Planning

Strategic planning

Schoolnet programmes should start with a strategic planning exercise: an environmental scan including the components outlined above, and a SWOT (strengths, weaknesses, opportunities and threats) or similar analysis.

Here are some factors to consider in deciding on a strategy, taking into account available resources, expertise and capacity, and external organisational and political dynamics. These may apply to the schoolnet programme as a whole or to individual projects within the programme:

▸ **Scale**: Is this a small or large project – a prototype, proof-of-concept, pilot project or mass rollout?

▸ **Risk**: Is this a high- or low-risk programme? Is there room for experimentation and trying out different models, or should the programme produce predictable, consistent results?

▸ **Equity**: Is there a concern that resources should be deployed to address equity imbalances, or be distributed equally among constituencies?

▸ **Breadth or depth**: In the short term, does the programme seek to involve the largest number of schools or teachers, or achieve more in fewer schools?

▸ **Cost-effectiveness**: Is it important that the programme be highly cost-effective?

▸ **Innovation**: Is it important to explore new approaches, or is the emphasis on implementing well-known best practice?

▸ **Time, cost and quality**: Which two of these three factors are most important?

▸ **Sustainability:** Is this a short-term, well-resourced activity, or does it need to be sustainable in the long term?

Many of the above factors are, of course, interdependent. For example, smaller projects may be more innovative and therefore have higher risk, favouring depth over breadth. On the other hand, if a small project is seen as a demonstration case for advocacy purposes, then it may be important to be low risk, and cost-effective. Larger projects attract greater concerns about equity, and it becomes harder to favour depth over breadth.

Project implementation

The next design issue to consider is the project implementation model. Traditional project management models start with detailed planning and then tightly manage implementation within the established plan. However, in contexts where there are higher levels of uncertainty or risk, it can be appropriate to use more iterative models which incorporate feedback frequently and allow the project plan to evolve continuously. Approaches such as action research or systems thinking models may also be appropriate.

Some Project Planning Models

Results-based management
Results-based management (RBM) is a "participatory and team-based approach to management designed to improve programme and management effectiveness, efficiency and accountability, that focuses on achieving defined results. Results-based managementÉintegrates the management of strategies, resources, activities and information about performance, with a view to improving effectiveness, efficiency and accountability, and achieving results. RBM can be applied in planning, monitoring, evaluating and reporting on any type of programme or management initiative."[1] For more information, see *www.unfpa.org/results/docs/rbmguide.doc*.

Logical framework approach
Logical framework is a project methodology originally developed for USAID. AusAID describes this approach saying, "The Logical Framework Approach (LFA) involves problem analysis, stakeholder analysis, developing a hierarchy of objectives and selecting a preferred implementation strategy. The product of this analytical approach is the Logical Framework Matrix (the Logframe), which summarises what the project intends to do and how, what the key assumptions are, and how outputs and outcomes will be monitored and evaluated."[2] For a detailed description, see *www.ausaid.gov.au/ausguide/ausguidelines/1.cfm*.

Systems thinking
Systems thinking emphasises the analysis of problems in a holistic way, looking at how many elements interrelate in a complex system. Systems thinking helps identify appropriate intervention points that are likely to have the greatest sustainable impact. For more information, see *The Fifth Discipline* by Peter Senge (Currency, 1994), and *Schools That Learn: A Fifth Discipline Fieldbook for Educators, Parents, and Everyone Who Cares About Education* by Peter Senge et al. (Doubleday/Currency, 2000).

Selecting schools and participants

If a schoolnet programme has a limited focus rather than being countrywide, there are several ways to select participating schools or teachers:

▶ **Select the best participants** (a "selecting-for-success" strategy): Environments are chosen in which the project is most likely to succeed or provide the best return on investment. This can include a competitive selection process, where schools or teachers are invited to submit applications to participate. The disadvantage of this approach is that it is "cherry-picking" – the easiest circumstances are chosen. Such optimal conditions are likely to exist in only a minority of schools, and the same implementation methodology may fail in more difficult environments.

▶ **Select a cross-spectrum of participants by various criteria** (e.g., urban and rural schools, primary and secondary schools, large and small schools): This creates the maximum diversity in the group of participants and optimises the learning potential of the project or programme.

▶ **Select the worst-case scenarios** (e.g., rural schools in poor communities which are under-equipped): This can serve equity goals by helping to level the playing field. It is also a strategy that can produce scaleable solutions: if a project succeeds in the worst-case environment, it should succeed in all environments.

Programme elements

An environment scan or baseline survey should reveal the existing educational ICT infrastructure and capacity in place and what the critical gaps are. Schoolnet programmes then need to define their activities and services in four core areas, each of which are discussed in more detail below:

▶ ICT infrastructure

▶ Professional development

▶ Curriculum integration

▶ Online content and software

Schoolnet programmes can be characterised as one of two types: push or pull programmes.

▶ **Push programmes** are like classical projects. They have a defined scope and outputs within a limited timeframe and budget. They are carried out with complete control over all of the elements needed to make them work, in a top-down way. For example, a push project might provide computers, technical

support, Internet connectivity, teacher training and some online content in a defined number of schools.

▸ **Pull programmes** usually contribute to developing an enabling and supportive environment for ICTs in education in an organic, demand-driven and evolutionary way. Such programmes attract participation, but are not necessarily concerned with all of the elements involved. For example, a project developing a repository of online content may not be concerned with connectivity or technical issues at the school level, although it may contribute to creating demand among schools for greater connectivity.

For push programmes, it is essential to include all of the required elements, appropriately linked (see the section on the value chain for educational ICTs in Guidebook 1). Failure to do so can put the success of the whole project at risk. Schoolnet projects are particularly susceptible to technical and connectivity failures, but all parts of the value chain should be given adequate attention.

Examples of Push and Pull Projects

Push projects

▸ The **Malaysia Smart School Pilot Project** selected 87 schools in which to implement the project. Technical and educational solutions were implemented and tested in the pilot schools with the intention that the Smart School model could then be applied to further schools.
▸ The **Philippines Coca-Cola Ed.venture Pilot** selected 15 schools through a comprehensive selection process that included assessing proposals from schools and site visits. The availability of telecommunications infrastructure limited selected schools to those in urban and peri-urban areas.

Pull projects

▸ **Singapore's edu.MALL** is an online education resource for all schools and teachers in Singapore. The education portal provides a range of information and services, including a learning resource centre, forum and professional development area.
▸ **SchoolNet Thailand** established a dial-up network to provide free Internet to all secondary schools in the country. The number of participating schools grew rapidly, from 40 schools in 1995 to over 4,000 in 2001.

ThinkQuest is a competition where students create educational Web sites. Any student at any school may enter so long as they form a team, identify a topic and have at least one adult coach.

Pull programmes, on the other hand, are more focused. Their success and the extent of uptake may depend on external factors (such as growth in connectivity or affordability), but their success is seen as adding incremental value, rather than as a complete end-to-end solution. Pull programmes should be aware of the impact of other elements on their operations, but need not explicitly address the entire value chain.

Schoolnet programmes may include both push and pull components. The choice may be influenced by the political and organisational culture. For example, push approaches may work well in well-resourced, strongly centralised systems, and decentralised heterogeneous environments may be better suited to pull approaches. In either case, effective use of ICTs in schools is dependent on all of the elements of the value chain being addressed in one way or another.

Project timeframes

Project timeframes should be in the range from two to five years, excluding planning time before the project actually starts.

Factors supporting longer time frames are the time taken to deploy technology in schools and the period of time taken for schools and teachers to fully integrate ICTs (estimated at four years by early research[3]). Equally, the rate of technology change means that technology planning over a period of more than three years risks being unreliable, and assumptions made at the outset of a project may become invalid.

Project evaluation should continue for at least one year after all project implementation activities have been completed.

ICT Infrastructure

Telecommunications services

Schoolnet programmes depend absolutely on accessible, affordable and reliable telecommunications services. In the best-case scenario, all schools should have access to broadband connections – defined as speeds of 200 Kbps or greater.

Some countries which have achieved universal access to broadband, such as Korea and Singapore, have even gone further to promote broadband connectivity by students at home. However, in many countries a significant number of schools will continue to have only dial-up access for some time. It is important, therefore, to ensure that schoolnet programmes cater for a range of bandwidth scenarios.

It is possible to substantially improve the connectivity position for schools through promoting a favourable telecommunications environment. Changes can be effected through legislation, relevant telecommunications regulations, licensing obligations for telecommunications companies or negotiation with telecommunications providers. There are a few specific issues to examine:

▸ **Universal access:** In countries with significant rural populations and underdeveloped fixed-line infrastructure, providing universal access to Internet services will require extensive use of satellite and terrestrial wireless connectivity. Making wireless and fixed-line services available at affordable rates may require regulatory reform and the licensing of multiple operators to create a competitive marketplace.

▸ **Flat-rate and distance-independent services:** Schools should be able to get Internet access for a flat monthly rate regardless of the school's geographic location. Metered pricing (with costs dependent on online time or traffic throughput) inhibits Internet usage, and distance-based costs create cost barriers for schools in rural areas.

From a global perspective, the positive effect of flat-rate pricing on Internet use is clear. The 2001 OECD 'Understanding the Digital Divide' study shows that metered rates have a serious dampening effect on Internet usage, which is 'just as important in determining the"accessibility of the Internet."

A recent economic study of 15 countries concluded that "other factors held constant, Internet subscriber penetration in countries with unmetered pricing is 31 per cent greater than in countries with metered pricing; and the time Internet subscribers stay online is 35 per cent greater in countries with unmetered pricing than it is in countries with metered pricing."[4]

▸ **E-rate**: Mechanisms to provide preferential tariffs for educational usage are known as e-rates. E-rates can be implemented as a special form of tax on telecommunications services which is then redistributed to beneficiaries (such as in the US), or as a legislative or regulatory requirement for telecommunications and/or Internet providers to provide discounted rates for certain categories of customers.

▸ **Obligations that promote universal access included in licensing conditions:** For example, companies that hold licences to provide telecommunications services can be required to meet certain targets for the connection of schools.

Some strategies can be used to mitigate the effect of limited bandwidth. Multimedia resources can be delivered to schools using datacasting (distributing data to multiple recipients through satellite broadcasting), or distributed on CD or DVD.

Making technology decisions

Schoolnet programmes need to carefully assess what extent they should become involved in providing technology solutions and services to schools. In general, schoolnets should focus as far as possible on the educational applications of technology rather than the technology itself. Schoolnets should, therefore, avoid supplying or operating commodity products and services (i.e., freely available on the open market) unless there's a compelling case to do so.

Here are the general principles to follow in making technology decisions:

▸ **Take a long-term, high-level view, observing trends:** Current trends include increasing bandwidth and ubiquitous computing (any time, anywhere). The Internet will increasingly be accessible using handheld devices (mobile phones, PDAs, tablet PCs) using wireless connections.

▸ **Adhere to open standards:** Open standards promote interoperability and platform-independence, which protect technology investments by making sure they will work in the widest range of environments, avoid reliance on a single vendor, and provide a degree of "futureproofing."

▸ **Adopt stable rather than cutting-edge technologies:** Technologies on the so-called "bleeding edge" tend to have higher implementation and support costs and change more rapidly than mature technologies.

Do not assume that the latest, and usually most expensive, technologies are necessarily what schools need. Match technology choices with curriculum goals, an assessment of the needs and present capacity of the school, and the level of resources that can be mobilised in support of the programme over the lifetime of the technology.[5]

▸ **Adopt appropriate and sustainable technologies:** Technologies should be suited to the task, affordable and easily supported.

Internet connectivity

Most schoolnet programmes have played a direct or indirect role in connecting schools to the Internet. In some cases, schoolnets originated as connectivity networks, and in other cases connectivity formed part of a larger solution or pilot project. The necessity for schoolnets to provide connectivity services may also change over time, as the country ICT sector develops.

There are several approaches to connecting schools:

▸ **Laissez-faire approach:** This is the default position where schools independently obtain connections to the Internet using commercial ISPs. This approach may be appropriate where there is a mature ISP industry with affordable and accessible services. However, it may promote inequities in access to Internet services, such

as favouring schools in urban environments where there are high densities of commercial users if local call-rate access is not available.

▸ **Managed free-market approach:** Schools independently obtain Internet connections through ISPs, but there is some element of centralised assistance or regulation (e.g., funding allocations to schools to pay for connectivity, legislated e-rates or agreements with telecommunications providers or ISPs).

▸ **Educational network:** Schools are connected through an educational network, which either operates its own infrastructure, or operates as a virtual ISP (i.e., using the network infrastructure of an existing larger commercial or non-commercial network). In some cases educational networks are centrally funded to provide free Internet services to all connected schools, and in other cases they operate on a cost-recovery basis where participating institutions pay for services.

Educational networks exist in a variety of organisational forms. In some cases, schoolnet programmes operate educational networks (as in Thailand), and in other cases, they are operationally separate. Educational networks can also exist at different levels, from national centrally funded networks (as in Korea) to smaller networks operated as co-operatives (such as the WAN Kota in Indonesia), facilitated but not directly managed by central government.

Educational networks are appropriate investments where there are sufficient numbers of schools to realise economies of scale, and an equivalent or better service can be provided at lower cost than using existing networks. Disincentives to creating educational networks may be high infrastructure costs, and the availability of the necessary skills to set up and run such a network.

School ICT infrastructure

There are many complex aspects to implementing and supporting school ICT infrastructure, which are explored in more detail in Guidebook 3 (Implementing Schoolnet Programmes) and Guidebook 4 (Schoolnet Practitioner's Guide). Here are some of the issues to consider:

Planning issues:

▸ Ensuring adequate physical infrastructure (buildings, electricity, security, furniture)

▸ Developing an integrated school technology plan, covering the educational, technical, training and financial aspects of using ICTs

▸ Establishing appropriate targets such as student-computer and teacher-computer ratios, and the percentage of curriculum (teaching) time that will involve student use of ICTs

▸ Establishing the total cost of ownership of ICTs

Technical issues (which often have educational implications):

▸ Use of new and/or refurbished or donated computers

▸ Network architecture: thin-client or fat-client networks

▸ Establishing a scaleable cabling and network infrastructure

▸ Software choice: proprietary or open source software

▸ Use of wireless networks

▸ Use of notebook computers

▸ Equipment maintenance options

▸ Technical support options

▸ Printing

▸ Physical layout of computer labs

▸ Distribution of computers: in labs, classrooms, or other locations

▸ Alternate technologies such as PDAs and handhelds

▸ Training for network administrators and end-users

(For more details on technical issues, see section "School ICT Infrastructure," in Guidebook 3 – Implementing Schoolnet Programmes).

Management and support issues:

▸ Access control

▸ Managing quality of service (especially Internet access)

▸ Information security (virus protection, Internet security, confidentiality, passwords)

The most important attributes of ICT infrastructure in schools are availability, reliability and consistency: ICT facilities should always be accessible and available, should always work and should always work in a consistent and predictable way.

Connectivity Models in Different Countries

In **Korea**, KERIS runs EDUNET, which provides free broadband Internet access to schools as well as portal and content services.

In **Singapore**, the first Masterplan for ICTs in Education (MP1) connected schools to the Internet through Singapore ONE, the national broadband network. The Ministry of Education worked in collaboration with the Infocomm Development Authority (IDA), creating the FastTrack@School programme to promote broadband access at schools and homes, as well as to encourage the development of interactive broadband multimedia technologies and content.

In **Malaysia**, the 87 schools in the Smart School Pilot Project were connected to the COINS high-speed network at speeds ranging from 128 to 512 Kbps (although it was found that the lowest speeds were insufficient to support the Smart School applications software and communications requirements).

In **Thailand**, SchoolNet provided free dial-up access to schools at local call rates through the Schoolnet@1509 network, run by NECTEC in partnership with the Telephone Organization of Thailand (TOT) and Communications Authority of Thailand (CAT). In 2004, the Schoolnet, MOE Net and higher education network UniNet will be merged into a single educational network called EdNet.

In **Indonesia**, dial-up access to the Internet is expensive for schools because local call rates are expensive, and there is limited availability of modems. A pilot project for edukasi.net, an online content site, involves 17 schools in co-operation with PT Telkom, Association of Indonesian Internet Service Provider (APJII), and School Information Network (JIS), and block grants have been made to a number of other schools for equipment and connectivity. To help solve the infrastructure problem, WAN Kota (wireless city WANs) are being established using the 2.4 GHz spectrum, initially in eight cities and now expanding to 30 cities, with between 10 and 40 schools connected per city.

In the **Philippines**, dial-up connections are still the most common mode of accessing the Internet. Although both fixed and wireless broadband capabilities are available via cable, DSL and satellite, the cost of these remains prohibitive for schools. The limited availability of fixed-line telephone service has become a major obstacle to the widespread use of the Internet in the basic education system. A little over half of public secondary schools do not have a land line, the majority of these schools being in rural areas. The concentration of ISPs in urban areas means that rural schools are charged long distance rates when dialing up to the ISP.

Curriculum Integration

The curriculum integration process

Curriculum integration can be simply described as using computers to learn, rather than learning to use computers ("use to learn, not learn to use"), or learning with and through computers rather than learning about computers.

Curriculum integration evolved as a response to the earliest computers-in-schools programmes, which emphasised "computer literacy," or technical knowledge of computers and competence in using applications. As an approach, computer literacy predates the World Wide Web, from an era when computers were much more likely to be standalone devices with far fewer capabilities than they have today.

Curriculum integration is about exploiting the ability of ICTs to add value to teaching and learning processes by integrating ICT-enabled activities into the curriculum. Such activities can include a wide range of ICT uses, such as:

▶ Using generic software packages (office applications, graphics and presentation packages)

▶ Using educational software for interactive learning, simulations and content mastery

▶ Using asynchronous and synchronous communication tools for online collaboration and information exchange (e-mail, Web forums, instant messaging, audio- and videoconferencing)

▶ Using the Internet as an information and research resource

Underlying pedagogical changes

Curriculum integration processes work best in environments where there has been or is a shift towards learner-centred, constructivist learning approaches. This set of changes has far-reaching implications for the role of the teacher and how the learning environment is structured, with increased use of group work and project-based learning, and more flexible use of classroom time and ICT facilities.

A fully integrated ICT programme may, therefore, be easier or harder to implement depending on whether the introduction of ICTs follows or precedes these general pedagogical shifts. ICTs can be seen as a catalyst for introducing new educational paradigms, or as a way of supporting changes already underway.

As the pedagogy shifts from being teacher-centred to being student-centred, the more necessary it becomes for the teacher to structure the learning experience by providing a framework, formulating guide questions, recommending web sites, and facilitating discussion.[6]

Curriculum Integration Processes in Some Southeast Asian Countries

Korea

Education for ICT utilisation is designed for a co-operative learning environment, rather than lecture-oriented learning. That is, students as a group search for various types of information over the Internet and actively produce and share the outcomes of learning by using the information they have found.

Singapore

Under MP1, ICT was integrated into all subject areas, as software and other ICT resources consistent with curricula objectives became available. Open tools such as word processing, spreadsheet and presentation packages were also used for all subjects, including mother tongue languages.

In these lessons, ICT was employed to facilitate the shift of learning from information-receiving to finding, collating and synthesising relevant information, and from learning to applying information to solving problems and communicating ideas effectively. The use of ICT also strengthened the teacher's repertoire of skills and opened up a wider array of learning resources for students to access. This provided a greater degree of independent learning, encouraging more able students to expand their horizons beyond the standard curriculum. The rich, interactive capability of ICT-based learning resources also motivated and engaged weaker students and allowed them to learn at an appropriate pace.

Philippines

The Pilipinas SchoolNet Coca-Cola Ed.venture Pilot is an ICTs and curriculum integration programme, and thus its main focus is on developing curriculum-based teaching and learning activities that effectively use ICTs. A further emphasis is on teacher-developed materials. Through a series of professional development workshops, teachers have been taught how to create structured lessons and projects in specific learning areas or projects that integrate lessons across different learning areas in the curriculum.

Specifically, teachers have been taught how to design online treasure hunts, Web quests, and tele-collaborative projects. These aim to develop higher-order thinking skills. The best tele-collaborative projects are those in which the students create their own knowledge products. In designing online treasure hunts, Web quests, and tele-collaborative projects, teachers are required to refer to the *Philippine Secondary School Learning Competencies Handbook*, the official guidebook to the national secondary school curriculum.

Developing ICT skills in students

When ICT enters the school environment, everything in the environment has to change to take up the opportunities and address the limitations of ICT.[7]

In the curriculum integration model, ICT skills are not taught to students as a distinct activity ("just-in-case" computer literacy), but are acquired "just-in-time," in the context of activity that is meaningful to learners.

ICT skills are also seen as encompassing a range of types of skills, from basic applications competence, such as the ability to send an e-mail message, to higher-order skills such as the ability to locate, evaluate, analyse and synthesise information from a variety of sources (referred to as information literacy). These higher-order skills apply across all curriculum areas and are sometimes articulated in national curricula as generic learning outcomes.

Mapping ICTs to national curricula

A core part of curriculum integration is the ability of teachers to choose appropriate ICT activities and resources for specific curriculum goals. This should be developed as a core competence of teachers.

However, this process can also be facilitated by developing guidelines, learning models for ICTs, and evaluating and categorising ICT content and software in a variety of ways such as by curriculum area and grade level.

Integrating ICTs in curriculum change processes

Given the close alignment between best-practice use of ICTs and pedagogical changes, ICTs should inform curriculum revisions at every level. This will ensure that ICTs provide maximum advantage to the education process, rather than being retrofitted to existing systems which often predate the information age.

Assessment strategies

Where teaching practices are changing substantially as a result of the introduction of ICTs, assessment practices need to follow suit. Assessment systems are usually the hardest components to change in education systems, as they may be related to examination and accreditation frameworks.

Singapore's second Masterplan for ICTs in education will redesign the curriculum to leverage new teaching methods made possible by technology and to fully integrate ICT into the curriculum. In contrast, under the first Masterplan, teachers mainly used ICT to support a given curriculum.[8]

Mapping ICTs to Learning Goals in Korea

As education for ICT utilisation is applied to all teachers, we have become more interested in how to effectively achieve teaching-learning goals by utilising existing educational content, rather than how to develop new educational content.

Accordingly, the plan for ICT use training programme development by subjects was undertaken in 2002. This plan seeks to document the teacher learning goals of the 10 common basic subjects from the Seventh school curriculum.

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

However, in many cases older assessment practices do not adequately measure the types of skills and competencies developed by students in ICT-enabled environments. This can produce skewed appraisals of the value of ICTs and inhibit the adoption of the learning approaches that hold the most value. Assessment strategies should, therefore, be revised along with curricula, and educators should be trained in new assessment processes as part of ongoing professional development activities.

The traditional paper-pencil-test method is not responsive to the instructional process that focuses on students' learning in which the students are required to practise higher-order thinking skills, and hands-on activities to construct knowledge.[9]

Promoting curriculum integration

Curriculum integration is a complex process which involves changes in many aspects of the education system. The following are the factors in the success of a curriculum integration strategy:

▸ Sufficient flexibility for schools and teachers to use appropriate ICT-enabled activities and learning resources to achieve curriculum goals as and when needed

▸ A basic set of application software

▸ Access to Internet connectivity and services

▸ Subject-specific software and content based on curriculum-needs

▸ Ability for teachers and schools to obtain new software and content as required based on curriculum needs

▸ Ability to change aspects of the classroom and school environment (e.g., timetabling)

▸ Alignment between curriculum goals and ICT activities

▸ Teacher training

▸ Updated assessment strategies

Some countries (including Singapore and Korea) have encouraged the curriculum integration process by setting targets for the proportion of curriculum time that should involve use of ICTs, ranging from 10 to 30 per cent. Of course, this depends on student-computer ratios that allow access to ICT facilities for the designated amount of time. In environments where student-computer ratios do not permit this, teachers can adopt alternate strategies such as combining online and offline work, and promoting group work where several students share a computer.

Setting Percentage-Time Targets for Using ICTs

Singapore
MP1 set out national standards for ICT infrastructure by 2002 as a guideline for schools. It envisaged that by then students would spend up to 30 per cent of curriculum time using ICT. To achieve this, 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 in order to achieve ICT-based learning for 10 per cent of curriculum time. Secondary schools and junior colleges were given an initial student-computer ratio of 5:1, enabling ICTs to be used for 14 per cent of curriculum time.

Korea
In every subject, more than 10 per cent of classroom activities are supposed to make use of ICT, and education in ICT utilisation should not be considered a special subject or as technical education.

Online Content and Software

The role of online resources

Providing online content resources is not an absolute requirement for schoolnet programmes to be successful. Many early schoolnets focused primarily on connectivity, assuming that the educational resources already available on the Internet would make the investment worthwhile. However, there are often convincing reasons to invest as much or more in content development as in connectivity and other areas:

▸ There may be language barriers preventing use of existing online content on the broader Internet (predominantly in English).

▸ There may be a lack of existing content in certain subject areas (especially where curricula have recently changed).

▸ Online content can support poorer or rural schools that have insufficient access to traditional content (e.g., print materials).

▸ Good online content resources increase demand for Internet access. This is a "virtuous cycle": as more schools become connected, it becomes more cost-effective to develop even more online content.

▸ Online content can change the dynamics of content production by encouraging content contributed directly by teachers.

Content and language

In many ways, the Internet is still a heavily English medium. In 2001, 69 per cent of content on the World Wide Web was in English, whereas just 36 per cent of Internet users were English (see Figure 2.1).[10] The ITU has identified language as an important component in information society readiness (i.e., a society's ability to use and benefit from ICTs).[11]

Countries with a large number of languages and a high language diversity (where few if any languages are shared by a large number of speakers) are at a special disadvantage when it comes to online content, as there is likely to be little online content available in minority languages, and there are fewer economies of scale for developing online content.

Some countries, such as Malaysia, have responded to this situation by seeking to improve English language proficiency among students. This strategy carries the risk that ICTs will reinforce the online dominance of English on the Internet, to the potential detriment of national languages and culture. It may, therefore, be important for countries in this position to develop focused content-development

initiatives in country languages for social and cultural reasons, rather than follow a more laissez-faire approach to relying on existing Internet content.

Figure 2.1: English Language on the Web

Internet users by language September 2002

English 36%
Chinese 25 %
Asian 25%
Italian 4%
French 4%
Japanese 9.7%
Spanish 7%
Other 16%
German 7%
Korean 4.5%

Web content by language 2001

English 69%
Chinese 4%
Asian 11%
Japanese 6%
German 6%
Korean 1%
French 3%
Spanish 2%
Other 9%

Source: ITU adapted from Global Reach, Global Research Institute[12]
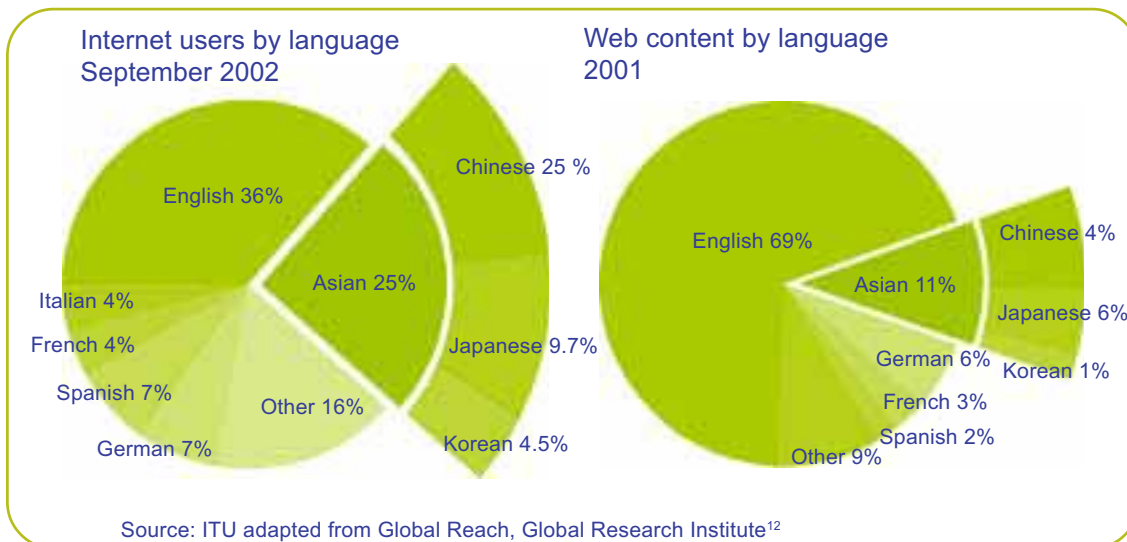
Responses to Language Barriers

Malaysia
The Internet offers a wide variety of materials in the English language. Ever since the government decided that the country needs to leapfrog into the ICT age and transform itself into a knowledge-based economy, there has been a general consensus that school-leavers did not have the necessary competency in English language. The ICT industry regularly urged the government to radically improve the standard of English language in schools and universities.

Although there was much public debate about increasing the usage of English language in the schools and universities, the cabinet did finally make the decision to use English to teach science and mathematics in 2002. Intensive training courses are underway to ensure that all science and mathematics teachers are fully equipped to teach these two subjects using the English language.

Thailand
SchoolNet@1509 needs good local content to attract teachers and students online. If left alone in the cyberspace dominated by English content, the language barrier will discourage most teachers and students from using the Internet. Therefore, it is essential to have Thai-language content with good educational value that is designed to help children do better in school.

Content, software and technology convergence

"Online content" is a broad term, which can be understood to mean educational resources in digital form that are accessible on demand. This could include a document, a digital video or audio clip, a Web page on a Web site or intranet, a multimedia encyclopedia or an interactive software application (such as a question-and-answer package, or a simulation game).

Over the last decade, technologies and standards have developed to the point where content and software is increasingly platform- and media-independent. For example, a video clip could be stored on a Web site on the Internet, on a school network server, or on a CD or DVD. Interactive educational software is migrating to environments such as Flash and Java, which allow the software to be used through a Web browser on almost any system.

This is a positive trend for education, as it means that there are many different ways to distribute and access content, and content can be repackaged and combined as required.

Indexing content

Schoolnet programmes can help teachers locate appropriate content resources by evaluating and indexing resources in various ways. Information about resources could include:

▸ Evaluation by a Ministry or Department of Education

▸ Feedback and evaluation from teachers or students

▸ Metadata about the resource, such as type of resource, grade level, and curriculum tagging to relate it to specific learning outcomes.

▸ Metadata to promote searchability, such as keywords and descriptions

This type of resource index can be hosted on a web-based portal, allowing online searching. The portal site may also act as a content repository to store some content, but would more commonly refer users to the online location of the resource, or where the resource is offline, provide ways for the user to order it.

Developing content

The process of developing ICT-based content can vary in complexity from simply moving static print-based content into digital forms, to developing interactive multimedia content requiring a range of instructional design, educational and technical skills. These are some common ways of approaching content development:

▸ **Inhouse development:** This may be appropriate where content development is a primary function of the schoolnet programme or institution housing the schoolnet activities. Moving into developing ICT-based content may require acquiring new skills, personnel or equipment.

▸ **Industry partnerships:** Private sector content developers can be encouraged and assisted to create digital content for schools. Ministries and Departments of Education usually have longstanding relationships with print publishers, and similar relationships should be developed for ICT-based content developers to help define requirements and ensure that content is aligned with the curriculum.

▸ **Localisation and customisation:** One form of industry partnership is working with software and content developers to localise and adapt educational resources for the local market. This could involve translation or other forms of adaptation to meet curriculum requirements. Global and local software companies are more likely to undertake such adaptations where there is a working partnership that will result in a viable market for the resulting products.

"Local development of ICT-based resources is crucial to support the curriculum. It increases the relevance and enhances the authenticity of the resources for the students and teachers."[13]

▸ **Grassroots content mobilisation:** Teachers and schools themselves are significant generators of educational content, such as lesson plans, templates, worksheets and sometimes more sophisticated products. Schoolnet programmes can mobilise this content by facilitating its distribution to other teachers through education portal sites or content repositories. A quality-assurance process based on formal evaluation or user feedback should be considered to keep the overall quality of the resources high.

Content and Software Development Initiatives in Southeast Asian Countries

Malaysia

As part of the Smart School Pilot Project, 1,494 courseware titles were developed for Bahasa Melayu, English language, science and mathematics. The content was in form of browser-based courseware, printed teachers' guides, student worksheets and exemplar lesson plans.

Indonesia

Edukasi.net is a learning site which is developed by the Center of Information and Communication Technology for Education, Ministry of National Education. Edukasi.net provides Web-based online learning materials for four subjects (physics, chemistry, biology and math) for senior secondary school and popular knowledge articles.

Thailand

Science, mathematics and ICT education materials for the school curriculum are developed by IPST and disseminated via the IPST Web site and its e-library. NECTEC commissioned Kasetsart University and IPST to develop content on the digital library for seven science, technology and engineering subjects as a part of SchoolNet's services to secondary school students. A $-based Digital Library Tool Kit has been designed to allow teachers with no knowledge of HTML to develop online lessons for students. The Digital Library now covers more than 7,100 subjects in 10 subject areas.

Korea

Up to 2001, public institutions had developed 6,454 items of educational content and the private sector had developed 3,724 items. Among the materials produced by public institutions, 102 items are defined as multimedia educational material, 95 as teaching-learning plans using ICT, 3,386 as teaching software and 2,871 as learning materials. KERIS has been authenticating educational software (produced by the private sector) since August 1998 to help consumers get reliable information on educational software and to provide developers with direction for software development and improvement.

Educational contests have been held since 1992 to encourage the development of educational software and to enhance teachers' interest in ICT use. The offices of education in cities and provinces hold preliminary contests in their districts and the contest is open to prospective teachers and students studying education in college or university.[14]

Singapore

MP1 set out strategies for acquiring and developing a range of software relevant to the local curricula objectives. Working with the Economic Development Board (EDB) and the National Computing Board (NCB), the Ministry of Education provided directions and specifications to ensure that the content developed was relevant to the school curriculum. EDB and NCB attracted leading global software houses to set up local operations and form links and consortia with local software developers. The focus was on developing high-quality software, especially in areas where suitable titles were lacking in the curriculum. These efforts have paid off and many locally developed educational software packages have been recognised internationally.

Professional Development

Educational ICT competencies

Pre-service training and inservice professional development programmes for teachers should be underpinned by a competency framework which defines the fundamental concepts, knowledge, skills, and attitudes needed for applying technology in educational settings.[15] Such a framework should go beyond computer literacy skills to encompass the ability to integrate ICTs into teaching and learning processes and adopt appropriate assessment and evaluation strategies.

Once such a framework is agreed upon at a national level, pre-service programmes can incorporate the required elements into teacher qualifications, and educational ICT competencies can be introduced as a requirement for new teachers being appointed into teaching positions. At an inservice training level, the set of educator competencies can be used both to inform and design schoolnet training programmes, as well as assess the suitability and value of training programmes being offered or run by commercial or non-commercial external providers.

An Example of an ICT Competency Framework

The International Society for Technology Education has developed the National Educational Technology Standards for Teachers (NETS-T), which defines performance indicators in six standards areas:

Technology operations and concepts
Teachers demonstrate a sound understanding of technology operations and concepts.

Planning and designing learning environments and experiences
Teachers plan and design effective learning environments and experiences supported by technology.

Teaching, learning and the curriculum
Teachers implement curriculum plans that include methods and strategies for applying technology to maximise student learning.

Assessment and evaluation
Teachers apply technology to facilitate a variety of effective assessment and evaluation strategies.

Productivity and professional practice
Teachers use technology to enhance their productivity and professional practice.

Social, ethical, legal and human issues
Teachers understand the social, ethical, legal and human issues surrounding the use of technology in PK-12 schools and apply those principles in practice.

Extracted from ISTE, http://cnets.iste.org/teachers/t_stands.html

Pre-service

ICT competencies should be thoroughly integrated into pre-service training courses to ensure that new teachers are equipped with appropriate skills when they enter the teaching system. Institutions involved in pre-service training should develop and update ICT components of their courses in consultation with the Ministry or Department of Education and the schoolnet programme to ensure that all of the require competencies are included and that there is a seamless transition from pre-service to inservice training for teachers.

In order to include ICT components in pre-service programmes, teacher training institutions may need to restructure or redesign courses, upgrade faculty skills and acquire additional ICT infrastructure such as computer labs.

Integrating ICTs into Pre-service Teacher Training in Singapore

The National Institute of Education (NIE) worked very closely with the Ministry of Education's Educational Technology Division (ETD) and schools to design the ICT component in the pre-service teacher education programme. It closely examined the vision, dimensions and strategies of MP1 before developing its ICT training plans for pre-service teachers. Four types of ICT courses for NIE trainee teachers were put in place for 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 into each curriculum subject class.

The foundation course focuses on hands-on ICT experience at the initial stage of pre-service teacher training. The course 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 on PowerPoint, Dreamweaver, Flash, Excel, Authorware and other applications for the trainee teachers during the term breaks and on Saturdays.

For the elective courses, more advanced ICT-based pedagogical principles and skill sets are offered. Examples include "Constructivist Learning with the Internet" and "Instructional Multimedia Design." Besides these courses, there is also an ICT component integrated into all subject areas such as mathematics, science, English and humanities.

For all these courses, students have the 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 has been used as 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 in the schools.

Planning principles for professional development programmes

Professional development programmes are discussed in more detail in Guidebooks 3 and 4. Here are some planning principles to consider:

▶ Teachers and schools take time to integrate ICTs fully into teaching and learning. Professional development for ICTs should be seen as a process of providing sustained, ongoing support, rather than a once-off training activity.

▶ Teachers should receive training and support for at least the first six months after the introduction of ICTs, and in the best case scenario for up to three to four years, or on a continual basis. Teachers should spend in the region of 30 to 100 hours per year in ICT-related professional development activities.

▶ Training and support should be needs-based and in an authentic context related to teachers' day-to-day teaching requirements. Use a variety of training and support methodologies, including face-to-face training, e-learning and mentor and peer support. Blended training models offer the best prospects for meaningful long-term participation by teachers.

▶ Training programmes should start with early adopters and champions and progressively expand to include all teaching and other school staff.

▶ As far as possible, training methodologies should model the ICT practices being advocated (keeping in mind the differences in learning styles between adults and children). For example, teachers should participate in an online collaborative activity as part of the training programme.

▶ A range of incentives should be in place to encourage commitment and completion. These can include certification and accreditation, improved promotion prospects and other recognition and reward schemes.

▶ Reliable ICT infrastructure (computers and Internet connectivity) and responsive technical support is particularly important during professional development programmes. Technical obstacles can quickly demotivate teachers and disrupt online learning communities.

Some Inservice ICT Training Programmes

Korea
Teacher training was encouraged by the guidelines for all teachers to receive ICT training at least once in three years. Their training history is counted when they file for promotion. ICT training was also encouraged for all staff, including principals and teachers of all school levels and subjects.

Singapore
An effective and continuous programme for training teachers in the use of ICT to achieve curricula objectives was central to the success of MP1. Every teacher was trained to handle ICT-based instruction and support new learning strategies among their students. A four-tier fan model was put in place to train teachers in every school in 1999. This approach generated a multiplier effect, enabling the sharing of expertise and experiences between schools. The heads of departments and teachers in the earlier phases who were selected as part-time instructors for other schools have had their teaching duties reduced by about one-third. The senior ICT instructors played the roles of the key trainers, mentors and co-ordinators for all schools during the planned implementation.

Malaysia
The inservice and pre-service training of teachers conducted by the ministry's Teacher Education Division concentrated on basic computer literacy skills, such as word processing, presentations, and spreadsheets. Basic ICT integration is also a part of the pre-service and in-service training, but these skills are not linked to effective participation in the Smart School Network programme.

The gap in the training of inservice teachers to participate actively in the Smart School Network will be addressed in the five-year ICT training plan to be managed by the Educational Technology Division.

Financial Planning

Investment rationales

Implementing ICT programmes on a large scale requires significant initial and ongoing expenditure. At the national government level, arguments in favour of such expenditure include:

▸ Developing a knowledge society, with social and economic benefits

▸ Improving the skills of entrants into higher education and/or the workplace

▸ Changing the mix of skills of school-leavers, particularly to improve performance in mathematics, science and technology

▸ Improving the efficiency of the education system as a whole

Private sector enterprises may choose to invest in ICTs in education for several reasons:

▸ As part of corporate social responsibility spending

▸ To help create new markets for ICT-related products and services

▸ As a marketing tool, to promote brand awareness and allegiance

▸ To contribute to creating a more skilled workforce.

In most cases, investing in ICTs does not lower the costs of providing education in absolute terms (e.g., it is seldom possible or desirable to reduce the number of teachers at schools), but may make the process of education much more cost-effective.

It is also often the case that the cost and efficiency benefits from investing in ICTs can take several years to realise, and much of the benefit is realised outside the education system; for example, companies benefit from more productive employees, and the economy as a whole benefits from increased global competitiveness. It may, therefore, be difficult to establish an affordable and appropriate level of spending on ICTs, given that the return on investment is distributed and hard to measure.

In situations where there is no substantive investment in ICTs and a laissez-faire approach prevails, ICT usage develops much more slowly and reflects existing distribution of resources and wealth among school communities. This raises equity issues with the prospect of worsening a digital divide in education, and longer-term economic issues of the cost of an outdated education system to economic competitiveness.

Balanced investment

Financial planning should always reflect the intended uses of ICTs in schools, and ensure that the correct types of investments are made to support an integrated implementation of ICTs which functions optimally (see the value chain concept outlined in Guidebook 1).

Balanced investment should in particular provide adequate resources for training and support functions, and for developing or customising online content. As a rule of thumb, spending on technology infrastructure should not exceed about two-thirds of a total budget for most infrastructure-oriented projects. In one example of an integrated project, the Malaysia Smart Schools Pilot Project, the proportion spent on technology infrastructure was significantly lower, at 16 per cent.

In making technology choices, decision-makers need to find the right balance between curriculum goals, levels of utilisation and available resources. For instance, if the goal of an ICT programme is merely the acquisition of basic computing skills...or, alternatively, if resources are not sufficient to provide the professional development opportunities and support services that are essential to the success of an ICT integration programme, then it might be more prudent to buy cheaper, less powerful computers and defer the installation of a local area network and Internet access.[16]

Spending Ratios in the Malaysia Smart School Integrated Solution (SSIS)

Teacher training	25%
Teaching and learning materials	23%
Smart School management system	8%
Technology infrastructure	16%
Training in the use of the various components of the SSIS	1%
Technical support services	4%
Project management, business process re-engineering, Systems integration	23%
Total budget	MYR 400 million

Special and integrated expenditure

In the initial phases of deploying ICTs in the education system, existing budgets seldom provide for the scale of expenditure required. ICT programmes are therefore often planned over an initial limited timeframe, with a special budget over and above standard annual budgets.

It may also be possible to mobilise unusual levels of investment from the private sector on the basis of a special effort to transform the education system.

Such special funding initiatives may be the only way to obtain support for the scale of investment required and to allow funds to be spent in a range of new ways that are not easily accommodated in line-item budgets. However, care should be taken to ensure that ICT expenditure does become effectively institutionalised. Special-case funding may only be a once-off possibility, and therefore create the window of opportunity for ensuring that once these resources are exhausted, ICTs have effectively become part of the line-item budgets of core functions.

At the beginning of the comprehensive plan for educational information [in Korea], KT donated a PC lab to every primary school in the nation, which was the biggest donation from the private sector for educational information. Now, the private sector's donation is minimal.[17]

Part of this process of institutionalisation could involve reallocating costs from non-ICT expenditure to ICT-enabled functions. For example, over time expenditure on printed textbooks should decrease in favour of electronic materials and online resources.

Cost of ownership

In a strict ICT sense, total cost of ownership (TCO) refers to all costs associated with deploying, operating and maintaining a computer network and applications. When applied to the education system, the total cost of ownership of ICTs can also be taken to include time spent training teachers on curriculum integration, for example.

TCO is important for financial planning and sustainability because budgets often do not fully reflect the total cost of ownership, and different elements of the total cost of ownership are often distributed through the system. For example, providing a school with computers introduces costs associated with technical support, ongoing telecommunications costs and staff training. The sustainability of an ICT project therefore depends on the total cost of ownership being affordable, and these costs being planned for by whoever will absorb them.

Comparisons of the cost-effectiveness of different solutions should always include the total cost of ownership. Operational budgets at a particular level may only include certain elements of the TCO, but should estimate the probable additional costs and ensure that these are understood and catered for across the system.

What is TCO?

Total cost of ownership *[is] a very popular buzzword representing how much it actually costs to own a PC. The TCO includes:*

- ▶ Original cost of the computer and software
- ▶ Hardware and software upgrades
- ▶ Maintenance
- ▶ Technical support
- ▶ Training

Most estimates place the TCO at about three to four times the actual purchase cost of the PC (see www.webopedia.com/TERM/T/TCO.html).

Comparing total cost of ownership

The total cost of ownership of a particular solution can vary widely from country to country. This is because TCO consists of a hardware and software component, the costs of which may be based on a foreign currency, and a services component, which is dependent on local labour costs.

Developed countries often have high labour costs, but the cost of hardware and software is relatively low. Developing countries usually have much lower labour costs, but may find that hardware and software is relatively much more expensive. This means that TCO should always be looked at in context.

For a discussion of the relative cost components of TCO and the relationship with labour costs and GDP, see the paper by Rishab Ghosh.[38]

Partnerships

Why enter into partnerships?

Schoolnet initiatives often involve a range of partnerships because of the broad implications and requirements of ICTs in education. Partnerships are working relationships in which two or more organisations collaborate to achieve an outcome which serves the goals of all parties.

Partnerships can be used to:

▸ Facilitate implementation

▸ Expand the total resources available

▸ Reduce the upfront investment required

▸ Distribute risk between multiple participants

▸ Obtain relevant expertise and experience

▸ Establish consensus about common goals and mitigate jurisdictional conflict

Facilitating partnerships can be seen as one of the major roles of schoolnet programmes.

The success of [Canada's] SchoolNet is a function of innovative delivery mechanisms which have involved provincial partners, and a wide range of other educational, business, and professional organisations...Partnerships and leveraging relationships can be viewed as the backbone of the SchoolNet initiative.[19]

Types of partnerships

Conducting the ICT policy in Korea with support from the private industries creates synergies, opening new markets for industries where they can test out the technology as well as the market. More than one- third of the whole population is related to education. Encouraging students to purchase individual PC at home surely expanded the IT market.[20]

Table 2.1 summarises different types of partnerships. Note that the table excludes direct contracting relationships, which are nevertheless very common.

Table 2.1: ICT Partnerships

Type of Partnership	Description	Examples
Intra-government partnerships	Collaboration between ministries, between levels of government, and with state-owned entities. These are important for co-ordination and for mobilising resources across various line functions.	Collaboration between Ministry of Education, Ministry of ICT and NECTEC in Thailand.
Government and NGO implementation partnerships	Partnership where the NGO implements ICT projects and/or support services, with funding from government or a third party (e.g., a company or development agency funder).	DepEd, FIT-Ed (Pilipinas SchoolNet), World Links and Coca-Cola in the Philippines
Donor partnerships	Funding relationship between a donor organisation and a government or non-government schoolnet programme, which contributes to meeting the strategic objectives of the donor.	JFIT and the ASEAN Foundation
Private sector partnerships	Provision of funding or in-kind resources from companies for: • Corporate social responsibility • Expanding markets • Marketing and brand awareness	Intel, Microsoft (worldwide) Coca-Cola (Philippines) KT (Korea)
Expertise partnerships	Involving the private sector, NGOs, in an advisory or consultative function.	Malaysia's Smart School project used consultants from the Multimedia Development Corporation and ICT companies.
Commercialisation partnerships	An agreement with a private sector entity where intellectual property that has been jointly developed can be exploited for commercial benefit. This can be done to reduce initial costs or for future royalty payments.	The Telekom Smart School company in Malaysia will be permitted to enhance and commercialise the Smart School Integrated Solution in exchange for royalty payments to the government.
Connectivity partnerships	Telecommunications providers and/or ISPs provide bulk services or bundled special deals at lower than market rates.	Telephone Organization of Thailand (TOT) and Communications Authority of Thailand (CAT) for Thailand's Schoolnet@1509
Community partnerships	Stakeholder and end-users are involved in the project's planning, implementation and maintenance.	Pilipinas Schoolnet worked with Parent-Teacher-Community Associations (PTCAs) to build ongoing financial support for Ed.venture centres.

Partnership guidelines

The strength of inter-ministerial collaboration is to draw mutual consensus towards ICT in education. In the Korean case, however, the support from other ministries was mostly moral support. If the collaboration was not done properly, it could have created tension among ministries – for example the Ministry of Information and Telecommunication could have overlapped with the Ministry of Education in the area of social infrastructure for ICT.[21]

The following are some guidelines for understanding and managing the pros and cons of partnerships:

Before entering into partnerships:

▸ Identify the common interests which form the basis of the partnership, and where interests diverge.

▸ Do a cost-benefit analysis of all the alternatives.

▸ Understand the impact of donations, especially in terms of indirect and operational costs that may be incurred.

▸ Balance the competitive interests of private sector companies with vendor-independence and open standards.

▸ Develop guiding principles on whether to enter into exclusive relationships with particular partners or not, which may determine whether it is possible to work with multiple partners who may be in competition with each other.

▸ Beware of establishing too many partnerships to achieve the same goal.

When negotiating or involved in partnerships:

▸ Clearly define the terms of the partnership, the respective contribution and responsibilities of all parties and exit strategies.

▸ Clarify working relationships between the parties.

▸ Be aware that maintaining partnerships needs ongoing effort.

While the government [in Thailand] has a strong intention and commitment to use ICT in all agencies, including in education, many plans have emerged to implement the government policy, with too many agencies involved in the same plan.[22]

Partnerships in Canada's Schoolnet

KPMG's evaluation of Canada's SchoolNet in 2000 identified partnerships as a critical component of the programme, saying:

"Tension between provincial and federal parties can be overcome when both are working towards a common goal, and when all parties are willing to offer resources while foregoing programme control at the delivery level. The presence of an apparent champion and a well-defined vision also ensure that the needed synergies are created and maintained.

▸ "The partnerships facilitated by SN are crucial to success of this endeavour and must be nurtured and maintained. Partners should be engaged at all stages of development and operations, and must be willing to be flexible and adaptive. The in-kind support from partners is as important as the cash contributions.
▸ "SchoolNet's partnerships require continuing direction and resources...to be sustainable over the medium to long term."[23]

Promoting Change

Change management

Introducing ICTs into the education system inevitably involves change. On a simple level, teachers and students need to become familiar with how to use new tools and do day-to-day tasks in a different way. On a more fundamental level, the availability of huge amounts of information and sophisticated communication tools has challenged many basic assumptions about education, and ICTs enable new paradigms of teaching and learning.

The larger the scale of an initiative, the more change management must be explicitly addressed in the planning process. Technology initiatives without sufficient change processes run the risk of functioning well at a technical level, but being underused or failing to achieve their true value.

There is extensive literature available on leading and managing change processes (see, for example, "The Eight Stage Process of Creating Major Change" from the book *Leading Change* by John Kotter). Much of this literature concerns change management in companies, but it applies equally to other complex enterprises such as schools and education departments.

Change Management in the Malaysia Smart School Pilot Project

The Smart School Pilot Project discovered that the pilot schools were initially making minimal use of the Smart School Network. Only the school ICT co-ordinator was using the network extensively to communicate with the Smart School Pilot Project Team and the help desk at the Ministry of Education. Change management activities had to be carried out to encourage school heads and teachers to use the network. Sessions were held with school heads and ICT co-ordinators, and it was established that e-mail could be used as an official means of communication between the ministry and schools.

The Smart School Pilot Project Team asked schools to develop their own change management plans, with activities for inhouse training, dissemination of information and co-ordination meetings. These change management plans were intended to be incorporated into the school's existing vision, mission and master plan.

Change management was considered a core part of the project, with 23 per cent of the total budget allocated to specialised services such as systems integration, project management, business process reengineering and change management.

The Eight Stage Process of Creating Organizational Change[24]

1. Establish a sense of urgency. Examine market and competition realities. Identify and discuss crises, potential crises, or major opportunities. ... Change won't occur where there is complacency.
2. Create the guiding coalition. Pull together a group with enough power to lead the change, and urge them to work together as a team. No one person has the credibility, expertise, or skills to provide the necessary leadership alone.
3. Develop a vision and strategy. Provide a vision that gives the change effort direction and motivates people...
4. Communicate the change vision. Use every vehicle possible to get the message out: big or small meetings, memos, company newsletters, formal and informal interactions. Communicate the vision in terms that will be understood in a five-minute discussion.
5. Empower broad-based action. Change those systems or structures that seriously undermine the vision. Emphatically encourage risk taking and non-traditional ideas, activities, and actions.
6. Generate short-term wins. Plan for visible performance improvements and early evidence that sacrifices are worth it. Recognise and reward people who make wins possible.
7. Consolidate gains and produce more change. Use increased credibility to change all systems, structures, and policies that don't fit together and don't fit the transformation vision. Reinvigorate the process with new projects, themes, and change agents.
8. Anchor new approaches in the corporate culture.

Champions and Leaders

Visible leadership is an important component of change management. Leaders can be champions of ICTs through their position in formal authority structures, but can also be found and encouraged at all levels, with peers leading by example. Champions are often "early adopters," open to new ideas and prepared to experiment.

Teacher champions need appropriate support and recognition and should be used as a resource to promote the adoption of best practice.

Teacher Champions in Thailand's SchoolNet

ICT teacher professional development programmes need champions to be role models of best practices in the use of ICTs in teaching and learning at all levels. These champions are dedicated people, and mostly motivated by the satisfaction gained from the improvement in students' learning. School principal champions whose ICT vision supports teachers' innovation are also needed.

However, these champions are not always sufficiently supported. For example, while teacher champions are invited to contribute to other schools or educational institutions to demonstrate their innovative projects to teachers in wider circles, their routine workload is still relatively high.

Their outside contributions are not considered as part of their workload, and this means such champions may not fulfil his or her workload requirement. This can lead to lost opportunities for promotion. The transfer of innovation to other classrooms within the same school is sometimes difficult. The support of the principal or peer teachers for this is essential.

Optimising Institutional Processess

Procurement

Examples of Private Sector Relationships and Procurement Models

In **Singapore**, the edu.MALL teachers portal was originally built through by a collaboration by the Ministry of Education, Kent Ridge Digital Labs and the National Computer Board. In 1999, maintenance and further development of the site was contracted to CHAPTER-E.com, the venture company of National Computer Systems (NCS) and Panpac Media.com.

In **Malaysia**, the Ministry of Education revised the normal tender process for the Smart School Pilot Project, issuing a concept request for proposals (CRFP) to enable the ICT industry to propose innovative solutions to deliver the benefits envisioned by the Ministry of Education. A selection and negotiation process reduced 25 initial proposals to two consortia, who formed a joint venture company comprising seven local companies and three multinational companies.

In **Thailand**, NECTEC avoided purchasing expensive server software by developing a Linux School Internet Server (Linux-SIS) as a cheaper alternative to be promoted and distributed to schools for schools ready to move beyond the first phase of Internet implementation. Since its introduction, Linux-SIS has been very popular in Thailand due to its excellent documentation in Thai language, its simple-to-install CD-ROM and its Web-based server management.

The way in which organisations procure goods and services can influence how schoolnet initiatives are implemented, for better or worse. Traditional procurement processes may not be well suited to the type of services required for an ICT project. These are some options to explore:

▸ Adapt or modify procurement processes. Rapid technology change means the horizons of what is possible are constantly expanding, and it may be difficult to define exactly what products and services one needs to procure for a given objective. Implement flexible procurement processes that leave room for innovation and make best use of private sector expertise.

▸ Consider a range of intellectual property models. In some cases it may be appropriate for a schoolnet or Ministry of Education to own all intellectual property developed by a private sector supplier. However, if reducing upfront

costs is important, models that permit subsequent commercialisation can be explored.

▸ Consider whether to procure services or products. In the area of software development and online services particularly, there are many models to choose from: outright purchase of software, hiring developers to customise or adapt existing packages, basing solutions on free and open source packages or using the services of applications service providers (ASPs).

▸ Consider what degree of risk is acceptable. Low-risk solutions may dictate older, well-understood technology that works reliably but has fewer capabilities than newer technologies.

Decentralisation

A related procurement issue is the extent of decentralisation: at what level are products and services acquired (school, district or region, or national), where are the funds located, and who has budget authority to incur expenditure?

There is a general trend towards school-based management, with management functions that were traditionally centralised moving to lower levels. School-based management and schoolnet programmes emphasising peer support models can promote decentralised decision-making for ICT services, which has the following advantages:

▸ Schools can purchase software, hardware, connectivity and support services as and when they need it, rather than fitting into a one-size-fits-all approach.

▸ Schools have different requirements and evolving needs based on their sizes, maturity of technology use and curriculum needs.

▸ Schools can quickly adopt new technologies and services, promoting innovation and experimentation.

▸ Decentralised decision-making promotes a sense of ownership and responsibility for future planning, leading to longer-term sustainability.

Decentralisation works well in environments where there is an effective marketplace: informed buyers and a range of good-quality, appropriate and affordable ICT products and services. However, in certain environments, these conditions may not exist. For example, rural schools often have poorer access to technical support than urban schools, or if there is a requirement for localised educational software, the software may simply not exist.

Thus there may be compelling arguments for centralising certain services, or central intervention to create the right products and services needed by schools. Centralisation is appropriate when it possible or desirable to:

▸ Leverage lower prices through bulk purchase

▸ Establish uniform quality of service standards across an entire system

▸ Ensure the provision of certain products or services that a competitive marketplace might otherwise not provide

▸ Provide universal service (e.g., Internet connectivity) through a central initiative at a lower total cost than if it were to be purchased by individual institutions

In most cases, centralisation trades off flexibility and responsiveness for greater efficiency, lower cost or the attainment of strategic objectives.

Centralisation and Decentralisation

In **Korea,** the regional education offices often purchase licences for school use annually, so that schools in the region can freely use software such as office packages, operating systems and multimedia tools. Each school also receives KRW 2 million each year (about USD 1,660) for purchasing educational software for their own unique needs.

In **Indonesia**, the problem of poor dial-up infrastructure is starting to be solved by using wireless networks. A number of WAN Kota (city WANs) have been established. Start-up costs are supported by grant funding, and the networks then operate as local co-operatives, collectively managed by the participating schools.

Adopting e-practices

As far as possible, schoolnet programmes should use ICTs in internal processes and external interaction, for example:

▸ Using e-mail and instant messaging for internal communication

▸ Using e-mail and Web sites for disseminating information to schools

▸ Soliciting feedback and responses from schools via e-mail and Web sites

Not only does this have efficiency benefits, but more importantly it models the ICT practices that schoolnet programmes seek to entrench in schools.

Education ministries and departments may need policy statements or changes to establish the validity and official status of ICT-based communications and protocols for handling electronic correspondence.

Education management information systems

While education management systems (EMIS) fall outside the scope of this handbook, it is worth noting that there considerable synergies with schoolnet programmes extending connectivity to schools.

ICTs can substantially improve the efficiency and speed of data collection from schools and reduce the amount of effort spent on administrative functions. As a change management strategy, ICT tools and systems that are of direct value to teachers in reducing administrative work or providing greater access to information can increase the adoption rate of ICTs by teachers.

Sustainability in Schools

What is sustainability?

In an ICT context, sustainability is the ability of a facility, project or resource to continue operating in a useful way over the long term. An ICT experts' discussion convened by the DFID Imfundo project described sustainable investments as "investments which continue to produce a return," where "return" is considered in a broad sense to include educational and social benefits. Sustainability is often used to refer to the extent to which computer facilities in schools continue operating after initial project funding or support has ended, but should also be considered more broadly to apply to the entire system of using ICTs in education.

Understanding sustainability

A number of different sustainability elements have been identified by practitioners in ICT for development and ICT for education sectors:

▸ **Economic sustainability**: the affordability of the solution and ability of a school to meet continuing operating, support and replacement costs

▸ **Social sustainability**: the extent of community involvement and acceptance of ICT facilities by end-users

▸ **Political sustainability**: leadership and policy support and the success of change processes

▸ **Technological sustainability**: long-term effectiveness of the technology infrastructure, including the extent to which it provides the needed services and can be extended when required

‣ **Educational sustainability**: an appropriate match between technology and educational goals, such that educational changes and benefits enabled by ICTs become institutionalised.[25]

Sustainability can also be understood in terms of the capital assets available in a school or community: human capital (skills and expertise), financial capital, social capital (the strength of relationship networks and institutional forces), physical capital (equipment and infrastructure) and content capital.[26]

Finally, sustainability can also be approached from the perspective of risk management. Projects are sustainable when all possible risks (e.g., skilled staff leaving or theft of equipment) have been assessed and strategies put in place to avoid them or mitigate the effects.

Capital Assets for Sustainability

Financial capital: mechanisms for (re)covering costs and replacing equipment (two separate issues)

Physical capital: obviously the technology is one of the keys, choice of technology may well be important, as will be the infrastructures which enable the technologies to operate.

Social capital: social and institutional arrangements that will keep the ICT being used for its intended developmental benefit.

Human capital: human resource training and skill development that not only keeps the ICT running but can plan future changes to the resources.

Content capital: the information communicated by the ICT seems to be one of the key capitals that prompt sustainability. If the information becomes out of date or irrelevant, then as this capital fails so too the whole "ICT project."[27]

Some Elements of Sustainability

Economic sustainability refers to the ability of a school and community to finance an ICT-enabled programme over the long term. Cost-effectiveness is key, as technology investments typically run high and in many cases divert funds from other equally pressing needs. Planners should look to the total cost of ownership...and build lucrative partnerships with the community to be able to defray all expenses over the long term. The need to develop multiple channels of financing through community participation ties economic sustainability closely to social and political sustainability.

Social sustainability is a function of community involvement. The school does not exist in a vacuum, and for an ICT-enabled project to succeed, the buy-in of parents, political leaders, business leaders and other stakeholders is essential. Innovation can happen only when all those who will be affected by it, whether directly or indirectly, know exactly why such an innovation is being introduced, what the implications are on their lives, and what part they can play in ensuring its success. ICT-enabled programmes must ultimately serve the needs of the community. Thus community-wide consultation and mobilisation are processes critical to sustainability. In short, a sense of ownership for the project must be developed among all stakeholders for sustainability to be achieved.

Political sustainability refers to issues of policy and leadership. One of the biggest threats to ICT-enabled projects is resistance to change. If, for instance, teachers refuse to use ICTs in their classrooms, then use of ICTs can hardly take off, much less be sustained over the long term. Because of the innovative nature of ICT-enabled projects, leaders must have a keen understanding of the innovation process, identify the corresponding requirements for successful adoption, and harmonise plans and actions accordingly.

Technological sustainability involves choosing technology that will be effective over the long term. In a rapidly changing technology environment, this becomes a particularly tricky issue as planners must contend with the threat of technological obsolescence. At the same time, there is the tendency to acquire only the latest technologies (which is understandable in part because these are the models which vendors are likely to push aggressively) Generally, however, planners should go with tried and tested systems; stability issues plague many of the latest technologies. Again, the rule of thumb is to let the learning objectives drive the technology choice and not vice versa—the latest technologies may not be the most appropriate tools for achieving the desired educational goals. When making technology decisions, planners should also factor in not just costs but also the availability of spare parts and technical support. [28]

Educational sustainability: Are the pedagogical changes generated by new technology consistent with the evolution of curricular content? Will they survive turnover among faculty? Or will they evaporate in the face of the very next technological wave? [29]

Revenue generation

Financial sustainability may depend on a school's ability to pay for running costs, technical support and hardware and software upgrades. Schools may pursue one or more of the following strategies to fund ICT costs:

▶ Making provision for ICT costs in the school's operating budget.

▶ Charging an additional levy to parents or students over and above school fees for ICTs.

▶ Generating income by using a computer laboratory to run training courses for the local community, or as a telecentre or cyber cafe.

▶ Fundraising from businesses or the local community.

Sustainability and equity

Appropriate conditions for sustainability, especially financial sustainability, are often regarded as a precondition for deciding where to deploy ICT facilities. Projects may select schools with the best prospects for sustainability, as a way of getting the best return on investment.

This approach produces a policy dilemma. As Cisler observes, in many situations the external environment may be the limiting factor on sustainability, and schools as individual institutions may be unable to meet sustainability criteria:

In regarding universal access to education as a basic right, the sustainability of educational technology should therefore be considered across the entire education system, rather than as a problem always to be solved at school-level.

Some practitioners in developing countries have reacted to demands for financial sustainability by pointing out that many places do not have enough people with money to spend on the needed services. Some countries have a large rural population living in poverty. The low population density and lack of market indicate that if the projects are important that does not mean they are sustainable without external help. Some see that outside donors are temporarily filling in by supporting a basic function (the right to communicate) that should be paid for by the state.[30]

Planning for sustainability

Pitfalls in Aligning ICT Solutions with Curricula

In the Malaysian Smart Schools Pilot Project, the Ministry of Education insisted on a one-to-one matching of the courseware with the curriculum specifications because of teachers' insistence that anything that departs from the curriculum would not be useful in the classroom.

As a result, when the curricula for all four subjects were changed in the middle of the Pilot Project, the courseware that was installed in the schools no longer matched the curricula. The so-called mismatch became one of the main excuses for teachers not to use the Smart School courseware.

Planning for sustainability is expensive and involves prioritising long-term benefits over short-term savings. Here are some planning principles for promoting sustainability:

Financial sustainability:

▸ Plan and negotiate for sustainability upfront. In externally funded projects, there is an expectation that there will be a transition from project funding to costs being covered by government funding, community funding or revenue generation. In government-funded projects, there may be a transition from national to regional or school funding, or school revenue generation. The contributions and expectations of all parties and relevant timeframes should be defined clearly.

▸ Ensure that the total cost of ownership is accurately estimated and understood.

▸ Develop a clear funding strategy: who will meet which cost elements, and how.

▸ Ensure that any assumptions about revenue generation are realistic.

Technical sustainability:

▸ Choose appropriate technologies that are stable and easy to support, with affordable operating costs.

▸ Avoid vendor lock-in and high switching costs by adopting open standards.

▸ ICT architectures should be vendor neutral.

Educational sustainability:

▸ Plan projects around educational goals rather than technology goals.

▸ Focus on broad and generic applications of ICTs, emphasising higher-order thinking and cognitive skills, information literacy and transferable skills, rather than applications that are too narrow or specialist. ICT resources should be aligned with the curriculum, but not to the extent that they become too easily invalidated by curriculum change.

Social and institutional sustainability:

▸ Establish a strong sense of ownership at all levels.

▸ Build ICT management and planning capacity in schools.

▸ Ensure a level of redundancy in staff and equipment.

▸ Encourage entrepreneurial partnerships for revenue generation

Broadening and Extending Schoolnet Impact

Responding to growth and change

Schoolnet programmes that have been operating for a number of years may find themselves coping with exponential or very large growth, or there may be sticking points which are difficult to get beyond. The external environment may have changed, and the global Internet will almost certainly have changed and developed.

Schoolnet programmes should therefore periodically assess why, what and how they carry out their activities, for example every three to five years. This process should be informed by as much evaluation and research data as possible.

Identifying the key drivers and constraints

Changing society from traditional to modern technology is not without resistance: the fast-moving will encounter obstacles and hurdles. The commitment of the country's leader is critical to support the movement through to its intended outcomes.[31]

Growth drivers are factors that contribute to expansion in Internet connectivity or usage of ICTs. For example, in technology history, personal computers became widespread with the availability of so-called "killer applications" such as the word

processor and spreadsheet, and the World Wide Web grew rapidly when its commercial applications were developed.

Growth drivers in education may include the availability of local language content online, effective teacher training, reliable infrastructure or applications that make it easier for teachers to do their day-to-day jobs. In addition, the "network effect" means that technologies such as e-mail and the Internet become more useful the more people are connected.

Typical constraints include high access costs, low Internet bandwidth, a lack of technical expertise or support, no telecommunications facilities or financial or other sustainability problems. Growth drivers and constraints should be seen as the most strategic intervention points for promoting increased usage.

Scaling up

"Scaling up" means the process of implementing solutions on a large scale that previously have been implemented on a small scale. However, while it is sometimes true that pilot projects are small versions of larger projects, there is a lot of evidence to suggest that large projects require a different level and type of planning than do small projects.

In scaling up a schoolnet programme when the financial resources are available to do so, ask the following questions:

▸ Can existing network infrastructure be expanded to cope with larger numbers, or is a different type or quality of infrastructure required? For example, moving from an urban to national network may require new types of connectivity such as satellite and wireless.

▸ Is there an adequate skills base and support infrastructure to support larger numbers of schools and teachers?

▸ What cost elements are likely to change between small-scale and large-scale implementation? For example, pilot projects may have been intentionally well resourced at a level that is unsustainable with larger numbers, or economies of scale in larger projects may increase efficiency.

▸ What impact will large-scale implementation have on the education system as a whole?

▸ What institutional arrangements may need to change or evolve? For example, small projects may be run on an experimental basis by an institution which does not have the mandate or resources to support larger projects.

How Schoolnets Have Developed

Thailand

SchoolNet Thailand was started by NECTEC in 1995 as an extension of the Thai Social/Scientific, Academic and Research Network (ThaiSARN) network. The number of schools connected increased from the initial 50 to 152 in 1998. SchoolNet was then merged with the Kanchanapisek Network to create a large-scale nationwide IP network for schools, with access at local call rates from anywhere in the country. By December 2001, over 4,000 schools were participating.

In 1998, the SchoolNet Content Development project created the Digital Library and Digital Library Toolkit to develop online content in the Thai language, and promoted participation in collaborative projects such as GLOBE and ThinkQuest.

Throughout SchoolNet's development and expansion, NECTEC has successfully acted as an incubator for the programme. The Ministries of Education, Science, Technology and Environment, the Transport and Communications have all become involved, along with other organisations contributing in specific areas, such as Kasetstart University and IPST (content), Telephone Organization of Thailand and Communications Authority of Thailand (connectivity), and Rajabhat Institutes (teacher training).

Singapore

The first Singapore ICT Masterplan (MP1) was implemented from 1997 to 2002. MP1 equipped all schools with computers and broadband Internet connectivity, including teacher training and facilitating content development. The second ICT Masterplan (MP2) is planned from 2003, with three main goals:

▸ To redesign the curriculum to leverage new teaching methods made possible by technology and to fully integrate ICT into the curriculum (rather than mainly using ICT to support a given curriculum)
▸ To move from a teacher-centred pedagogy when using ICT to a student-centred strategy
▸ To allow schools greater autonomy and flexibility in using ICT funds, unlike the current "one-size-fits-all" approach

MP2 is therefore extending and deepening the pedagogical changes made possible by MP1, with increased emphasis on flexibility, content and curriculum issues, and research in the use of ICTs in education.

Korea

The construction of an infrastructure to facilitate ICT use in schools began in 1997. It was accelerated in 2000 by the President's New Year's Message, and the Comprehensive Plan for ICT Use in Education was completed by the end of 2000, with 10,000 schools countrywide equipped with computer labs and Internet connections. The plan was co-ordinated by the Ministry of Education and Human Resources Development, in collaboration with other ministries and with substantial support from the private sector. A new body was created in 1998 to run EDUNET, the Korea Educational Development Institute, which later became the Korea Education Research and Information System (KERIS).

In the second stage of ICT Use in Education, the Ministry of Education and Human Resources Development seeks to promote information literacy by using ICTs constructed in the first stage. The main task of the second stage is the development of educational indicators, as it is expected that evaluating the level of ICT use in education will lead to self-regulated development and continuing quality management. To this end, the government is promoting co-operation among ICT research institutes and strengthening collaboration with international organisations.

Promoting institutionalisation and building capacity

Institutionalisation takes place when a set of activities becomes fully integrated into the core business of an institution, in this case the Ministry or Department of Education. Institutionalisation is an important process for schoolnet programmes for the following reasons:

▸ It allows new systems and practices to become widely adopted and supported.

▸ ICT-related expenditure starts being built into normal operating budgets rather than funded as a special case.

▸ It reduces over-dependence on a small group of skilled people.

However, care should be taken so that institutionalisation does not compromise the underlying value of ICTs. For example, the introduction of ICTs leads to new forms of teaching and learning, which should then lead to the curriculum itself evolving. At an organisational level, ICTs can enable flatter, less hierarchical organisations which are more dynamic and responsive, and apply knowledge management practices to make better use of their human capital. Institutionalisation should therefore be considered along with opportunities for institutional transformation.

Institutionalisation requires:

▸ The support of key decision-makers

▸ Acceptance of the relationship of ICTs to the institution's core business and a common understanding of what needs to be done

▸ Appropriate capacity (people and skills)

▸ Adequate resources (primarily financial, i.e., budget provision)

▸ Agreement about where various responsibilities are located (i.e., who should do what)

Building capacity may be particularly difficult. Smaller projects are relatively easy to resource because only a few experts are needed, and people who have multidisciplinary skills can be chosen. Larger projects require:

▸ More capacity (more people of equivalent skill level)

▸ Capacity in areas previously unaffected by ICTs

▸ New working relationships between people of different specialisations (e.g., curriculum designers and technology experts)

Evaluation and Assessment

Why evaluate?

Evaluation is an important part of any initiative, but especially so in the field of ICTs, where there are many unknowns about how best to apply technology, and the technology itself is involving very rapidly.

Evaluation can vary in extent from retrospective evaluation at the end of implementation phases (summative evaluation) to early and periodic evaluations that help shape conceptual understanding and influence the way implementation is carried out (formative evaluation). In the best case, there should be a continual cycle of planning, implementation, reflection and refinement.

At a strategic level, evaluation is often carried out to:

▸ Assess, adjust and improve implementation strategies

▸ Demonstrate value in order to motivate for further funding or resources

▸ Promote accountability to funders and public

▸ Understand the cost-effectiveness of ICTs, particularly what level of investment may be warranted

▸ Document and share best practices

▸ Establish the extent of progress towards national goals and policies

▸ Benchmark activities and progress against other countries

▸ Promote institutionalisation, a sense of ownership and continuing quality management

▸ Embed lessons learnt in policy

▸ Establish future direction.

ICT Indicators

Many evaluation methodologies can be applied to projects or initiatives, including case studies, interviews, field observations and analysis of different types of data. A structured approach to evaluating ICT use is to develop and apply a set of ICT indicators, which may include both qualitative and quantitative indicators, covering a range of technological and educational aspects of ICT use.

Research by SEAMEO-INNOTECH on ICT indicators in a range of countries[33] has shown quantitative indicators usually include ICT infrastructure and connectivity. Common indicators used for measuring or determining ICT infrastructure include:

▸ Availability of computer hardware, ratios of computers/student, computers/ classroom, computers/teacher, type of computers (standalone, multimedia in network)

▸ Availability of connectivity, bandwidth and type of connection

In evaluation studies, indicators are used as evidence or signs by which we can assess or evaluate materials, methods, an intervention, a programme or a project. Indicators are measuring devices. They define concepts in terms of the measurements and data it is possible to collect and analyse. They define what data to collect and at what time intervals.[32]

Qualitative indicators applied include:

▸ Acquisition of desirable ICT skills

▸ Students who had positive views about technology activities in schools

▸ How much learners think they have improved in various activities

▸ Development of practical, foundational and reflexive competencies

▸ Teachers agreeing that telecommunications technologies can enhance learning and teaching

▸ Teacher confidence in the use of ICTs

▸ Change in teaching methods

▸ Impact of computers on educators and learners

▸ Factors that encourage telecommunications use

▸ Barriers to computer related activities[34]

When ICT indicators are being used to determine the effectiveness of a schoolnet programme (rather than natural or organic growth in ICT usage), it is essential that a consistent set of indicators is applied periodically and related to the activities of the schoolnet programme. Baseline data should be recorded before the start of the programme.

ICT Indicators in Southeast Asian Countries[35]

The development of indicators in the region follows three paths:

▸ Ministries of Education or the government set up task forces or committees to take charge of developing indicators measuring the use and impact of ICT in education.
▸ The vision and goals of the ICT programme serve as basis for the formulation of ICT indicators.
▸ The impact of the use of ICT in education is determined through surveys and research and thus serves as basis for the formulation of national indicators.

In **Korea**, the Ministry of Education and Korean Educational Research and Information Service (KERIS) have formulated and used a set of indicators, categorised into support, input, utilisation or output. The support indicators include training hours given to teachers and principals, budget allocation, the year plan and incentives for teachers. Input indicators consist of the ratio between computers and students, Internet connectivity and speed, educational software and the number of applications used. Utilisation indicators include subjects using multimedia, the percentage of classes using a Web board or computer labs, the percentage of teachers joining ICT associations and discussion forums, student usage of computers and use of the Internet. Output indicators include teachers and students having an e-mail address, a home page and ICT certificates and students having completed a 32-hour ICT course.

In **Malaysia**, the creation of the Smart School System serves as benchmark for ICT integration in schools. Some of the initial proposed indicators are both quantitative and qualitative. They focus on the use of ICT in curriculum, in pedagogy, in assessment and materials. The quantitative indicators include decreased drop-out rates and recorded achievement gains each year, while the qualitative indicators include caring and competent teachers and a broad, flexible curriculum that caters to the differing needs and abilities of students.

In the **Philippines**, SEAMEO-INNOTECH conducted a national survey to profile the ICT capabilities of elementary and secondary schools in the Philippines. Indicators include the existence of an enabling environment, the computers skills of school personnel, the presence of computers in schools, instructional or academic use of computers, ICT infrastructure and Internet connectivity.

In **Thailand**, initial use of indicators through a survey included Internet connectivity in schools, the computer:student ratio, uses of ICT in schools and school administration and connection to SchoolNet. A committee has been formed to concentrate on formulating indicators to measure the impact of ICT use in schools.

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

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

Self-assessment tools

There are a number of self-assessment tools that are designed to be used as a reflection and planning tool at the school and community levels. Such tools can form part of school technology planning processes and can also be integrated into teacher professional development programmes.

Self-assessment tools can promote evaluation and assessment throughout a system, so that continual reflection and improvement become shared values, rather than top-down activities.

Well-known self-assessment tools include enGauge, the STaR Chart, and the LoTi Framework (see boxed text below).

Some Self-Assessment Frameworks and Tools

*EnGauge, a new Web-based framework developed by NCREL in the US (*www.ncrel.org/engauge*/) addresses three significant questions: What value does technology bring to the schools? How can our schools ensure a return on these investments? And why does technology work in some schools and not in others?*

The enGauge *Online Assessment is designed to provide a system-wide view of a school's and/or district's use of technology for teaching and learning. The online assessment comprises surveys for nine different school community stakeholders. Once an* enGauge *project has been set up and survey participants have taken the surveys, several types of reports or profiles are generated.*

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

The **LoTi Framework** by Christopher Moersch describes levels of technology implementation on a scale from 0 to 6, focusing on the use of technology as an interactive learning medium. There is an accompanying online diagnostic tool designed to assess each participant's level of integrating computers and technology with classroom instruction via the LoTi Framework.

Adapted from www.unesco.org/bangkok/education/ict/unesco_projects/JFIT/sitanalmet.htm

Macro-economic indicators

In planning evaluation frameworks, the national context beyond the education system should not be neglected, even though it may be significantly more difficult to establish direct relationships between macro-economic conditions and the performance of the education system.

On the input side, ICTs in the education system may be largely constrained by the extent of the ICT sector in the country as a whole. Indicators in this area may be useful in the process of benchmarking performance against other countries. Possible indicators for comparison include:

▸ Access to telecommunications services, as defined by teledensity (telephone lines per 100 people), and availability of broadband services (measured by organisations such as the ITU)

▸ Internet penetration: total country international bandwidth, number of Internet subscribers.

Output indicators should look at the extent to which ICTs in the education system are contributing to a knowledge society and increased economic competitiveness. Intermediate indicators could include:

▸ Entrants into the job market have better skills in desired areas

▸ More students entering higher education and improved performance

At a broader level, a number of frameworks have been developed to assess the capacity of countries to exploit the opportunities offered by ICTs. These include the Network Readiness Index (NRI)[36] created by the Center for International Development (CID) at Harvard University, and the ITU's Digital Access Index.[37]

Over a sustained period (for example five to 10 years), it should be possible to draw connections between the extent of ICT integration in the education system, and such macro-economic country attributes.

Planning guidelines

Here are some planning guidelines for evaluation and assessment components:

▶ Plan upfront for evaluation. Before the implementation phase of the schoolnet programme starts, develop a conceptual framework, and identify evaluation partners and agents. Collect baseline data from participating schools or individuals, and decide on what data will be collected during the project, by whom and when.

▶ Evaluation should cover as many aspects of the programme as possible: pedagogical, technical and financial. Indicators should be developed to measure adoption, diffusion and impact on learning and measurement tools designed accordingly.

▶ Situate the evaluation within well-established literature on education research, learning theories, management theories and ICT research to provide the study with multiple perspectives.

▶ Ensure that perceptions are aligned with the project objectives and that there is agreement on what constitutes success or failure.

▶ Define the expected relationship (if any) with existing national standardised tests. For example, is it anticipated that ICT use by students will lead to improved results on certain existing tests, or is the educational technology component primarily aimed at producing different types of outcomes?

▶ Allow some open-ended investigation in the evaluation: explore aspects of ICT use that may be unexpected or unpredictable.

▶ Interpret and analyse evaluation findings to inform pedagogical practices and policy planning and implementation. For teachers or principals, the findings can be used as a start-up kit or guidebook in the integration of ICTs. For policymakers, the findings may provide a better idea of how education policies facilitate or constrain the integration of ICT in schools.

▶ Regularly communicate evaluation priorities, activities and outputs to all participants.

▶ Document emerging best practices for others.

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www.lotilounge.com

Implementing Schoolnet Programmes

Introduction

This guidebook is about establishing and running schoolnet programmes. It mostly looks at operational "how to" questions rather than the "who, why and what" questions, which are discussed in Guidebook 2 – Planning a Schoolnet Programme.

This guidebook, therefore assumes, that your planning has considered, in broad terms, the following:

> ▸ The national education and ICT policy context
>
> ▸ Existing telecommunications and ICT infrastructure
>
> ▸ The receptiveness of the education environment to ICTs
>
> ▸ The objectives of the schoolnet programme
>
> ▸ The organisational form of the schoolnet programme
>
> ▸ What activities and services the schoolnet will provide
>
> ▸ How the schoolnet will be funded and resourced
>
> ▸ How the outcomes of the schoolnet programme will be measured and evaluated

You can then focus on the specific chapters below that will be most helpful.

Starting Schoolnets

Starting a schoolnet programme

The time and effort involved in starting a schoolnet can vary from a simple founding meeting to establish a co-operative or association of schools to complex processes involving multiple stakeholders and funders that can take years to complete.

There is no easy answer as to which is the "right" process – it all depends on the local context. In some cases it may be useful to launch a small but visible project quickly, which can nevertheless expand rapidly in due course if there is a sustainable growth model. In other cases, there may be opportunities to harness more resources and achieve a bigger initial impact, but the consultation and planning processes will necessarily take longer.

Starting a schoolnet should involve the following steps:

1. Identify a project leader for the start-up process – someone who takes responsibility for developing the schoolnet from concept stage to when it becomes operational.

2a. Establish the ICT situation in schools, and the most pressing needs.

2b. Locate the schoolnet programme within the national policy context. Set out the envisaged benefits and how the schoolnet will contribute to national educational, economic and social development goals.

3a. Build support and buy-in for the schoolnet by consulting with key stakeholders and constituencies.

3b. Define the parameters, scope and mandate for the schoolnet programme.

4a. Explore and develop all of the opportunities for funding and resources – from government, the private sector, local and international donors and development agencies, schools and school communities.

4b. Plan the schoolnet activities and services in detail. Identify the initial pilot projects and what they will involve. Develop a business plan for the schoolnet over the next three years.

5. Build the schoolnet infrastructure. Put in place any legal foundations or contractual agreements, create the institutional home for schoolnet operations (whether a new entity, or within an existing organisation), recruit and train staff, and set up any required technical infrastructure.

6. Implement schoolnet projects, activities and services.

Figure 3.1: The schoolnet start-up process
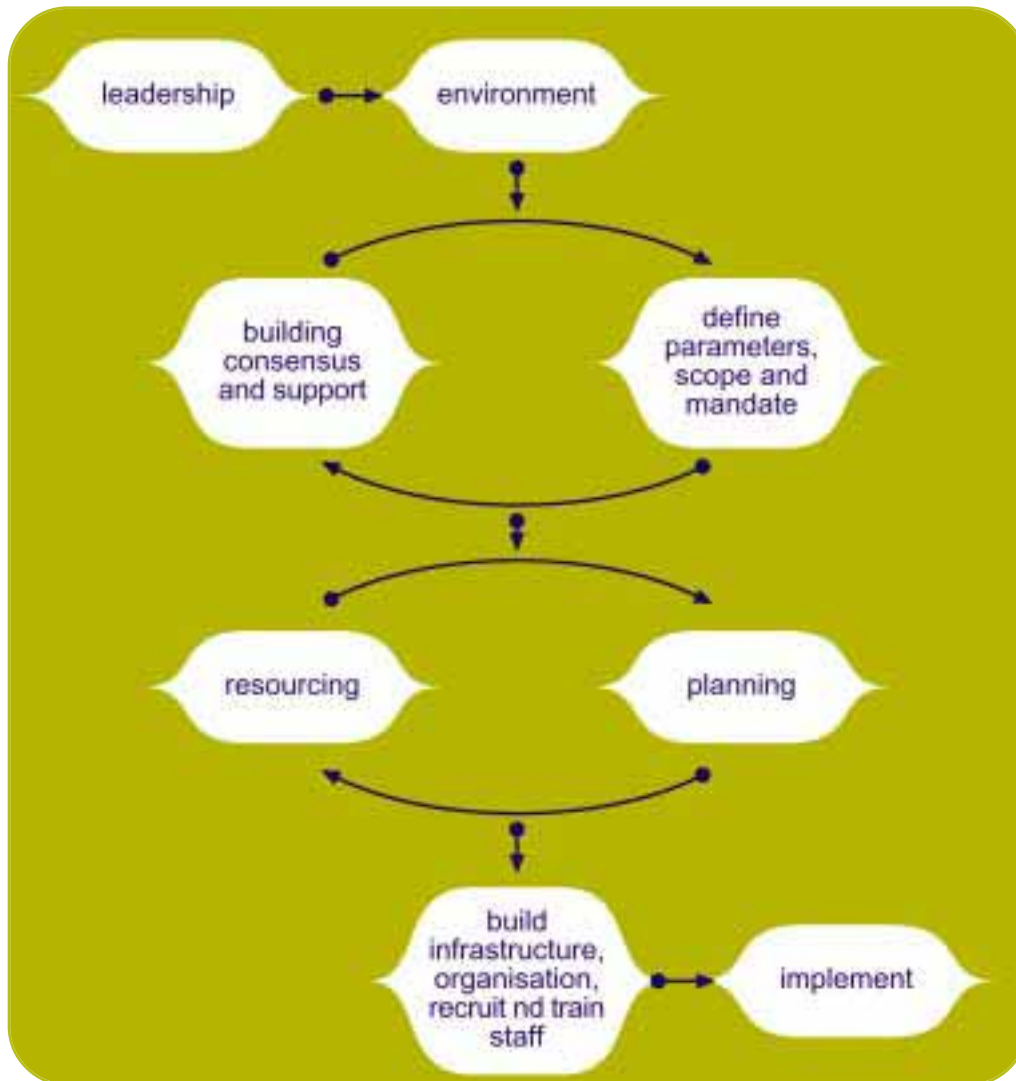
Government-initiated schoolnets

Schoolnets that are initiated within government departments should ensure the following:

▸ Determine which other departments and government or government-owned agencies should be involved.

▸ Resolve any jurisdictional issues that may arise (e.g., between levels of government).

▸ Define the roles and responsibilities of all parties. Establish what resources will be contributed by whom, and which budgets will fund various activities.

▸ Establish co-ordination and communication mechanisms between the various departments and agencies involved.

▸ Establish the nature of relationships between government and outside organisations. For example, will the private sector be involved as contractors and consultants, or as contributing partners? How can expertise in the NGO and development sectors be used? How will donors and development agencies be approached?

Schoolnets Started by Government

SchoolNet Thailand was initiated in 1995 and run by NECTEC, the National Electronics and Computer Technology Center. NECTEC is an autonomous body within the Ministry of Science, Energy and Environment.

NECTEC viewed itself as an incubator of SchoolNet Thailand rather than its owner, and as SchoolNet Thailand has grown and matured, various functions are in the process of being transferred to the Ministry of Education.

The Smart School Pilot Project in Malaysia was initiated by the Ministry of Education with the Multimedia Development Corporation. A consortium of private-sector companies was appointed to implement the infrastructure and services, overseen by the Educational Technology Division within the Ministry of Education.

Schoolnets initiated outside government

Schoolnets started outside government structures can ensure a smooth pathway for their establishment and growth by liaising closely with Departments of Education and other government departments and agencies. Government approval of or involvement in schoolnet initiatives may also be a requirement of external funders.

The larger the size and scope of the planned schoolnet, the more this will be necessary. Departments of Education will usually seek to ensure that the proposed initiative is in the best interests of schools, fits within existing policies and procedures, does not duplicate or conflict with other initiatives and responds in some way to the government's perception of the most urgent needs.

Schoolnets need to consider the following:

▸ What sort of government involvement is required? Is it sufficient for government to be aware of the proposed schoolnet, or is there potential for government to be an active partner?

▸ Will explicit permission is required for certain activities (e.g., training teachers, or placing computers in schools)?

▸ Who is likely to be involved from government (which ministries, departments or divisions), and at what level of government (national, provincial/state or local)?

▸ What are the likely consequences for government and schools (e.g., do schoolnet projects entail schools or Departments of Education committing staff, funds or time in any way)?

▸ Is government involvement essential for the long-term sustainability of the initiative? If so, what strategies can help to promote government involvement and institutionalisation?

A Schoolnet That Started Outside Government

Pilipinas Schoolnet forms part of the non-profit Foundation for Information Technology Education and Development (FIT-ED), which was established to "increase IT awareness in the Philippines and to contribute to the effort to enable Philippine society for the Information Age."[1]

FIT-ED is active in several areas, including policy development, promoting connectivity and establishing partnerships. Pilipinas SchoolNet focuses on connectivity, training, and tele-collaboration. Its vision is to "build a network of schools throughout the Philippines that will leverage the Internet and related technologies to improve learning and to better prepare the Filipino youth for the demands of the knowledge economy."[2] Pilipinas Schoolnet's Web site is at www.pilipinasschoolnet.org.

The schoolnet life cycle

In many ways, starting a schoolnet is the easy part! Once schoolnet programmes are up and running and have demonstrated some successes in a few schools, they face the bigger, harder questions such as these:

▸ How can one achieve impact on a large scale?

▸ How can seemingly intractable problems such as poor telecommunications infrastructure be overcome?

▸ What needs to be done to institutionalise ICTs through the education system?

▸ What is the real educational impact of the schoolnet, and how can this be measured?

▸ Is the schoolnet programme financially sustainable in the long term (over five to 10 years)?

Changes in the external environment also constantly impact on schoolnets. Technology evolves rapidly, and over time technologies and services such as Internet connectivity become well understood, commodity items. To remain relevant and vibrant, schoolnets should:

▸ Evaluate projects on an ongoing basis, using feedback to improve and evolve implementation strategies

▸ Track educational and technology change, particularly technology innovations, new ways of using technologies and technologies gaining mass appeal

▸ Move up the value chain, concentrating less on basic services such as connectivity (once these are widely available at an acceptable quality and cost) and more on value-added and specialist services such as professional development and content localisation or adaptation

▸ Periodically introduce new types of activities, both online and offline

▸ Build and expand the virtual network with increasing numbers of schools and relationships with other schoolnets and national and international organisations involved in educational ICTs

▸ Build a strong sense of ownership by stakeholders, particularly teachers and students.

From time to time, schoolnets may also reflect on whether the job they set out to do has been done. Some milestones are clearly achievable (e.g., providing universal connectivity to schools), and a schoolnet's own efforts may be overtaken by market forces and growth in the ICT industry. However, where a schoolnet's core vision is about promoting innovation in education, each new technology change brings new opportunities for reinvention and pushing the envelope.

Resourcing and Planning Schoolnets

Funding sources

Resourcing and planning schoolnets are in some ways two sides of the same coin – available funding and other resources determine the extent of activities, while at the same time the activities planned inform budget requests and funding proposals. At a minimum, the process therefore entails the following:

1. Defining plans and activities with a provisional budget and costing of services

2. Submitting budget requests, funding proposals and exploring other resource partnerships

3. Revising plans and activities based on available resources (committed budget, funding and in-kind resources such as donated services, expertise, equipment or products)

However, in complex or large projects there could be several iterations before a final plan and budget is reached. In negotiating budgets and funding with sponsors, it is easiest to work with activity-based costing: for example, reflecting the cost per school connected or per teacher trained, rather than aggregate costs for salaries and overheads.

How a schoolnet is resourced also depends on the operational model that will be used. For example, specific activities or services could be done by the schoolnet itself (either internally or by contracting companies or people to do the work), or provided through agreements with supporting partners. Schoolnets can therefore range from being a "schoolnet lite," where the schoolnet is a small entity primarily co-ordinating the service delivery of other agencies, to a complete operational entity which carries out most of the work itself.

A range of different funding models can also be used. For example:

▸ Funding can go directly to the schoolnet to implement an agreed programme.

▸ Funding can be provided to end-users (typically schools) to purchase specific services and/or equipment from a schoolnet.

▸ The schoolnet can provide services on a cost-recovery basis, operating as a sustainable business. The responsibility for fundraising moves to schools and other users of the service.

Funding sources include:

▸ Government

▸ Donor agencies

▸ Private sector

▸ Fundraising by school communities

Funding proposals should include:

▸ The overall concept (e.g., vision and mission)

▸ How the proposal is aligned with the priorities of the funder (e.g., how the project will further the development objectives of donor agencies) and/or advantages to the funder (e.g., public relations benefits for companies)

▸ An outline of the project being proposed, including timeframes and outcomes

▸ A list of partners who will form part of the project

▸ A summary budget

Obtaining funding can be a drawn-out process. Funding or sponsorship agreements can take anywhere from three to 18 months to be approved, finalised and signed.

For more information on funding sources, see section on Partnerships in Guidebook 2.

Human resources

Schoolnets are often initiated by a relatively small set of enthusiastic and committed people, who may also have skills across a range of educational and technical areas. Invariably, larger numbers of people are required when projects reach implementation stage.

However, adding new staff is not always easy. In the process of scaling up the size of the initiative, the initial vision and sense of innovation in the schoolnet can be diluted, as new recruits may lack the broad perspective and drive of the founders. Care should be taken not only to develop the required skills in new staff, but also to transfer values and attitudes.

Schoolnets can build their human resources in several ways:

▸ By employing staff directly, to the extent that budgets permit

▸ By seconding staff for a limited period (e.g., teachers with experience in ICTs, or personnel from education departments, other government departments, or NGOs)

▸ By making use of volunteers and interns (e.g., through organised international or national volunteer programmes, or by recruiting directly from local communities)

In areas where schoolnets are not able to build capacity internally for certain functions, alternative strategies include using consultants or outsourcing certain business processes.

Schoolnets that are institutionally located within larger organisations also have the advantage of not having to directly manage certain functions such as accounting and finance, at the expense of the flexibility that smaller organisations have.

Managing partner and donor relationships

Successfully managing relationships with partners and donors is a key ingredient for the success of schoolnet programmes. Well-managed relationships can lead to:

▸ Repeat funding, continuation and expansion of projects

▸ Increased access to other resources of partners

▸ Positive publicity for all parties, and enhanced prospects for developing new relationships with other partners or donors

On the other hand, relationships that do not work well lead to mutual dissatisfaction and stress, threaten the schoolnet's resource base and operational capacity, and require more effort to pursue new partnerships or funding sources to replace those that are lost.

The key elements in managing relationships successfully are these:

▸ Negotiating agreements based on mutual interest. (See the section on partnerships in Guidebook 2 and the boxed text Partnerships in the Pilipinas SchoolNet Programme below for more principles on developing partner relationships.)

▸ Ensuring that agreements are concluded in a contract or other written agreement (e.g., a memorandum of understanding) before the working relationship commences or money changes hands. The written agreement should include:

  • The legal entities involved in the transaction
  • The contributions of the respective parties (in funding, equipment or services)
  • What outcomes will be delivered
  • How and when progress and expenditure will be reported
  • When and on what conditions payment will be made
  • ny major risks or external factors that could impact on progress

    Written agreements should outline what both parties expect, but also anticipate the worst-case scenario, and cater for situations where there may be a dispute or if activities do not go to plan. There should be mechanisms for the original targets or assumptions to be changed by mutual agreement.

▸ Providing regular written reports to partners and funders and holding periodic meetings (e.g., once every three months). Meetings and reports should highlight the successes achieved, but also disclose failures or problems, with suggested remedies or alternative strategies.

▸ Actively managing public relations processes and corporate branding where required. This is particularly important for corporate sponsors, as public exposure may be a large part of the benefit for companies. Typically this includes highlighting corporate involvement in press releases and including company logos on Web sites, equipment or printed material used in schoolnet programmes.

▶ Involving partners and funders to the full extent that they are willing. In some cases, funders may have a hands-off approach, but in other cases they may have an active interest in how the project unfolds, or they may wish to handle certain functions such as public relations directly.

▶ Managing risks and liabilities appropriately. Don't commit to high-risk outcomes without the risks being well understood by all parties. Consider risks from external factors, such as exchange rate variations, in the event that funding contributions are set in a foreign currency.

While successful partnerships can be win-win situations, they can also have a broader impact on the schoolnet, with some long-term disadvantages. In particular, schoolnet programmes can become funder-driven, with implementation being focused in particular ways that funders are likely to support, at the expense of underlying research and development or innovation. Schoolnets can mitigate these problems by developing an appropriate mix of core funding and project-specific funding, and working with different types of partners or funders, including funders with research interests.

Partnerships in the Pilipinas Schoolnet Programme

In choosing partners for connectivity, training and content development, FIT-ED considered a number of factors: expertise or quality of service, coverage or the ability to serve a geographically dispersed group of schools, the organisation's objectives in joining the project, and its willingness to provide its services for free or at reduced cost. Put another way, the partners chosen were those who could provide the best, most cost-effective service.

Recommendations for successful partnerships:

▶ Make partnership building a cornerstone of your programme. Get the Ministry of Education involved. Mobilise the community. Get buy-in from the telcos and ICT vendors. Get local universities and training institutions to participate.
▶ Identify your programme stakeholders and let them know about your programme. Communicate your goals and your needs clearly to each of them, and let them know how your programme will benefit them.
▶ Your programme is only as good as your partners, so pick your partners wisely. Make sure that your goals and the goals of your partners are compatible and that there are no conflicts of interest.
▶ Be able to identify what value each partner adds to your programme. Assess the value of each potential partner based on your specific programme requirements as well as your constraints.
▶ Clarify the terms of the partnership—your respective roles and responsibilities and the duration of the partnership—and make sure everybody sticks to their commitments.
▶ Added value can be in many forms: cash, discounts or subsidies, technical assistance, leadership, organisational support, etc. Explore different types of partnerships with different types of institutions and individuals.
▶ Always keep your partners informed. Keep them interested in your programme by providing them with regular updates. Let them know what impact their contribution has had. It will be easier to get them to contribute more if they know that their efforts have borne fruit.

Developing a business plan

A business plan should guide the schoolnet in its operations and finances over the medium term (e.g., one to three years). The term "business plan" does not mean that the schoolnet should operate as a for-profit entity or adopt corporate values, but that the schoolnet's operations should be carefully planned as in a well-run business, with attention to managing income, expenditure, activities and risks.

The schoolnet should already have a strategic plan, which describes the environment, vision, mission and objectives. The business plan translates these into concrete details, including the following elements:

▸ Activities, projects and services that will be implemented

▸ Expected numbers of schools, teachers, end-users or clients

▸ Timeframes for the above

▸ Staffing required

▸ Core infrastructure required

▸ Partners and donors involved

▸ Income from various sources

▸ Budgets, with anticipated month-by-month expenditure and cash flow

▸ Potential risks and liabilities.

Business planning should be completed before each operational cycle begins, and there should be mechanisms to review progress periodically against the targets.

Project planning

Project planning principles should be applied to each project within the schoolnet programme. Projects are defined as activities that have an identified scope and objectives, take place within a specific timeframe and are allocated fixed resources and budget.

The objective of project management techniques is to ensure that projects are completed on time, within budget and to an acceptable quality. Project management does this by:

▸ Defining, co-ordinating and scheduling the set of inter-related activities required to achieve the outcomes

▸ Estimating and allocating resources to activities as required

▸ Proactively managing progress and resolving any obstacles before or as they arise

Good project planning will make the development of an overall business plan much easier.

Capacity planning

Many schoolnet programmes face rapid growth rates at some point. For example, the number of schools or teachers involved may easily double every year for several successive years. Schoolnets face challenges in the following areas in high-growth situations:

▸ **Infrastructure**: Where schoolnets are providing network access or network-based services, network infrastructure needs to be expanded as the number of users increases. This can include bandwidth, access infrastructure such as dial-up lines and server hardware. Smaller networks are more vulnerable to network bottlenecks than larger networks. For this reason, schoolnets that work with large ISPs are at an advantage, as they do not have to invest in expanding infrastructure, and a larger network is more easily able to absorb sudden increases in usage.

▸ **Support**: Increased demand for e-mail, telephonic, online or onsite support.

▸ **Quality of service**: If infrastructure and support capacity do not keep pace with growth, the quality of service provided to and perceived by end-users will decrease. If not addressed, this can lead to dissatisfaction and potentially fragmentation of the broader schoolnet network as schools or teachers seek service and support elsewhere.

▸ **Nature of services**: As the volume of users grows, demand may increase for different types of services not previously offered. For example where a connectivity network is very successful, demand will increase for online content, and training teachers may become more important.

Capacity planning involves estimating potential growth in the near-, mid- and long-term, as well as developing strategies to accommodate increased volumes. The easiest form of growth to plan for is linear growth, where demand increases steadily and predictably. However, growth can also take place in unexpected ways, and have qualitative as well as quantitative impacts. The following factors should be taken into account during capacity planning:

▸ Increased volumes may need infrastructure with greater robustness and redundancy. This may mean a different type or quality of equipment, rather than just scaling up existing systems.

▸ As volumes increase, proactive support becomes more important. This involves adopting strategies to reduce support requirements overall. This can include providing better documentation, putting documentation or self-help guides online or improving products and services so that they are easier to use and fewer support problems arise.

▸ Different support strategies may be required for increasing volumes, especially if the profile of participating schools and teachers changes. For example, if more rural schools become involved, onsite support becomes more difficult and expensive.

▸ Larger volumes can produce qualitative changes. For example, an online community of all schoolnet schools that works well with relatively small numbers may not scale well when volumes increase. In this case, it may be useful to establish multiple online communities, mailing lists or Web forums based on common interest or geographical area, rather than lose a sense of community altogether.

As an example of growth, the membership of Korea's EDUNET has shown an average annual growth rate of 160 per cent since 1996. The number of individual subscribers in December of 1996 was 40,000. It grew to 190,000 in 1997, 570,000 in 1998, 1.5 million in 1999, 2.6 million in 2000, 4.8 million in 2001 and over 5 million in April 2002. Almost every teacher in the country is a subscriber and there are 3.5 million student subscribers, 46 per cent of whom are elementary and secondary school students (see Figure 3.2). [3]

Figure 3.2: The growth in usage of Korea's EDUNET

Further details on monitoring usage to inform capacity planning see page199.
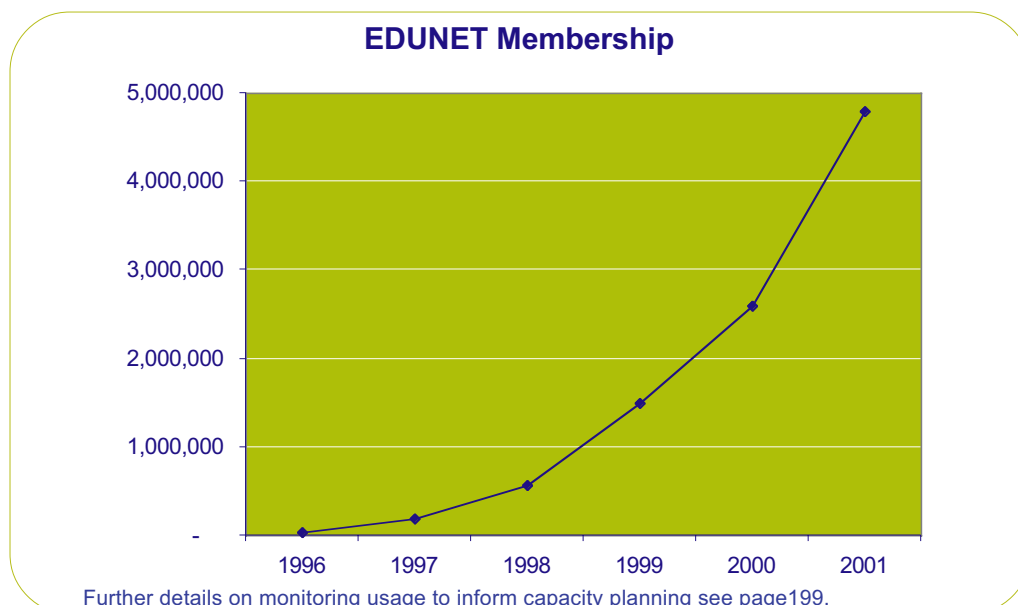
Working with Schools and Teachers

Selecting schools for projects

For schoolnet projects which work with a limited number of schools, the school selection process is a vital part of placing the project on a sound footing. Good school selection can improve the chances of the project's success, while selecting inappropriate schools can increase costs and lead to poorer results.

School selection should be based on a selection plan or rationale, informed by the project's strategic goals, objectives and constraints, and any requirements of external stakeholders. Strategic approaches to selection (see the section on SelectingSchools and Participants in Guidebook 2) include:

▸ Selecting for success: choosing the best-case scenarios in the easiest environments

▸ Cross-spectrum: choosing a wide range of target environments

▸ Worst-case scenario: choosing the most difficult environments

Typical constraints include:

▸ Access to infrastructure (electricity, telecommunications, physical buildings)

▸ Geographic location (proximity to support staff and, in some cases, telecomms and Internet costs may be distance-dependent)

▸ school type (e.g., secondary schools) or range of subjects offered

Within the constraints and any broader requirements, a range of factors in each school can be considered that are likely to lead to the project's success, including:

▸ Interest, motivation and commitment of the school management and teaching staff

▸ Means to ensure financial sustainability, where the school is required to meet certain upfront or operating costs

▸ Alignment between the goals of the project and the educational needs and interests of the school

▸ Effective school planning and management processes

The selection process itself should be thorough and as procedurally fair. A common process is to select schools through competitive application. This involves:

▸ Identifying a group of schools which meet the basic criteria (location, type of school, etc.)

▸ spell out the purpose of the project, the selection criteria and what will be required of the school if selected. Schools should submit a proposal including replies to structured questions in the invitation to apply, and a sustainability plan for supporting the project in the long term.

▸ Short-listing a manageable number of schools which submit acceptable proposals. If necessary, proposals can be scored in a number of areas, and a total score for each school compiled.

▸ Visiting the short-listed schools to interview school management and staff, verify information contained in the proposal and inspect the buildings and infrastructure.

▸ Selecting the final participants based on the results of the proposals and follow-up visits.

Additional support can be provided to schools during the selection process, such as in the form of information meetings to present the project and its requirements, or workshops which help schools examine the planning and sustainability issues involved.

The process of visiting schools can also be used to gather valuable information for subsequent use. For example:

▸ Baseline data for evaluation purposes

▸ The extent of ICT skills among teachers and general educational environment, which can inform the training programme

Once schools have been selected, each school should sign an agreement with the project which details the respective contributions and commitments of both parties. Where schools are required to prepare in some way before implementation can start (e.g., by furnishing computer laboratories, getting electrical points or telephone lines installed or improving physical security), this should be followed up and verified by the schoolnet to avoid subsequent delays or complications.

The School Selection Process for the Philippines Ed.venture Project

Fifteen public high schools were selected to participate in the Ed.venture pilot based on the following criteria:

▸ *Schools recommended* by DepEd or by programme partners.
▸ *Availability of space:* a room available to house the Ed.venture Center which conforms to technical specifications or which the school is willing to upgrade.
▸ *Availability of basic utilities:* reliable electricity supply and available fixed-line telephone service.
▸ *Availability of Internet service:* within the service area of one or more ISPs.
▸ *School administrator support*: willingness to initiate and support ICT-enhanced teaching and learning practices. Experience in implementing enrichment programmes and in community mobilisation and fundraising is preferred.
▸ *Counterpart funding:* schools must be able to provide counterpart funding for the preparation of the room to be used for the Ed.venture Center and to pay for all recurring operational costs.
▸ Schools should be in *underserved* areas, or if not then the schools themselves must be underserved.
▸ *Technical support staff:* schools must be able to designate a centre manager (CM) and an assistant manager (ACM) to take charge of the day-to-day running of the Ed.venture Center.

Thirty schools were considered for the pilot based on recommendations from the DepEd regional and division offices and/or project partners. Each underwent a screening process that included:

▸ An interview with the school administrator
▸ School profiling and needs assessment
▸ Identification of potential community partners that could help the school secure counterpart funding
▸ Visual inspection and technical assessment

Of the short-listed schools, 15 were selected for inclusion in the pilot and asked to sign a memorandum of agreement (MOA) with Coca-Cola and FIT-ED. Co-signatories were the community partners identified by the school (e.g., DepEd, local government, local school board, PTCA). FIT-ED had previously sought the buy-in of the Department of Education and the local government.

Promoting opt-in programmes

Many schoolnets run ongoing opt-in programmes and services as well as specific projects. Opt-in programmes (referred to as "pull programmes" in Guidebook 2) invite participation from anyone interested, rather than working with a fixed group of schools or teachers. Examples include:

▸ ThinkQuest: a Web site design competition targeted at students

▸ SchoolNet Thailand's Digital Library, to which teachers can contribute content

▸ Online collaborative projects involving students and teachers from multiple schools

Professional development programmes can also function well as opt-in programmes, as teachers are likely to be more motivated and involved. Computerisation and other infrastructure programmes can also be promoted on an opt-in basis, through mechanisms such as providing matching grants to schools.

Opt-in programmes are a valuable counterpart to top-down implementation projects, as they promote organic growth and interest in using ICTs in education, and provide entry points for those asking "How can I (or my school) get involved?" They are also good candidates for corporate sponsorship, as they promise potentially broad exposure to companies and can be used to highlight excellence and innovation in media-friendly ways.

Promoting participation in such programmes is mainly about persuading teachers, students and schools about the benefits of taking part, through techniques such as social marketing and structuring appropriate incentives. Schoolnets can:

▸ Highlight the educational benefits. For example, projects involving collaboration to develop online content can build communication, teamwork and research skills. However, such educational benefits may not obvious or the most appealing component of the programme. For example, students may be more likely to participate in a project because it involves a new experience such as communicating with someone in another country. Different messages can be targeted at different levels: for teachers, the educational value, and for students, how the activity will be engaging and fun.

▸ Provide incentives. These can be in the form of recognition, prizes or awards for the best projects or entries, or opportunities such as participation in a special national or international event. For teachers, involvement in ICT activities could contribute towards career advancement, such as improved promotion prospects, or recognition of prior learning in professional development programmes.

Examples of Opt-in Programmes

ThinkQuest

ThinkQuest is an international competition where student teams engage in collaborative, project-based learning to create educational Web sites. The winning entries form the ThinkQuest online library. Students between the ages of nine and 19 form teams of three to six students, supervised by a teacher-coach.

Teams have approximately five months to work on their sites, focusing on their chosen topic area. Contest winners receive prizes from the Oracle Foundation, including travel to the annual ThinkQuest Live event. National winners may also be honoured and awarded prizes by national partners of the foundation.

Nine additional country or regional versions of ThinkQuest exist, such as ThinkQuest Singapore and ThinkQuest Africa, with similar rules and awards systems.

Participation in ThinkQuest helps to develop a wide range of skills in team members, including primary and online research skills, online collaboration in multicultural contexts, critical thinking, and writing, editing and presentation skills.

More information is available from *www.thinkquest.org*.

Collaborative projects facilitated by Pilipinas SchoolNet

As part of the Coca-Cola Ed.venture Pilot Project, Pilipinas SchoolNet has provided training to teachers on designing and participating in tele-collaborative projects. These are some of the projects designed by teachers for the English subject area:[4]

▶ *Go, tell it to the mountain*
  This project will be a collection of descriptive narratives on local yuletide celebrations all over the country. Due to the various cultures and traditions of the Filipino people, they differ in the way they celebrate the yuletide season.
▶ *Figure it out for me*
  The project is about the use of the common figures of speech and expressions premised on the different translations of the student-participants. While there is a universal meaning to a specific expression or figure of speech, it will be interesting to learn if the translation makes sense in terms of its structure and meaning.
▶ *Mythical space*
  Participants will build an online library of unpublished local fables, myths and legends that will showcase the depth of our cultural heritage.
▶ *Nature in focus*
  Students from different schools share information regarding the beauty of selected spots in their locality through an exchange of original poems.
▶ *Philippine literature*
  This project is a means for students from different regions to share local unpublished literature specifically legends, short stories and folk tales.

Marketing techniques that can be used include:

▸ Distributing free resources or materials linked to the project or programme (such as free CDs with related material)

▸ Using e-mail, Web sites and other online community mechanisms to advertise opportunities and keep people updated and informed

▸ Using people networks to encourage teachers to promote the programmes to other teachers and schools

▸ Using the mass media, such as radio, TV and newspapers, to reach students, teachers or parents

▸ Holding high-profile awards functions to recognise exceptional work, preferably on a regular basis (e.g., annually)

▸ Profiling participants and highlighting individual stories about participation and the benefits that specific students or teachers received from their involvement

About Social Marketing

Social marketing is the "planning and implementation of programmes designed to bring about social change using concepts from commercial marketing." Social marketing originated in the health sector, but can be applied to any environment, such as education, where the objective is to influence practices and behaviours rather than sell a product.

According to the Social Marketing Institute, important marketing concepts include:

▸ The ultimate objective of marketing is to influence action.
▸ Action is undertaken whenever target audiences believe that the benefits they receive will be greater than the costs they incur.
▸ Programmes to influence action will be more effective if they are based on an understanding of the target audience's own perceptions of the proposed exchange.
▸ Target audiences are seldom uniform in their perceptions and/or likely responses to marketing efforts and so should be partitioned into segments.
▸ Marketing efforts must incorporate all of the "4 Ps," that is:
　1. Create an enticing "product" (i.e., the package of benefits associated with the desired action).
　2. Minimise the "price" the target audience believes it must pay in the exchange.
　3. Make the exchange and its opportunities available in "places" that reach the audience.
　4. "Promote" the exchange opportunity with creativity and through channels and tactics that maximise desired responses.
▸ Recommended behaviours always have competition which must be understood and addressed.
▸ The marketplace is constantly changing and so programme effects must be regularly monitored and management must be prepared to rapidly alter strategies and tactics.

Adapted from Social Marketing Institute, *www.social-marketing.org/sm.html.*

For more information, visit the Social Marketing Institute Web site at *www.social-marketing.org.*

ICT leaders and managers

Schoolnet projects which work with schools as institutions need to identify and support the ICT leaders and managers in the school. These include:

▸ The school principal and/or deputy-principal, often referred to as school managers or administrators.

▸ The ICT co-ordinator or computer lab manager, usually one or two teachers with specific responsibilities for managing ICT facilities in the school

▸ Heads of subject departments.

School principals may not start out as "ICT leaders," but through virtue of their position, they have broad responsibility for ICTs in the school, including leading pedagogical and other change processes to make best use of ICTs and ensuring the development and execution of a technology plan for the school (see below). Ensuring that principals develop the knowledge and skills to undertake these functions is, therefore, essential.

The ICT co-ordinators are usually the early adopters and ICT enthusiasts on the staff, who are given responsibility for ICT infrastructure and sometimes other processes such as staff training and ICT integration. These staff lead by example, and are likely to be the most active users of ICTs in the school. They often require specific technical and other support in managing computer networks. However, ICT co-ordinators may also be more likely to relocate to other schools or more attractive positions in the private sector, especially if they develop advanced ICT skills. It is wise, therefore, to build in some redundancy, for example in training programmes, to train at least two ICT co-ordinators per school.

Heads of departments should carry overall responsibility for promoting the process of ICT integration with their subjects.

Support for ICT Leaders in the Pilipinas SchoolNet Coca-Cola Ed.venture Pilot Project

Educational technology management training was developed for school administrators. Focus areas include curriculum integration planning, business modelling, and community mobilisation and partnership building.

Two workshops for school administrators on optimising the use of ICTs in the school were conducted in April and May 2002. This workshop introduced participants to basic concepts in ICTs in education and provided a framework for ICTs and curriculum integration at the school level. Broad curricular/pedagogical, technical, professional development, administrative and financial issues were also discussed.

A year later, a more focused ICT planning workshop was conducted. This time around, the school administrators were taken step by step through the process of drafting a medium-term plan for ICT integration in their school. They were then tasked to go back to their respective schools and begin the planning process. Deadlines were set for each stage of this process through to the end of the school year in March 2004.

Midway through the school year, the planning had already been delayed. This was due largely to lack of time on the part of the school administrators and perhaps insufficient motivation. It would seem that like teachers who need focused pedagogical support, school administrators also require more dedicated assistance in coming up with their ICT integration plan.

More programme attention also needs to be given to encouraging school administrators to become ICT literate themselves and to begin to lead by example. Again, lack of time and motivation have been the biggest barriers.

School technology plans

School management is recognised as a significant factor in the success or failure of ICT projects in schools. In order to promote the effective use and integration of ICTs in schools, schoolnets should encourage or require schools to develop school technology plans. Such a plan should act as a roadmap for the school's implementation of educational technology over several years and contain targets and operational plans.

School technology plans are best developed through a consultative process, which could involve the entire staff, but should at the minimum involve the school management staff and heads of departments. It may also be beneficial to involve outside stakeholders (e.g., from the parent community), and resource people

such as educational ICT experts. Schools may need to do some research and gather information, such as estimated running costs of the planned ICT facilities, for the planning process.

Schoolnets can help schools with the technology planning process by providing appropriate resource and training materials, holding workshops for school management staff and building the process into the schoolnet project process. For example, schools could be required to submit an initial technology plan as part of the selection process, refine this during training sessions run by the schoolnet and finalise and submit it within three months of ICT equipment being installed at the school. Thereafter, the school should regularly assess progress against the technology plan, for example every six months.

Technology plans should include the following elements:

▸ An assessment of the school's current ICT position, possibly informed by a SWOT (strengths, weaknesses, opportunities and threats) analysis

▸ An ICT vision for the integrated educational use of ICTs

▸ Staff professional development:

- What training may be required for which staff over what time period
- What support will staff to participate in training, for example reduced workload or extramural activities during the training period

▸ Roadmap of the curriculum integration process

▸ An ICT use policy (also called acceptable-use policy), including measures to promote child safety online

▸ Physical access to ICT facilities: who will have access when, how will it be managed

▸ Physical security of ICT facilities

▸ Management of ICT facilities: who will manage ICT facilities on a day-to-day basis and what training and support would they need.

▸ Technical support: what outside technical support systems will be used

▸ Financial sustainability:

- Estimates of operating costs
- Provision for replacing and upgrading equipment over time
- Strategies for revenue generation

▸ Information security measures and policies to protect against viruses, loss of data and restrict access to confidential data

Change management

Change management is

> "*A systematic approach to dealing with change, both from the perspective of an organisation and on the individual level....Change management has at least three different aspects, including: adapting to change, controlling change and effecting change. A proactive approach to dealing with change is at the core of all three aspects.*"[5]

School technology plans may (or should) have far-reaching implications for teaching and learning processes at schools. Adopting change management strategies can make the process of implementing the technology easier and contribute to its overall success.

There are many change management resources available online and in print (see, for example ,"The Eight Stage Process of Creating Major Change" by John Kotter, in his book *Leading Change*).

Motivating teachers

Motivated teachers lead to successful ICT projects and meaningful ICT integration taking place. Uninterested or demotivated teachers, on the other hand, can make a project fail, no matter how good the technology, infrastructure or training.

The following strategies can be used to motivate teachers:

▸ Concentrate on making the day-to-day jobs of teachers easier. Teachers will already be required to do extra work to become familiar with ICTs and new teaching approaches, so ICTs will be welcomed where they can reduce their workload. Such "quick wins" provide immediate advantages that encourage teachers to tackle more difficult challenges in the long term. Time-saving uses can include:

- Use of word processors and spreadsheets for administrative uses, making schedules, setting and reusing tests and exam papers
- Downloading commonly used teaching resources such as lesson plans from Web sites

▸ Ensure that inservice training for teachers has meaningful consequences:

- At a minimum, teachers who complete training courses should receive a certificate.
- Ideally, training courses should be accredited, providing pathways into further tertiary qualifications (diplomas or degrees), and contributing to improving teachers' chances of promotion and salary improvements.

- Create avenues for recognising innovative and excellent use of ICTs by teachers and schools. These can be in the form of awards or grants, possibly sponsored by companies or organisations that work closely with Ministries or Departments of Education and schools.

- Showcase visible results, highlighting the achievement and enthusiasm of students who have used ICTs in some way.

- Promote peer support and collaboration through ICTs.

- Provide improved daily access to ICTs, for example through providing teachers with dedicated or shared use of notebook computers or making available grants or low-interest loans for teachers to buy home PCs.

- Ensure that the broader environment is supportive. There should be effective ICT leadership in the school and a sense of purpose in using ICTs.

- Wherever possible, eliminate obstacles and demotivating factors. Teachers should have effective access to support when required, reliable infrastructure and adequate time allocated for ICT use.

The above strategies may not all be easy to implement. Some require funding and resources, other require effective leadership and management, or collaboration between several institutions.

Schoolnets can start with the strategies that can be immediately implemented, and then work on progressively implementing others over time. It should also be kept in mind that integration of ICTs within a school environment is a long-term process, involving shifts in work practices and organisational and cultural changes.

Some Approaches to Motivating Teachers

Malaysia
Other than the teachers teaching the four subjects included in the Smart School Pilot Project, other teachers in the pilot schools were generally not motivated to improve their ICT skills.

Since the government implemented a new civil service scheme in 2001 which encourages and rewards civil servants who acquire competencies in specific areas, there is now greater motivation on the part of teachers to acquire ICT skills and knowledge.

The Smart School Development Team is experimenting with the "international computer driving licence,",which offers competency certification at the end of the course to determine whether certification would motivate them to sign up for training and using ICT in their work after the training.

Singapore
Hewlett-Packard (Singapore) has sponsored the HP INIT Award since 1999 to recognise teachers' creative use of ICT in teaching. This award encourages teachers' innovation in applying ICT to enhance their students' learning, and motivates teachers to move on 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.

NIE has also established a set of Advanced Diploma and Advanced Postgraduate Diploma in Education programmes to enable teachers to upgrade and keep up-to-date in their content knowledge of school subjects or state-of-the-art educational methodologies or technologies, guidance and counselling methods or educational administration courses. These advanced diplomas then provide an alternative route for admission into the institute's bachelor's and master's degree programmes. The teachers, however, can opt to sign up for individual modules in the programme, and hence, having a wider choice of inservice continuing professional development.

School ICT Infrastructure

Introduction

Schools acquire ICTs in a number of different ways, usually reflecting how they are funded. Acquisition routes include:

- ▸ Supplied by Department or Ministry of Education

- ▸ Supplied through a schoolnet or other project sponsored by a company or donor

- ▸ Donated directly to the school by companies or individuals

- ▸ Purchased by the school from the school's budget, or funds raised by the school.

This chapter deals with school ICT infrastructure from the perspective of a schoolnet or government project implementing ICTs in a number of schools with some degree of central control or responsibility. Usually this involves providing a complete solution, following one or several standard models.

Where this is not the case (e.g., the Schoolnet is working with schools that already have ICT equipment, and hardware implementation does not form part of the project), schoolnets can support schools in establishing and operating ICT infrastructures in other ways, by:

- ▸ Providing advice to schools, such as on appropriate standards or technologies

- ▸ Offering technical training and support – although it quickly becomes difficult to support the wide range of possible environments and technologies that schools may use

- ▸ Developing some standardised solutions that schools can adopt (discussed in the chapter on customising and adapting technology, below).

ICT needs assessment

The first step is to establish what ICT facilities are required, through a needs assessment process. This should take into account:

- ▸ The educational objectives of the project (e.g., supporting science teaching, promoting online collaboration, or developing information literacy skills)

- ▸ The curriculum and learning objectives within the school

- ▸ Who needs access to computers, in what locations and for what purposes (e.g., students in a computer lab for using specialist software, or teachers in the staffroom for downloading teaching materials)

▸ Whether the project providing ICTs is for a specific, targeted purpose, or for building an ICT platform in the school for a wide range of uses

In most cases, budget and technology constraints will also be an important factor. The needs assessment process should produce a high-level description of the facilities required that can then be turned into more detailed technical specifications.

Procurement options

The next step is to decide on a procurement strategy. Approaches can vary from being very hands-on, where the schoolnet decides on the specifications of the equipment, handles procurement, installation and support, all the way to a hands-off approach where the schoolnet pays a contractor or the school directly to install and maintain ICT facilities to a certain agreed standard.

The advantages of a hands-off approach are that the schoolnet is free to concentrate on the value-added educational components, rather than being concerned with low-level technical details. However, to be successful, there need to be companies that understand the school environment and requirements and can provide equipment and services to an acceptable quality.

The geographic distribution of schools or other factors may also require working with more than one supplier, or it may be possible to choose between a single national company with an extensive distribution and support network and many smaller local suppliers.

School preparation

Before computer labs or other computer facilities can be installed in schools, all of the required infrastructure needs to be in place. Schoolnets should work through the following checklist with schools:

▸ Is there adequate space to house the planned computers (e.g., in a computer laboratory or other location)?

▸ Is there appropriate furniture (e.g., desks at the right height, with a suitable layout)?

▸ Are there enough electrical (plug) points installed?

▸ Is the electrical supply sufficient to handle the load of the number of planned computers and other equipment?

▸ Are there any special problems that may occur when installing network cabling (e.g., long distances between locations which may require fibre-optic cabling)?

▸ Is there adequate physical security for locations where computers will be installed (e.g., burglar bars, security gates, solid walls and roof, etc.)?

▸ Are there other security deterrents that should be in place, such as a monitored alarm system or a watchman?

▸ Is there a telephone line or other telecommunications services installed where required?

▸ Does the school have an insurance policy to which new computer equipment should be added?

Schools should also consider ergonomic factors which contribute to creating comfortable, attractive environments for people to use computers, such as blinds, fans or air-conditioning for temperature control, carpets to reduce dust and noise, and attractive furnishings and decorations (such as posters on the walls).

From a project planning perspective, schoolnets need to keep careful track of site preparation to ensure that all of the prerequisites are completed in time and the next phases of the project are not delayed. Schools can often underestimate the expense involved and the time required, especially where several different things need to be done (such as installing electrical work, new burglar bars and a telephone line). In some environments, new telecommunications services can take weeks or months to install, especially for rural schools.

School technology components

Following are the elements to consider in developing a complete technology solution for a school. These considerations should lead to a set of specifications that can be used as the basis for a procurement tender or to invite further proposals or responses from suppliers.

Computer hardware

▸ How many computers are required, and what will they be used for (e.g., 20 general-purpose computers in a computer lab and five for administrative use)?

▸ What quality or warranty requirements should be imposed? Higher-quality computers with a longer warranty period will cost more upfront, but can lower support costs in the long-term.

▸ Which computers may be required to support multimedia applications or any other special requirements?

▸ How many computers should be notebooks rather than desktop computers?

▸ Are there uses for handheld PDAs or alternate access devices that can communicate with the network through WiFi, Bluetooth or other methods?

▸ What backup solutions will be needed on servers and/or desktops (e.g., tape drives, CD-R or DVD-R)?

Network (LAN) architecture

▸ How many computers need to be connected to the LAN?

▸ What cabling and switching infrastructure is required to support fixed (wired) connections?

▸ Is wireless support required for notebooks or as an alternative to wired connections for desktop computers? If so, how many computers will use wireless connections, and in which areas?

▸ Will workstations use thin-client architecture (where the workstation is mostly a display device running applications from a server), fat-client architecture (applications are mostly installed and run on the workstation itself) or a combination?

Thin-client and Fat-client Architectures

On a thin-client network, inexpensive workstations connect to a server, which runs the user's programmes. The workstation itself is an input and display device, and most of the work happens on the server.

On a fat-client network, the workstation has most of the software installed on its own hard-drive, and applications are run locally. The network file server is only used for authentication, file storage, printing, Internet access and other central services.

Thin-client networks require cheap workstations, but expensive servers which have lots of processing capacity and memory. They are easy to operate and support, as every user sees the same environment on the server, and problems with individual workstations are minimised. Thin client networks require a fast underlying network.

Fat-client networks require expensive workstations, but servers do not have to be as powerful as for thin-client networks. They are more flexible, as individual users can install applications on their own computers if required, but they may be more demanding to support.

Software platforms

▸ What operating system will be used on both workstations and servers? The choice of operating system determines many other things (such as the range of application software that will be supported) and will probably also have cost implications.

▸ Is it feasible or appropriate to use open source software (see boxed text below on this topic), as the server or workstation operating system, or for applications?

▸ What services must the network servers provide? These can include:

- Authentication (based on usernames and passwords)
- Access control (for restricting access to local resources or Internet sites based on various criteria)
- File storage and backups (for individual and shared data)
- Printing (for sharing network printers),
- E-mail
- Groupware (for shared calendars and other items)
- Intranets (internal Web sites)
- Caching proxy services for improving Internet access

▸ What languages and language character sets does the software need to support in its user interfaces?

Proprietary or Open Source?

Proprietary software is sold to users by software vendors. Users have limited rights in relation to the software; they cannot use or distribute it outside the terms of the software licence, which may limit use of the software to a single computer, or a number of computers within an organisation.

Proprietary software is also sometimes called closed-source because it is usually not supplied with source code. Users cannot modify the software by changing the source code, and cannot distribute altered versions of the software.

Open source software is software which is distributed with source code, allowing users to modify it. Open source software is also licensed under one of a number licences which permit users to redistribute the source code of the software, and to create and distribute modified versions of the software (referred to as "derived works"). A complete definition is provided by the Open Source Initiative at *www.opensource.org/docs/definition.php*.

Well-known proprietary software includes products by Microsoft. Well-known open source software includes the GNU/Linux operating system, the Apache Web server, and the OpenOffice software suite.

Two advantages of open source software are, therefore, thus that it is free (although it is possible to buy services and support), and that it can be modified or adapted if needed. However, in some situations a particular proprietary software product may be more suitable than an open source product, or an open source equivalent may not be available. Open source software also tends to be more heterogeneous than proprietary software and can be more complex to implement or administer.

Initial cost is therefore only one component of the total cost of ownership (TCO) which should be considered when deciding on which software operating systems and applications to use.

Software applications

▸ What generic applications are required (also known as productivity software or office suites)? The basic list should include a word processor, spreadsheet, presentation (slide show) programme, e-mail application and Web browser.

▸ What general or special educational software is required? (See boxed text below on content-rich and content-free software.)

▸ What software is required for school administration functions (e.g., database, financial and accounting package, or integrated school administration system)?

▸ What intranet systems are required (often integrated with or dependent on the operating system)?

▸ Is a specific learning management system (LMS) or content management system (CMS) required?

Content-rich and Content-free Software

Content-rich software delivers content to users in accessible and engaging ways. The content can be loosely structured or searchable, such as in multimedia encyclopedias, or presented in a sequence based on skill level, learning outcomes or curriculum areas.

Content-free software provides users with environments that can be used for exploration, simulation or creative tasks. At the most generic level, a spreadsheet is a content-free software tool which can be used for creating graphs and exploring how equations can be represented graphically. Well-known educational packages of this type include Clicker (see *www.cricksoft.com*) and My World (see *www.granada-learning.com*).

Projection equipment

▸ Projection equipment such as data projectors or large-screen TVs can be used in teaching situations in computer labs or to make a few computers more effective in a setting such as a classroom or large presentation venue. Data projectors that are small and portable can be moved around for use with notebooks, or in different venues as required. Computers with DVD drives and a data projector can replace the traditional VCR and television combination.

Printing

‣ Networked printers allow all network users to print their work. Where is printing most commonly needed, and what volumes of printing are required?

‣ Is colour printing required, and in what volumes?

‣ Is there scope for integrating network printing with faxing and photocopying solutions using digital copiers?

Connectivity

‣ What telecommunications services are available to schools (e.g., analogue telephone lines, ISDN, leased-line circuits at various speeds or ADSL broadband)?

‣ Are all telecommunications services available to all schools involved in the project? If not, what is the worst-case scenario? Are wireless or satellite options available?

‣ What is the ideal and minimum Internet bandwidth required?

‣ Are there affordable fixed-cost solutions available (where the telecommunications and Internet access charges are fixed or capped)?

‣ If not, are variable cost solutions likely to be affordable given the projected monthly volume of usage by the school? Do schools have the ability to manage Internet usage so that the costs do not become unaffordable?

‣ What equipment will be required at the school for the Internet access solution that is chosen (e.g., analogue modem, ADSL modem/router, synchronous leased-line router, satellite or wireless equipment)?

Internet services

‣ What domain name will the school use for its e-mail addresses and/or Web site? Is there a naming convention for schools?

‣ How will e-mail services be provided to users (e.g., based on the local school network, or on a central server accessible via Web mail or IMAP)?

‣ Will users have access to their school mailboxes when at home or outside the school?

‣ What authentication, access control and firewall systems may be needed to ensure adequate information security and managing Internet access appropriately?

In designing a complete technology solution for a school or group of schools, the solution should be kept as simple as possible (e.g., using a single server).

However, school networks can often evolve into more complex, heterogeneous environments over time (e.g., using several different operating systems on workstations or servers). To facilitate such expansion, the solution should be based on open standards wherever possible, as these allow easier growth and integration with future technologies.

Dealing with donations and refurbished equipment

Ministries of Education, schoolnets and individual schools periodically are offered or solicit donations of used computer equipment which is still functioning, but considered obsolete for its original purpose (such as in a corporate environment). This may be available "as-is" or refurbished in some way.

Assumptions underlying such donations include that:

▸ The equipment is still usable in a different context (education), where computing requirements may not be as demanding.

▸ Even taking into account refurbishing or shipping costs, such equipment is still cheaper than buying new equipment.

However, the low acquisition cost may be offset by factors such as:

▸ A higher failure rate than new equipment, given that refurbished computers are already three or more years old

▸ No or very limited hardware warranty

▸ Potential compatibility and integration problems from older hardware

▸ Lower productivity or higher user frustration

▸ Higher support costs, either through increased hardware failures, limited ability to run current software, or running older software which is more difficult to support (e.g., older versions of Microsoft Windows are no longer supported by Microsoft, and may be more difficult to protect against viruses and security exploits).

The total cost of ownership equation is therefore not always in favour of refurbished equipment, as purchase price is often traded for higher support costs, and a careful cost-benefit analysis should be done before accepting donated equipment. However, a number of strategies can be used to manage hardware donations more effectively and to lower subsequent support costs. These include:

▸ Defining minimum hardware standards that will be accepted (processor type and speed, hard-disk size, RAM, etc.)

▸ Ensuring that there is a professional refurbishing procedure in place, with effective quality assurance mechanisms, and a hardware warranty (even if for a limited period)

▸ Using refurbished PCs as thin-client workstations, where hardware performance is less important and workstation failure has lower consequences

▸ Supplying refurbished PCs for home or individual use on a non-supported basis

▸ Building in a redundancy margin by supplying 20 per cent or more extra PCs than required, so that PCs with hardware failures can be discarded and easily replaced from spares

The final factor to consider is the environmental cost of decommissioning old computers. Computer hardware contains a range of toxic ingredients, and should therefore be disposed of in an environmentally sound way rather than being discarded. There may be long-term costs associated with such disposal. When corporations or developed countries pass on old computers to schools in developing countries, they may be passing on associated environmental costs to communities which are less able to afford them.

Information security

Information security refers to practices which protect information from being lost or accessed by unauthorised users. Related to this is the necessity to protect the integrity and efficient operation of computers and networks from intrusion, viruses or worms and other denial-of-service attacks.

Information security practices are a combination of technical and human solutions. Technical solutions include:

▸ Anti-virus protection on workstations, servers and e-mail servers

▸ Backup solutions so that data and servers can be quickly restored if lost

▸ IP level security to protect against unauthorised interception of data or passwords on the network or Internet, and unauthorised access to services. This can be implemented by using end-to-end encryption (e.g., secure Web sites or VPNs) and firewalls (restricting access to certain services to and from specific network and Internet addresses).

Human factors include:

▸ Choosing secure passwords which can not be easily guessed, and changing passwords regularly

▸ Establishing and enforcing appropriate access controls for various network services

▸ Backing up data regularly, and following sound backup practices such as storing a set of backup tapes or media off site.

> **Preventing Virus and Network Attacks in the Malaysian Smart School Project**
>
> The Data Centre 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 to help prevent virus attacks. Guidelines for dealing with hacking and virus attacks are provided in the Smart School ICT Policies and Procedures document which has been updated twice since it was introduced in 2000.

Managing Internet access

Reasons for managing Internet access include:

▸ Containing Internet access costs, where Internet access costs are variable based on time or volume of traffic

▸ Managing quality of service: where bandwidth is limited, educational uses and applications should have priority over use of the Internet for casual or entertainment purposes

▸ Restricting access to inappropriate or unwanted content or Internet services

In the first instance, these should be dealt by establishing and communicating a school policy on Internet use and educating teachers, students and parents about the policy and appropriate use. Technical measures should be considered as a second-level approach to the problem, especially as many technical solutions are imperfect and can sometimes be circumvented by determined users.

Firewall, proxy/caching or access control systems can include:

▸ The ability to block nominated Web sites and Internet services by user , group and time of day

▸ The ability to restrict bandwidth to certain sites or types of files (e.g., MP3s)

▸ The ability to set a limit to the total Internet traffic by user per day or month

▸ The ability to subscribe (usually at a cost) to "blocklists" of sites that should be restricted

However, such systems (especially site-blocking systems) should be implemented only after careful consideration, as they have the potential to inadvertently limit access to legitimate sites and content and impose ideological bias through the content filters applied.

Some Examples of Technology Models

Malaysia's Smart School Integrated Solution

The technology infrastructure that supported the Smart School Network and other components of the Smart School Integrated Solution were determined in negotiations over the terms and conditions of the Smart School Pilot Project Agreement signed between the government and the short-listed consortium.

Three models of technology were employed in the pilot project. A summary of the equipment provided to the schools is given above.

Level B (laboratory model)	Level B+ (limited classroom model)	Level A (full classroom model)
37 computers	81 computers	520 computers
2 notebooks	2 notebooks	5 notebooks
3 servers (communications, databases, applications)	3 servers (communications, databases, applications)	6 servers (communications, databases, applications)
Fast Ethernet backbone (100 baseT) with 128/64 Kbps leased line	Fast Ethernet backbone (100 baseT) with 128/64 Kbps leased line	Fast Ethernet backbone (100 baseT) with 512/256 Kbps leased line

Pilipinas Schoolnet Coca-Cola Ed.venture Pilot

Project schools each have a local area network with between 11 and 22 PCs. PCs run on Windows 98 and have the Star Office Suite. Linux servers were provided (if needed) and these run on Red Hat or Mandrake. A printer and a TV with decoder (in lieu of an LCD projector) are also part of the connectivity package.

Three of the 15 pilot schools already had a local area network (LAN) consisting of a Windows NT server and 10 Pentium II PCs. One pilot school had seven Pentium I PCs while another had two Pentium II PCs. These were donations from DepEd, the local government unit, and/or private sponsors. The rest of the schools had no existing hardware or software.

A Type I network was deployed in schools where there was no existing server. For this type, a Linux server was provided. Type II networks were configured in schools with an existing server.

Several interacting factors determined the final number of PCs and the corresponding network equipment included in the connectivity package for each of the schools, namely:

▸ Number of existing computers
▸ Size of the room
▸ Size of the student population and/or average class size
▸ Programme budget limitations

Slightly more technical problems were encountered in the four schools that had existing PCs compared with those with all brand new computers, as the older PCs were more likely to malfunction.

Customising and Adapting Technology

When to customise or adapt

In situations where a schoolnet is involved in deploying or supporting computer networks in a significant number of schools (more than 10), there may be advantages to customising or adapting software solutions, rather than just using software packages installed "off-the-shelf" at each school.

While this requires time and resources for technical research and development, documentation, quality assurance and other processes, reasons for doing it include:

‣ **Ease of use**: Tailored solutions can be easier for schools to use and manage because user interfaces can be customised to the set of features that are most commonly used.

‣ **Support:** There are many support advantages to providing customised systems to schools. Where a large number of schools are running identical or similar systems, economies of scale in support and documentation are possible, and it is easier to diagnose and resolve problems, as the technical environments are well understood. Systems designed with robustness and security in mind are easier for school network managers to use, less likely to break, and should be easier to restore to working order. In the best case, this translates into fewer support incidents and fewer onsite support visits, which reduces support costs.

‣ **Features**: Off-the-shelf solutions may not include features which are important in a particular environment (e.g., customisation of user interfaces in a local language).

‣ **Cost**: Customised solutions, particularly those built on free and open source software, can provide product features at a lower cost than the equivalent commercial alternatives. However, for this to be a cost-effective approach overall, the total cost of ownership, including support and running costs, needs to be lower.

‣ **Integration**: There may be cases where it is useful to integrate school systems with regional or national systems in some way (e.g., by replicating content from a national portal on a local network, or uploading data from school administration systems to national databases).

However, there can also be disadvantages to moving away from off-the-shelf solutions towards customised products. The most important factor to consider is that the burden of support moves from the software supplier to the schoolnet, and it is vital to ensure that the solution being supplied to schools is well supported throughout its lifespan.

Customised Solutions Developed by Schoolnets

SchoolNet Thailand's Linux Schools Internet Server

NECTEC developed the Linux School Internet Server (Linux-SIS) in 1997 to be promoted and distributed to schools as a cheaper alternative to using expensive server software for schools ready to move beyond the first phase of Internet implementation.

Since its introduction, Linux-SIS has been very popular in Thailand due to its excellent documentation in the Thai language, its simple-to-install CD-ROM and Web-based server management. Users do not need to know any Linux commands.

Linux-SIS has been actively developed and supported by NECTEC. Version 4.0 in October 2000 incorporated the Digital Library Tool Kit and Easy Library, and has made the installation process and system management simpler. SIS training courses are in constant demand from schools looking for a reliable Internet server at the lowest cost.

Malaysia's Smart School Integrated Solution

The Smart School Integrated Solution was developed by the Smart School consortium contracted by the Ministry of Education to implement the technology infrastructure for the Smart School Pilot Project. The Smart School Integrated Solution comprises the following main components:

▶ Browser-based teaching-learning materials and related print materials for four subjects
▶ A Smart School management system
▶ A Smart School technology infrastructure involving ICT and non-ICT equipment, LANs and a virtual private network that connects the pilot schools, the ministry's Data Centre and the ministry's Help Desk

The Smart School Management System (SMMS) covers nine areas of school management: financial, student affairs, educational resources, external resources, human resources, facilities, school governance, security and technology. The SSMS also integrates teaching and learning materials, assessment, ICT security management, network and system management, user support and a help desk 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, possibly external, databases and applications
▶ Allowing access to existing databases within the various divisions in the Ministry of Education

The SMMS also allow parents to remotely access their own children's records in the school in order to keep track of their children's progress in school.

The Smart School Integrated Solution is supported by a centralised help desk and service centres throughout the country to provide maintenance and support. Pilot schools were also given an ICT security policies and procedures document developed by the consortium.

Bundled systems

Bundled systems are software packages where the Schoolnet has selected a number of technologies and software applications and combined them to produce a total solution. They can vary in extent from being a server solution to a complete network system, encompassing server, workstations, operating systems and application software.

Standardised workstations and servers

A powerful method of reducing support costs and minimising downtime (i.e., time when computers are unavailable for use) is to standardise workstation configurations and sometimes also server configurations. This approach involves running identical software installations on all workstations. The objective is to:

▸ Reduce variations between workstations, improving consistency for end-users, and reducing support requirements

▸ Decrease the amount of effort and time required to restore workstations to working order, should they become unusable through hardware failure, viruses or other causes.

Thin-client systems provide all of these advantages built-in, as the workstation desktop presented to the user is in fact a session on the network server. This means that there is effectively no software configuration on the workstation which can go wrong, and users always see the same desktop configuration, no matter which workstation they use.

In fat-client environments, the worst-case scenario should a workstation become unusable is that the operating system and all of the application software must be reinstalled and reconfigured. This can be a time-intensive and complex task, and quickly becomes unmanageable where there are more than 10 computers on a network.

To solve this problem, workstation configurations can be standardised by using so-called "images" – a complete copy of an installed and configured workstation. Workstation hard drives can then be quickly reimaged when necessary, resetting the workstation to the original state.

While this approach is very effective when up and running, there are some drawbacks:

▸ Creating images and setting up mechanisms for reimaging can be technically complex, especially with products that enforce licensing and copy-protection schemes.

▸ A software image can only be applied to other computers that have identical or similar hardware. Imaging is therefore practical only where a lot of computers share the same hardware specifications.

The same imaging technique can also be applied to servers. For example if a schoolnet has created a standard "server image," schools can reimage their servers easily if needed, although more manual configuration will be needed after reimaging than in the case of workstations.

Imaging Tools

Two well-known software tools for creating and duplicating software images are **Ghost** and **ImageCast**. Ghost is available from Symantec at *www.symantec.com*. ImageCast is available from Phoenix Technologies at *www.phoenix.com*.

Microsoft has tools and techniques for automatically deploying Windows installations, including the Sysprep tool. (Consult the Microsoft Knowledge Base at *support.microsoft.com)*. For Windows XP, see the article at *www.microsoft.com/WINDOWSXP/pro/using/itpro/deploying/duplication.asp*.

Linux and other open source systems can usually be replicated using Ghost or ImageCast and can easily be customised to install or replicate systems automatically, if not being used in a thin-client configuration.

Local language versions

It may often help users to have computers, software applications, content and Web sites appear in the language with which they are most familiar – notwithstanding the argument that it also helps users to be familiar with languages most commonly used on the Internet. (See also the section on Content and Language in Guidebook 2 for an outline of issues involved in online content and language.)

The ability to display content or application user interfaces in a local language depends on:

▸ The language script being supported in Unicode (see boxed text on Unicode and internationalisation)

▸ Having an appropriate font (typeface) for the language script on the user's computer

▸ The content or user interface itself being translated (if it didn't originate in the target language)

Language support in proprietary commercial software is usually determined by whether the software vendor considers there to be a business case for supporting that language. For example, Microsoft Windows XP supports Japanese, but provides incomplete support for the Thai language, referring to it as a language in an "emerging or minority language market."[6] It may be possible to lobby or influence software vendors to provide support for a particular language, but if the vendor declines, there are no further options available.

Open source software, on the other hand, can be customised and translated into local languages by anyone prepared to invest the time and resources to do so. Open source projects usually welcome user interface translations and are likely to incorporate them into the product for others to use. Some online services, such as Google, also welcome contributed translations.

For contexts where local language support is important, schoolnets may therefore have more options in working with open source software and solutions.

Unicode and Internationalisation

Unicode (*www.unicode.org*) is a system for encoding characters which permits the use of multiple character sets for representing text in different languages.

The World Wide Web Consortium (W3C) is actively involved in developing Web standards to support storing and displaying Web content in as many languages as possible. According to the Consortium:

"W3C has successfully stressed the role of Unicode as the base of the architecture of the Web. Recommendations from W3C for data formats and protocols use ISO 10646/ Unicode to identify and describe characters. In implementations, Unicode is the hub for conversion between different character encodings, making sure data can be handled in a uniform way and displayed, searched, sorted, and manipulated without fear of data corruption.

"But character sets are not the only thing that must be addressed for the Web to work internationally. Attention must also be given to a wide range of potential issues that include such things as specifying the language of content, applying directionality aids for Middle Eastern languages, ensuring support for variations in typography for various writing systems, ensuring cultural appropriateness of data formats, and many more.

"Various additional style properties are necessary to cover typography in different scripts. They include various writing directions, the use of a grid in layout, and text justification. Most Latin-based documents use a simple horizontal left-to-right writing direction in which the next line always appears below the previous one. East Asian languages (for instance Japanese) are frequently written top to bottom, with lines arranged from right to left."

Adapted from *www.w3.org/International/Activity*

Device customisation

Most handheld devices, whether PDAs, mobile phones or combined devices, can run third-party applications, beyond those provided by the manufacturer. Platform-independent languages such as Java and wireless standards such as WiFi and Bluetooth have contributed to making handhelds general-purpose network devices which can be used for almost any application.

While handhelds may not have the computing power of a notebook or desktop computer, they can be used for a range of educational purposes. Schoolnets and schools can also customise handhelds to make them even more flexible.

resources

Some Resources on Handheld Devices in Education

The Center for Highly Interactive Computing in Education at the University of Michigan (Hi-CE) has been developing educational applications for handheld computers for four years. Devices include the Palm, Pocket PC, Texas Instruments graphical calculators, and Gameboy. (See *www.handheld.hice-dev.org*/).

HandheldLearning is a Web site dedicated to all people in schools— administrators, teachers, staff, and students—to help them use handheld computers for improving their learning organisations. (See *http:// educatorspalm.org/)*

Handango is a commercial site, providing applications for download for a wide range of PDAs and mobile phones. (See *www.handango.com*/).

Installing, Maintaining and Supporting Networks at Schools

Managing an integrated deployment process

The key to successfully deploying and supporting technology in schools is to ensure that all of the steps in the process are well integrated. The preparation phase, before computers are actually installed in schools, is very important, and the more thorough the preparation, the fewer support problems will arise down the line. Conversely, incomplete preparation or poor quality installation can lead to a lot of support problems, which can become very expensive (e.g., if technicians

must repeatedly visit a school in a remote rural location to fix a recurring problem). Table 3.1 presents a suggested process:

Table 3.1: Managing an integrated deployment process

	Stage	Description
1	Gather requirements and identify constraints	Identify end-user and project needs. Constraints are factors such as a limited budget or limited availability of telecommunications services for Internet connections.
2	Research technologies and possible solutions	Explore the various technical solutions – hardware, software and networking equipment – that will meet the requirements. This can involve evaluating a range of products and looking at how various products can be customised.
3	Develop specifications and final solution	Decide on the final specifications and technologies that will be used. This should be clear enough to form the basis of a tender or request for proposals to suppliers.
4	Procure equipment and services	Identify suppliers to provide the needed hardware, software and services, through a tender or other procurement process. The final agreement with suppliers should include detailed descriptions of what must be supplied and/or how equipment should be installed, and for services, there should be a service-level agreement (SLA) describing the quality of service to be provided.
5	Set up test environment or deploy in one pilot school	Build one complete working network in a test environment and/or at a pilot school. This should not be a prototype set-up, but exactly the same configuration that will later be installed in schools.
6	Develop user, installation and support documentation, and train support and installation staff.	Using the test environment, develop detailed documentation, including screen-shots, of how the system works. This should include installation tasks (e.g., configuring Internet access with ISP details), and day-to-day administration tasks such as adding or removing users. Train technicians who will be installing the final systems at the schools and technical support staff who will be involved in providing follow-up support.

7	Quality assurance of solution and documentation	Ensure that the test environment works correctly and meets the user requirements and that the documentation is clear, consistent and comprehensive. For effective quality assurance, there should be some separation of roles. Ideally, there should be no overlap between the people who develop the system, the people who write documentation, and the people who do the final quality checks.
8	nstallation in schools	Install the equipment in all of the target schools (possibly over a period of months, depending on the number of schools and how spread out they are).
9	Quality assurance of installation	Ensure that the school installations have been carried out to an acceptable quality.
10	Train school ICT managers	Do the initial training of the school ICT managers (i.e., the staff who will be responsible for managing ICT facilities on a day-to-day basis. This should be done as soon as possible after the network is installed, but ideally not before.
11	Support	Provide ongoing support to schools.

It is important to ensure that there is a process for resolving any type of problem that could occur (e.g., hardware failure, installation problems, end-user difficulties) and that there aren't any problems for which no one is prepared to take responsibility.

In some cases, structuring procurement processes appropriately can help. For example, if networking cabling, hardware and software purchasing and installation are all being outsourced to companies, signing a contract with a single company that subcontracts various services can provide a single line of accountability. This also has the advantage of reducing the management overheads of co-ordinating multiple contracts and suppliers.

Projects involving a relatively small number of schools (e.g., fewer than 20) are at a disadvantage, as the research, development and set-up costs are disproportionately high relative to the total value of the project. On the other hand, such small pilots are often valuable, and the support issues may be more easily managed if there is only a small number of people involved in the development and implementation process.

Installation

Installation in schools needs to be aligned with any school preparation necessary, such as installing telephone lines or electrical points (see the section on school preparation above). In large projects where schools are widely distributed, it's particularly important to track the readiness of schools for installation, as otherwise substantial delays can occur, leading to repeat installation visits and increased costs.

When installation takes place, the work done should be signed off by the school principal, and a follow-up visit to check quality and completeness may be valuable. Installation is also a good time to develop a detailed asset register, recording the serial and licence numbers of hardware and software allocated to schools.

The best verification systems are those which require evidence of actual operation. For example, to check Internet connectivity, require the installation team to complete an online form on a Web site, and send and receive an e-mail message.

Wherever possible, assign responsibility for follow-up onsite support to the same supplier or team which handles installations, so that installation teams have an incentive to do the installation well.

Training ICT co-ordinators

At least two staff should be trained from each school in managing and maintaining the computer network and first-line support. Training courses should:

▸ Be hands on and in the same technical environment as the school's network – preferably at one of the participating schools

▸ Avoid theory in favour of practice

▸ Cover common day-to-day operations that network managers will need to do (such as creating and removing users)

▸ Be followed up by refresher and/or more advanced courses.

Technical Training and Support in the Pilipinas Schoolnet Coca-Cola Ed.venture Pilot

Technical support training aims to build the school's capacity for "autonomous maintenance" (i.e., the local staff provides first-line troubleshooting and maintenance, and arrangements with external service providers are optimised0. The following areas are covered:

a. PC troubleshooting (hardware and software)
b. Network administration
c. Software installation and configuration
d. Network security

Capacity-building towards autonomous maintenance was a big challenge. In most cases, there was not sufficient technical skill in the school, and the CMs and ACMs, although the most knowledgeable staff, had no experience with maintaining a local area network. The training burden, therefore, was significant. In the few instances where there were highly skilled personnel in the school, they did not stay in their posts for long. Three of the assigned CMs resigned soon after their Ed.venture Center became operational in order to take up ICT-related jobs outside the country. They had to be replaced by less skilled staff.

Face-to-face training for CMs and ACMs was conducted in three batches. A total of 28 technical support staff were trained. A Center Manager's Manual, which includes, among other things, standard operating procedures, was developed by CITE and given to the CMs/ACMs, for their reference.

This introductory course was followed several months later by more intensive one-on-one instruction for CMs and ACMs at their respective schools. This strategy of individualised training was devised in response to the slow acquisition of skills after the initial training. Results of this second phase were generally positive.

Although some schools are still weaker than others in terms of technical skills, the general reliance on CITE and FIT-ED for technical support (via phone, e-mail or actual school visits) has become less and less over the past year. In some cases, schools contracted trained technicians to provide technical support. In others, in-school technical support is supplemented by local technicians paid for by the school. As of June 2003, Ed.venture no longer provides onsite technical support to schools, but can still be applied to for assistance via telephone or e-mail.

Hardware maintenance and onsite support

The most common and disruptive technical support problems are hardware failures. Hardware failure can be minimised or its impact reduced by:

▶ Buying better quality equipment with lower failure rates – the cheapest equipment to buy may not be the cheapest overall solution, if it fails often

▸ Buying equipment with extended warranty periods (e.g., three years instead of one), and onsite warranty replacement (i.e., the company will arrange for the component to be collected from and returned to the school, or send a technician to fit it in place)

These are both cases where spending more up front can reduce subsequent support costs. The appropriate trade-off depends partly on the cost of onsite support. Where there are many schools in remote rural locations, replacing hardware or providing support onsite is likely to be very expensive because of the travel time and costs to reach the school from the nearest support centre. However, if most of the schools are in easily accessible urban areas, buying cheaper hardware at the expense of more support visits may be appropriate.

In general, onsite support is more expensive than remote telephonic or Internet-based support, and wherever possible, proactive strategies (such as good documentation, effective training and reliable hardware) should be followed to reduce the need for onsite support. However, a completely arms-length approach to schools may be counterproductive, and scheduled periodic visits to schools can also be a valuable proactive support strategy.

Help desks

Help desks are a "one-stop shop" for resolving problems. They should act as an interface between the school, and whichever support technicians, suppliers or organisations can resolve the problem. Help desks should perform the following functions:

▸ Answer support calls received from users – by telephone, fax, e-mail or online.

▸ Record the details of the user and the problem, and assign a call reference number for subsequent tracking and follow-up.

▸ Wherever possible, resolve the problem immediately by helping the user to diagnose the problem and providing advice and support.

▸ Failing that, assign the call to the person or organisation responsible for dealing with problems of that type.

▸ Follow up with responsible parties to ensure that open calls are resolved in a timely manner, and keep users informed of progress

▸ Produce management information to measure and improve the quality of service provided; for example the average time taken to resolve a problem.

Help desks typically use call logging and customer-relationship management software and may also use advanced telephone systems (e.g., for call queuing, or interactive voice response). They should also be able to access school networks remotely, through dial-up or Internet-based connections, to resolve problems online or reconfigure systems where possible.

Schoolnets that are supporting a significant number of schools or users should always implement some form of help desk, even if it is relatively small (e.g., two or three support staff), as such structured support systems ensure that problems will be resolved and not forgotten about or lost.

Help desks can be run internally or outsourced. Outsourced help desks may be more efficient or cost-effective, especially where the types of problems likely to be encountered are well defined and well documented, but they may also provide a more impersonal service to schools. However, in experimental or pilot projects where the types of problems that could occur are not known in advance, the strategic advantages of running an inhouse help desk may outweigh any cost advantages of outsourcing.

The Malaysia Smart School Project Help Desk

The Smart School Help Desk was set up as a one-stop centre for queries and the escalation of queries regarding the Smart School Integrated Solution and its components. The Help Desk ensured that any problems with the network were addressed within the limits of the service level agreement set out in the Smart School Pilot Project Agreement.

The school ICT co-ordinator in every pilot school was the single point of contact between the help desk and the school for logging problems with any part of the Smart School Integrated Solution, including the network.

Help desk personnel were provided by the consortium developing the Smart School Integrated Solution. These personnel included a support services manager, a help desk executive, a help desk supervisor, eight operators, a network executive, a programmer, three administrative assistants, an application specialist team leader and six application specialists.

A comprehensive systems and network management framework, which encompassed strategies, tools, standards, procedures and workflows, and organisation and training programmes for help desk personnel was used. A proprietary "FOCus" system was used as a central database for the help desk to record and store all maintenance details (including a bug resolution log, all maintenance activities, fault classifications and clearance procedure details).

Users are able to access the help desk using the following means:

▸ Telephone (where the caller is charged local call charges for any call made to this number from anywhere in Malaysia)
▸ E-mail
▸ Internet through the World Wide Web
▸ Fax
▸ Mail correspondence

The help desk operates from 8 a.m. to 6:30 p.m., Monday till Sunday.

Proactive support

Proactive support involves:

▸ Using a variety of methods to reduce potential system failure and support requirements of users

▸ Identifying potential problems before they can occur, and fixing systems before they fail

▸ Identifying problems as they occur and initiating action to resolve them, rather than waiting for users to contact the help desk

Proactive support reduces overall support costs and improves the availability of systems and user satisfaction. Elements contributing to proactive support include:

▸ Thorough and easy-to-use documentation for everyone involved in the process from installation teams to end-users. Documentation should not only include common procedures, but also troubleshooting steps.

▸ Frequently asked questions (FAQ) lists, which collect the most common questions together with answers (especially helpful for new users)

▸ Appropriate information security systems and policies to prevent viruses, worms or deliberate intrusions

▸ Network and other monitoring systems that identify problems as they occur, or unusual patterns of activity

▸ Support systems that can record common problems and the solutions for later reference (e.g., on a Web site)

▸ Automated software update systems that update software components to the latest versions without requiring user input.

Alternate support options

Some other strategies that can also be used to improve technical support include the following:

▸ Using students from nearby tertiary institutions or technical colleges (Students may welcome the job experience gained from supporting an operational network.)

▸ Using Internet-enabled peer support through e-mail mailing lists or Web site forums on which people can post descriptions of problems they have and help other people resolve problems

▶ Placing support technicians at schools as part of internship or job experience programmes

However, these strategies should be seen as supporting approaches, as the quality of service that schools receive cannot be managed in the some way as centralised support services, or support contracted to companies. There should still be a last-resort support system to solve problems that don't get solved through any other means.

Technical Support in SchoolNet Thailand[7]

One of the problems faced by SchoolNet in the early stages was the lack of technical support, which prevented many schools from using the Internet. Some schools stopped participating in project activities, while others used local ISPs to access the Internet instead.

Technical support is crucial in the implementation process. NECTEC staff in the SchoolNet team were only able to provide full technical support at the beginning of the project. When the demand for technical support increased, NECTEC developed a volunteer technical support group that could go out to schools to help. NECTEC has also developed a technical support manual and help desk service.

As a result of the increasing number of schools in the SchoolNet (approximately 4,000), NECTEC cannot provide all of the required support and, as a result, many schools look for support from local computer companies. Other strategies such as the development of sister schools to help each other, and some universities setting themselves up as nodes to help schools, have not had much success in practice.

At present, the Ministry of Education has provided a budget for technical support to schools in provincial areas, through subcontracting local technical colleges.

Providing Internet Services

When to provide Internet services

The extent to which schoolnets are involved in providing Internet services varies greatly. Some schoolnets started primarily as connectivity networks (such as SchoolNet Thailand), later expanding into content and training, while others (such as Pilipinas SchoolNet) have focused more on equipping schools with computers, training and curriculum integration with schools using commercial services for connectivity and e-mail.

How and why schoolnets decide to provide Internet services directly is largely a strategic choice, based on factors such as telecommunications infrastructure and the extent of the ICT sector in the country. (Some of these issues are discussed in Guidebook 2.)

Schoolnets should consider carefully which Internet services to provide (if any) and favour providing those that contribute the most value to the educational objectives. Some reasons for schoolnets to operate services include:

▶ User requirements cannot be met by existing services

▶ The schoolnet can provide the service at a lower overall cost, and/or at a better quality, than existing service providers (including through sponsorships or partnerships with commercial providers)

▶ Speed of implementation or flexibility is important (e.g., in experimental or pilot projects)

▶ Integration across a range of services is important

The following are factors to consider in operating Internet services are:

▶ The capital costs to set up the service (e.g., hardware and connectivity)

▶ The technical expertise required to set up and maintain the service

▶ The operating costs of the service (e.g., server hardware, backup systems, bandwidth)

▶ How to provide end-user support and help desk services if required

▶ The extent to which the service can be scaled up as and when required to serve large numbers of schools or users

Some of these potential difficulties can be avoided by schoolnets becoming virtual service providers. A virtual service provider acts as the interface with the school or end-user, but outsources the technical and/or support infrastructure to another larger provider. This has many advantages, including requiring almost no capital costs and not having to worry about how to scale up the service.

Schoolnets should take into account that providing Internet services requires becoming to some extent a service-focused organisation with a sustainable revenue model for maintaining and expanding the service. This may be easy to do where the schoolnet forms part of a larger operational organisation, but may be a challenge if the schoolnet has been established as a separate start-up entity with project funding for a fixed period.

Conversely, schoolnets can also use Internet services as a means to develop sustainable business models for their own long-term support if they can provide the services at a competitive rate to the private sector and build in an operating surplus

Using third-party services

Where it's not appropriate or possible for schoolnets to provide services directly or act as virtual providers, two options are available:

▸ Use commercial services (Schoolnets can either play a role in negotiating discounts for schools as a group, or outsource the service as a whole to a service provider)

▸ Use free third-party services

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Some Free Third—party Services

E-mail
Yahoo Mail: *http://mail.yahoo.com/*
MSN Hotmail: *http://hotmail.com*

Mailing lists
Yahoo Groups: *http://groups.yahoo.com/*

Web site hosting
Yahoo GeoCities: *http://geocities.yahoo.com/*

Instant messaging
Jabber: *www.jabber.org/user/*
Yahoo Messenger: *http://messenger.yahoo.com/*
ICQ: *http://icq.com/*
MSN Messenger: *http://messenger.msn.com/*

Most free services are supported by advertising, which can be intrusive, and typically have other constraints such as:

▸ Limited volumes or capacity (e.g., a size limit on hosted Web sites)

▸ Limited ability to customise (i.e., a fixed set of features)

▸ Lack of integration with other services

However, where these constraints are acceptable, the advantages of these services – including no cost and almost no setup time – are appealing.

Internet access services

Providing Internet access – whether dial-up, over fixed circuits or wireless – is a complex undertaking which requires expertise, good underlying equipment and infrastructure, and a network as large as the geographic distribution of schools.

In countries where there is a large, competitive market for ISP services, it may not be possible for schoolnets to provide Internet services more cost effectively than the private sector, all other things being equal. The cost advantages gained by operating on a non-profit basis may be outweighed by the economies of scale that larger networks can provide.

It may be appropriate for schoolnets to establish and operate dedicated educational networks in cases where one or more of these conditions exist:

▸ The size of the existing private sector ISP industry is not significantly bigger than an educational network would be.

▸ Some underlying elements of the service are being donated, discounted or sponsored (e.g., by a telecommunications company).

▸ The network can piggyback on existing infrastructure (e.g., a tertiary education network).

▸ The buying power of large numbers of schools can be leveraged to obtain bulk discounts.

▸ Other ways exist to reduce costs (e.g., by mobilising volunteers).

As noted above, a good solution in many cases is to be a virtual ISP. That way, the schoolnet can still retain the primary relationship with the participating schools, while being able to negotiate discounts or sponsorships with the outsourcing partner. In this situation, the schoolnet is responsible for billing the schools for Internet services (or whomever is responsible for payment), and the schoolnet in turn pays the outsourced ISP. Technical support can be provided either by the schoolnet or the ISP, depending on the agreement that has been negotiated.

In cases where the schoolnet provides services that need a secure network, but does not provide the connectivity itself, virtual private networks (VPNs) can create secure private networks on top of public Internet infrastructure. VPNs are a relatively simple technology, which can be provided either by hardware (on routers) or software (on servers).

Approaches to Internet Connectivity

Korea and Thailand both operate dedicated educational networks: EDUNET run by EDUNET, and Schoolnet@1509 run by NECTEC (due to be incorporated into the national EdNet network). In Thailand, Schoolnet@1509 is able to offer free Internet with a single national access number at local rates through the participation of the Telephone Organization of Thailand and Communications Authority of Thailand.

In **Singapore** and **Malaysia**, schools have been connected to the existing national broadband networks, Singapore ONE and COINS, the Corporate Information Superhighway. Malaysia set up a virtual private network (the Smart Schools Network) using COINS for the 87 pilot project schools.

In **Indonesia** and the **Philippines**, dial-up connections through ISPs are still the most common mode of accessing the Internet, although national coverage is poor and dial-up rates can be expensive. In the Philippines, Pilipinas SchoolNet negotiated for sponsorship and discounts from telcos and ISPs, and in Indonesia, WAN Kotas (City WANs) are connecting a number of schools through wireless connections on a local co-operative basis.

Cost-recovery models for Internet access

In appropriate circumstances, schoolnets can operate as Internet access providers on a cost-recovery basis (i.e., charging a fee to end-users that covers the set-up and operational costs). This is a viable option where:

▸ Internet access services are not otherwise available to schools at a similar cost

▸ The service can be set up at relatively low cost, and the skills to do so are readily available

▸ Schools can afford the proposed charges

In start-up situations where central or external funding is not easily available, cost-recovery networks can be a cost-effective and sustainable way of providing

services. They are mostly suited to peer-to-peer connection technologies that are easy to deploy, such as dial-up, fixed-line or local wireless services.

A potential disadvantage can occur where there is a range of schools from poor to wealthy: poorer schools may not be able to afford the costs from their own funds, limiting participation to better-off schools. This is an unavoidable equity problem however. Possible solutions include services for such schools to be centrally funded, or "adopt a school" models, where sponsors cover the participation costs of some schools.

Cost-recovery networks are also likely to be relatively limited in scope. While they may provide a range of online services that can be provided at low cost, such as e-mail and Web services, they may not have the ability to invest significantly in facilities such as education portals, for which it is more difficult to directly recover the costs from users.

In the long-term, schoolnets which provide services on a cost-recovery basis are exposed to normal competitive market forces. As Internet services become more of a commodity, schoolnets may lose market share or find that the original assumptions underlying the service no longer hold. This could threaten the sustainability of schoolnets, but could also provide opportunities for them to move into value-added services such as teacher training and educational support.

Indonesia's WAN Kota

The WAN Kota Project in Indonesia is a model for providing wireless Internet access services to schools and other clients within a city. Each WAN Kota (City WAN) is run at the city level.

A local steering committee consists of a local government representative (district MOE) as an advisor, and the heads of the school principal associations for vocational, general and junior schools. The steering committee appoints one full-time manager, three technicians, and three programmers to run the project on a day-to-day basis. These are mostly vocational secondary school teachers and students and active members of the local school information networks (SINs).

Management committees raised funds from clients (participating schools), and built the WAN infrastructure on their own. The number of clients per city varies between 10 and 40 schools and is growing. Some teacher training centres, universities and local government offices have also joined the network.

Each client contributes around US$ 300 annually. School committees and district education boards do not mind this new financial obligation. Additional resources are obtained from advertisements and other sponsorships. A more entrepreneurial management team even showed a cost-recovery or income-generating business plan.

DNS services

DNS (the domain name system) is what translates names (e.g., *www.google.com*) to IP addresses on the Internet, so that names can be used for Web sites, e-mail addresses and other services instead of numbers. Each school should ultimately have its own domain name that can be used for e-mail addresses at that school (e.g., *someone@schoolname.sc.kr*), and the school's Web site (e.g., *www.schoolname.sc.kr*). In this example, **.kr** is the country-code top-level domain (in this case, for Korea), and **.sc.kr** is the second-level domain for schools.

Note that domain names are not an absolute requirement to be connected to the Internet. In particular, schools which have dial-up connections only may just have an e-mail address at their ISP or a Web mail account (e.g., *xyz@hotmail.com*). However, a domain name gives a school a permanent address which can stay the same if the ISP or method of connecting to the Internet changes.

In many countries, schoolnets manage the second-level domain name for schools. This involves:

▸ Managing name servers for the second-level domain (Internet servers which answer DNS queries)

▸ Establishing policy and procedures for domain name registrations (e.g., what institutions are permitted to register names under this domain, what application procedures should be followed, and what registration fees, if any, are levied)

▸ Creating and updating domain name registrations for schools under this domain as required

Schoolnets derive their authority to carry out this function from the country's top-level domain administrator (see the boxed text below on getting started with DNS). This is also the person or organisation whom the Schoolnet should consult if a subdomain for schools does not exist, and the schoolnet wishes to create one.

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Getting Started with DNS

The DNS Resource Directory provides lots of links to DNS resources and software, including the official RFCs (request for comment, which are effectively the Internet's operational standards) concerning DNS: *www.dns.net/dnsrd/*

O'Reilly and Associates publish many standard reference works and tutorials on common Internet topics and building blocks. *DNS and BIND* (4th ed.) describes how DNS works and how to configure BIND, the most common name server software used on the Internet: *www.oreilly.com/catalog/dns4/*

To find out which organisation or person is responsible for Internet domains on a country level, consult this list of country code top level domains (ccTLDs), maintained by the Internet Corporation for Assigned Names and Numbers (ICANN) and Internet Assigned Numbers Authority (IANA): *www.iana.org/cctld/cctld-whois.htm*

E-mail services

E-mail is the most basic and still one of the most useful tools on the Internet. Schoolnets should make e-mail as widely available as possible to participating schools, teachers and students. There are two types of e-mail services that schoolnets can provide: single-user accounts and domain-based email.

Single-user accounts provide an address for an individual (e.g., *someperson@someisp.com*). Technologies that can be used are:

▸ POP3 (a single mailbox, where the user downloads the mail to his or her own computer)

▸ IMAP (a mailbox supporting multiple folders, where new and read mail is stored on the e-mail server)

▸ E-mail aliases where the system forwards the e-mail for a particular address to another address (e.g., mail to *abc@x.y.z* is forwarded to *def@p.q.r*).

▸ Web mail, which allows a user to log in and read e-mail from a POP3 or IMAP mailbox online.

Domain-based e-mail systems forward e-mail for an entire domain (e.g,, *any user @someschool.sc.kr*). The mail can be forwarded to the destination server using:

▸ SMTP for permanently connected servers

▸ SMTP with ETRN or ODMR for intermittently connected servers (e.g., using dial-up connections)

▸ UUCP (mostly for dial-up connections and widely used by some schoolnets, but not widely supported by commercial ISPs)

The school server which receives the e-mail for the domain then makes it available to users on the local network (using whatever methods are supported by the operating system or network). This has the advantage of the local network manager being able to create as many e-mail accounts as needed (e.g., one for every student in the school) at no additional cost.

Single-user e-mail accounts are almost always bundled with dial-up Internet access services, but there may be a need or market opportunity for schoolnets to offer domain-based e-mail for schools using dial-up connections or some other connectivity types. Value-added services commonly provided with e-mail are virus scanning and spam filtering.

E-mail services can also be provided through a virtual or outsourced model. See the section "Schoolnet Infrastructure" and the boxed text on a reference

model for providing online services, later in this chapter, for more details on the requirements for providing e-mail services.

E-mail Services in the Pilipinas SchoolNet Coca-Cola Ed.venture Pilot

Ed.venture does not have a centralised platform as FIT-ED did not consider this a cost-effective option for a small-scale pilot. Schools that have created school and project Web sites use free Web hosting services like Geocities. For their e-mail accounts, students use free services such as Yahoo and Hotmail.

FIT-ED does, however, provide all school administrators, CMs/ACMs and teachers with a Pilipinas SchoolNet e-mail account hosted by Pinoy Mail, the first free e-mail hosting service established in the Philippines. Each account has a capacity of 3 MB.

Migrating to a centralised platform would be worth considering when more schools join the programme and a culture of resource-sharing and online collaboration has been developed among the schools. In the meantime, schools can continue to independently maintain their Web sites and use free online collaboration tools.

Mailing lists

Mailing lists can be a simple but powerful way of keeping in contact with groups of people and building virtual communities. Mailing lists are enabled by list management software, which:

▸ Maintains the list of users subscribed to the list

▸ Allows users and/or the list manager to add or remove people from the list

▸ Maintains archives of messages to the list, which can be viewed through the Web

▸ Allows users to set list preferences, such as receiving messages individually or periodically in a digest

▸ Allows the list manager to configure the list appropriately (e.g., allowing only people subscribed to the list to send messages to it)

Providing a mailing list service requires:

▸ An Internet-connected server running a mail server and a Web server

▸ Mailing list software

▸ An appropriate domain name for the mailing lists and list Web site.

The mailing list system, once configured, can then support any number of distinct lists, each with its own list manager.

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Getting Started with Mailing Lists

Mailman is a popular free mailing list manager that runs on UNIX systems (such as Linux): *www.list.org/*

The book *From Workplace to Workspace: Using E-mail Lists to Work Together*, by Maureen James and Liz Rykert (IDRC 1998) "provides practical and useful advice on how to set up an e-mail list, how to launch it and how to keep it active and vibrant": *http://web.idrc.ca/en/ev-9369-201-1-DO_TOPIC.html*

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Web site hosting

Many schools wish to set up Web sites for their school as one of the first activities after getting online. Hosting such school Web sites can be a straightforward service for schoolnets to provide. The minimum requirements are having:

▸ A server connected to the Internet with a reasonable connection (amount of bandwidth) and disk space.

▸ A Web server

Creating a new Web site for a school involves:

▸ Registering a domain name for a virtual Web site (e.g., *www.schoolname.sc.kr*), or placing the Web site under an existing domain (e.g., *www.school.net.th/schoolname/*).

▸ Configuring the Web server appropriately

▸ Allocating space to the school (including enforcing a space limit or quota if required)

▸ Providing the school with a user name and password to update the Web site, using FTP or WebDAV

Value-added services that can help schools build dynamic, interactive Web sites include providing:

▸ A scripting language (such as php)

▸ A back-end database (such as mysql)

▸ Predefined services that can be integrated into the site, such as guest books and Web forums

▸ Content management systems that allow the school to update content on the Web site without needing to know HTML

▸ Template systems that help a school to build a Web site that follows a standard design by filling in a set of forms

▸ Usage statistics, which show the number of visitors to the site and the most commonly accessed pages

The same approach can be used to host Web sites created for other purposes, such as entries in Web site design competitions such as a country ThinkQuest programme.

A server configuration which can provide most of the above services is described in the boxed text on a reference model for providing online services, later in this chapter.

Web forums and Web-based collaboration tools

In environments with permanent or low-cost Internet connectivity and high-bandwidth connections, people are increasingly using online Web-based environments for discussion and collaboration, rather than e-mail. These can provide structured and threaded views of discussion forums involving more users than would be manageable in mailing lists, and they can provide online spaces for collaborating on the development of content or knowledge products.

Providing such environments usually requires:

▸ A server with a fast connection to the Internet

▸ A Web server

▸ A back-end database

Commercial or free server and software systems for online environments are readily available, but a fair amount of customisation may be needed to get the right "look and feel" for users. For more details, see the boxed text.

AMP Environments

A popular combination of components for building interactive Web sites is the Apache Web server, mysql database and PHP scripting language. All of these applications run on either UNIX or Windows systems, and are sometimes referred to as WAMP (Windows-Apache-mysql-PHP), LAMP (Linux-Apache-mysql-PHP) or FAMP (FreeBSD-Apache-mysql-PHP) systems.

Once a schoolnet has an *AMP system running, there are a number of free Web applications available that run in this environment. Of course, there may be a good reason to use a solution that runs in another environment (such as Cold Fusion, or ASP), but *AMP environments provide an easy and free way to become familiar with the typical features of Web-based collaboration tools.

Some of the popular free applications in use include phpBB and W-Agora for Web-based discussion forums, and TikiWiki, Postnuke, Drupal and Typo3 for integrated online community and content management systems. (See the boxed text on a reference model for providing online services later in this chapter for the URLs.)

A wide range of products, commercial and non-commercial, is listed at "Forum Software for the Web: an independent guide to discussion forum and message board software for Web sites and intranets" at *www.thinkofit.com/webconf/ forumsoft.htm.*

Resource directories

The purpose of resource directories is to help teachers and students find relevant high-quality resources on the Internet. While teachers and students can, of course, find information using public search engines and directories such as Google and Yahoo (and should develop search and information literacy skills to help them in this), education resource directories run at a country level can be tailored more closely for local needs, relating directly to the school system.

Conceptually, resource directories are searchable catalogues which categorise resources in one or more ways so that users can quickly find what they are looking for. An editorial or quality assurance process is applied to ensure that the resources listed are relevant, of appropriate quality and accurately described. Directories can vary in complexity from a small set of static Web pages maintained by a few people, to large database-driven systems with sophisticated search engines and user interfaces.

Resources in the directory could include:

▶ Online teaching and learning resources anywhere on the Internet (Web sites, individual Web pages or content in other file formats such as PDF documents)

▶ Offline resources, such as educational software or products for sale, print or audiovisual material that can be ordered

▶ Books in print format, available from one or more libraries which provide online catalogues

▶ National educational policy documents, training materials and other resources

Metadata (information about resources) should describe each item in terms of categories such as:

▶ Subject or curriculum area to which it applies

▶ Learning outcome

▶ Grade or age for which it is appropriate

▶ Topic or theme

▶ Any other information such as keywords which will make the resource easier to locate by users

With appropriate classification, users can choose how they wish to browse through the directory, and search it in structured ways (e.g., to locate all resources related to geometry in the grade 11 mathematics curriculum)

Information about resources can be contributed to the directory by:

▶ Curriculum developers

▶ Subject specialists

▶ Users (teachers and students)

As ell, the directory can incorporate comments, reviews and feedback on resources from registered users.

A simple resource directory which consists of static pages and limited search functionality can be built using a normal Web site with a third-party search engine. However, this approach is only viable for relatively small directories which do not change frequently. Directories containing a fuller set of features need the following elements:

▶ A back-end database

▸ A front-end Web interface for users (to locate resources in various ways)

▸ A front-end Web interface for directory maintainers (to add and update entries)

▸ A search engine, which can query the database according to user requirements

▸ Notification systems, which advise users of new or updated resources by e-mail

To be effective and provide a quality experience for users, resource directories need to be as up to date and dynamic as the underlying resources that they describe on the larger Internet. Internet resources are fluid by nature. For example:

▸ The content of a resource can change

▸ The location of a resource can change

▸ Resources can become unavailable

▸ Access conditions to the resource may vary (e.g., previously free content could become paid-for content or require registration before use)

Operating a directory therefore needs a combination of good technology (such as automated link checking systems) and constant oversight by directory maintainers. Fortunately, applying appropriate technology should allow tens or hundreds of maintainers to contribute to keeping the directory up to date.

Resource directories by their nature are somewhat specialised, and schoolnets are unlikely to find products which provide all of the features that they may want "out of the box." Creating a resource directory will probably need some design and systems development or customisation work.

Directories can usually be implemented on top of systems such as content management systems, or online community Web sites, which may provide some of the underlying features required.

Content hosting

Schoolnets are likely to want to host some types of online content directly at some point (rather than just providing links to external content). This could include:

▸ Content developed by the schoolnet (e.g., training materials for teachers or learning materials for students).

▸ Content developed and contributed by teachers in the schoolnet community

▸ Local copies of resources listed in the resource directory (subject to permission from the copyright holders)

A number of different methods exist for developing content repositories. These include:

▸ Including the content files directly into a Web site by giving contributors update permissions on part or whole of a site. Web folders can be created on request for contributors.

▸ Creating Web forums, which allow participants to post messages with file attachments. This could be suitable for relatively small contributions by individual teachers (e.g., a lesson plan). The associated message can describe the content, and messages can be organised into appropriately named forums.

▸ Using Web-based archives of e-mail forums. Content can be contributed simply by e-mailing files as attachments to the mailing list. Other users can then browse the archive online and download any files attached to messages.

▸ Establishing a content management system (CMS) and assigning update rights on various sections to contributors. A CMS will allow easier management of uploaded content, and can enforce a common look and feel across an entire site.

▸ Create custom content development toolkits, which allow contributors create content online and upload files in a structured format (e.g., using a series of simple forms). The contributed content can be stored directly in a Web site, or in a back-end database.

At a technical level, content hosting requires:

▸ A server with a fast connection to the Internet, sufficient disk space and backup systems

▸ A Web server and usually also a back-end database

▸ Software applications that facilitate content management (e.g., a Web forum system or content management system)

If it is important to track user access to content or present the content in structured ways (e.g., in a training course), a learning management system (LMS) may also be appropriate. If necessary, access to content can be restricted by username/password and/or Internet address (e.g., to comply with licensing restrictions on commercial content).

Schoolnets may also want to consider ways of distributing content offline for schools or users who have low-speed or expensive Internet connections. This can include distributing content on CD or DVD, or datacasting via satellite.

The SchoolNet Thailand Digital Library Tool Kit

The Digital Library Tool Kit has been designed using web-based technology, which offers an easy-to-use function allowing teachers and especially those with no knowledge of HTML to develop Net based lessons for students.

Seven different templates are available. Teachers enter the name of the resource, an explanation, keywords, the subject and whether for primary or secondary schools. Using forms on the Web site, teachers then enter the text, upload pictures and submit the item. The new resource appears immediately in the Digital Library.

By February 2003, teachers had contributed more than 6,700 titles to the Digital Library.

Education portals

Education portals usual integrate many of the facilities outlined above. Portals aim to be the launch pad for their users – the place on the Internet where most of their information and communication needs are met in one way or another.

In a commercial context, portals are used to capture "mindshare" and market share, usually for targeted advertising and to attract users to pay-for-view content. Portals in the education sector are used to help meet the information needs of users through a consistent and easy-to-use interface, while encouraging the development of vibrant online communities through attracting many education users to one place.

Portals can include any of:

▶ Resource directories

▶ Online content

▶ Web mail e-mail services

▶ Online discussion and collaboration spaces

▶ News aggregation (relevant news highlights from a variety of sources)

▶ Personalisation (allowing individual users to customise the portal's appearance and functionality)

▶ Links to other related services of interest to users

▶ Professional development opportunities

▸ E-mail notification services

At a technical level, portals are a special type of database-enabled Web application. Portals can either be custom-built using various software building blocks (e.g., a Web server, database, content management system, discussion engine, etc.), or implemented using a range of commercial or free portal software products, which integrate a range of features.

Singapore's edu.MALL Portal

Edu.MALL is a network that connects educators, communities and resources in the use of ICT in education. It includes a learning resource centre, forum and professional development area.

It provides a one-stop Web-based access to educational resources and online information services for teaching and learning. It aims to be a supporting mechanism for teachers to have access to information and share their ideas, experiences and setbacks. It also aims to reach out to students and parents to promote creative thinking and lifelong learning in a fun manner. This will touch the students from education to socialisation, hobbies to lifestyle and take them on an interest-driven, light-hearted surf into the digital future.

Operating on the metaphor of a real shopping mall, edu.MALL consists of the following:

▸ eduLibrary: A compilation of ICT teaching and learning resources
▸ eduQuest: Aims to promote research culture in schools and the Ministry of Education so that Singapore will become the research leader of ICT in education. To meet this aim, eduQuest provides a platform to showcase collaborative and research projects on the use of ICT in education. It also connects people for dynamic partnerships on ICT in education.
▸ Professional development: An updated list of ICT-related courses for teachers, heads of departments and principals.
▸ Infrastructure and support: It provides information about ICT support and services for schools.
▸ eduGallery: A showcase of innovative projects, good practices and updates/ registration of ICT competition for schools.
▸ Consultancy centre: Provides advice and guidelines and addresses enquiries for implementing ICT in schools.
▸ Forum: Provides a platform for educators to engage in discussions on the use of ICT in education.
▸ News brief: Regular e-mail updates on ICT in education and information and classroom resources.

A metaphor of the mall was chosen for the one-stop access Web-based platform to provide a useful and powerful mechanism for structuring, organising and designing end-user interface, and navigating Web-based interactive and learning environments. The metaphor used, powered with the right technology, has saved the edu.MALL project team a lot of time in user-training, and this has enabled teachers, students and parents to get on board quickly.

Common features of education portals
For a comparative look at education portals, see *Best Practice in Education Portals* by Neil Butcher (Commonwealth of Learning, 2002.), www.col.org/Consultancies/02EducationPortals_Report.pdf.

Push services

Push services are ways of keeping in contact with registered online community users through notification services such as e-mail, or text messaging on mobile phones. Push services attract users back to online environments by sending them targeted alerts or summaries on particular topics that they have elected to receive. They can also keep contributors to online forums involved by e-mailing follow-up replies to the online posting back to the original contributor.

Technically, push services require database-driven applications that are integrated with e-mail systems or other notification systems.

Examples of Services with Push Components

Development Gateway
The Development Gateway is "an interactive site for information on sustainable development and poverty reduction" built by the Development Gateway Foundation. The Development Gateway allows users to register and subscribe to particular topic areas such as e-learning.

New items posted in those topics can be e-mailed as weekly updates to subscribers. Each update contains a short synopsis of the new resource or item, with a URL that links back to a detailed description of the item on the Development Gateway site and allows the user to click through to the relevant external site: *www.developmentgateway.org/*

News Services
Many news sites and services now allow users to subscribe to daily headlines. An e-mail is generated to the subscriber with article summaries and URLs that allow the user to click through to the full text of the article.

Sites such as The Economist (*www.economist.com*) allow subscription to particular topics, and an e-mail alert is generated whenever an article appears online in that topic area.

image captured from www.economist.com

Schoolnet ICT infrastructure

Operational capacity for technical services

To provide technical services to schools, schoolnets will need some level of operational capacity. The exact elements required depend on the types of services provided and the nature of agreements with outsource partners or other suppliers, but they include the following:

▸ **Technical staff**: Schoolnets will need one or more system administrators to set up and integrate the various services being provided, and they may need system developers if applications need to be customised or custom-written. More specialised functions such as network engineers may also be required.

▸ **Servers**: Schoolnets will need one or more servers for internal operations (such as help desk applications) and hosting online services.

▸ **Connectivity**: Internet connectivity to the schoolnet's servers should have enough bandwidth to accommodate the highest projected level of usage.

▸ **Backup and disaster recovery:** Systems are required to ensure that services can be up and running quickly in the event of hardware failure or a network intrusion.

▸ **End-user support:** A system is needed, including a help desk with support staff to resolve problems from users and to provide proactive support.

▸ **Billing system:** If the schoolnet is operating services on a cost-recovery basis paid for by schools, an appropriate billing system is needed.

Where schoolnets make use of extensive outsourcing arrangements, there will be less need for inhouse technical capacity and expertise, although it will still be necessary to have staff who understand the services and technologies being provided by outsourcing partners and who can develop and manage appropriate service level agreements.

Building educational networks

There are a number of approaches to building educational networks at the IP (Internet protocol) level. The right approach may depend on what services are available from telecommunications companies and ISPs, the number of schools to be connected and whether the network will be funded by individual schools or centrally.

The operational capacity and expertise available to the schoolnet may also determine whether services are provided internally or outsourced. Finally, schoolnets should consider the prospective growth of the network – how quickly new schools will be connected – and the ability of various solutions to scale up.

Here are some typical models for educational networks:

▸ Act as a virtual ISP by entering into an outsource agreement with a large ISP to resell access services directly to schools. Providing national and international connectivity and IP addresses for individual sites becomes the ISP's responsibility, and the ISP bills the schoolnet on the basis of the number of schools connected and the access bandwidth provided to schools (i.e., the speed of the connection from the school to the network). End-to-end security, if needed, can be provided by using a virtual private network (VPN).

▸ Build one or more small access networks to provide connectivity to a relatively small number of schools (e.g., fewer than 50), within a defined geographical area such as a city. Access technologies can include leased-lines, wireless connections and dial-up. National and international connectivity is provided through a single connection to an upstream ISP, which also provides a suitable IP address range.

▸ Build a large national IP network, effectively becoming a national ISP for schools. This will require significant capital investment and technical expertise. The educational network can connect to other national and International networks directly, or connect to a tier-1 ISP for these services.

▸ Build a large outsourced network. Contract a large ISP, telecoms company or existing national network to provide a network service with defined access, national and international bandwidth, and quality of service (such as uptime). The outsourcing partner becomes responsible for all operational aspects of the network. This approach is similar to being a virtual ISP, except that the outsourcing arrangement is to provide a defined network service rather than a series of individual connections.
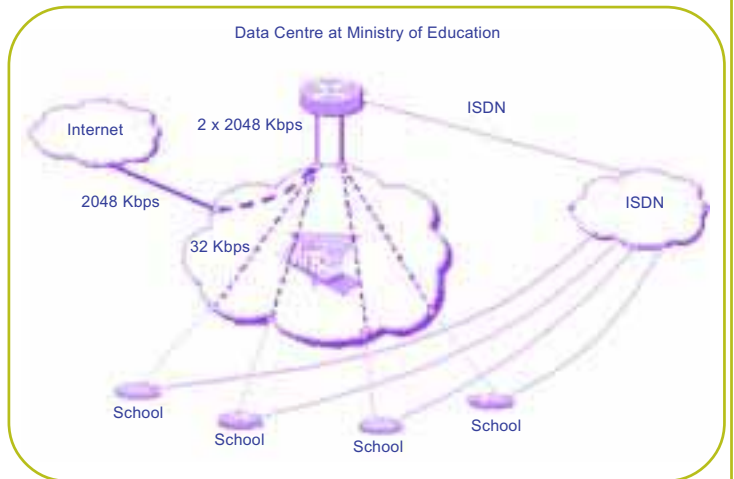
Figure 3.3 shows some models for connecting schools.
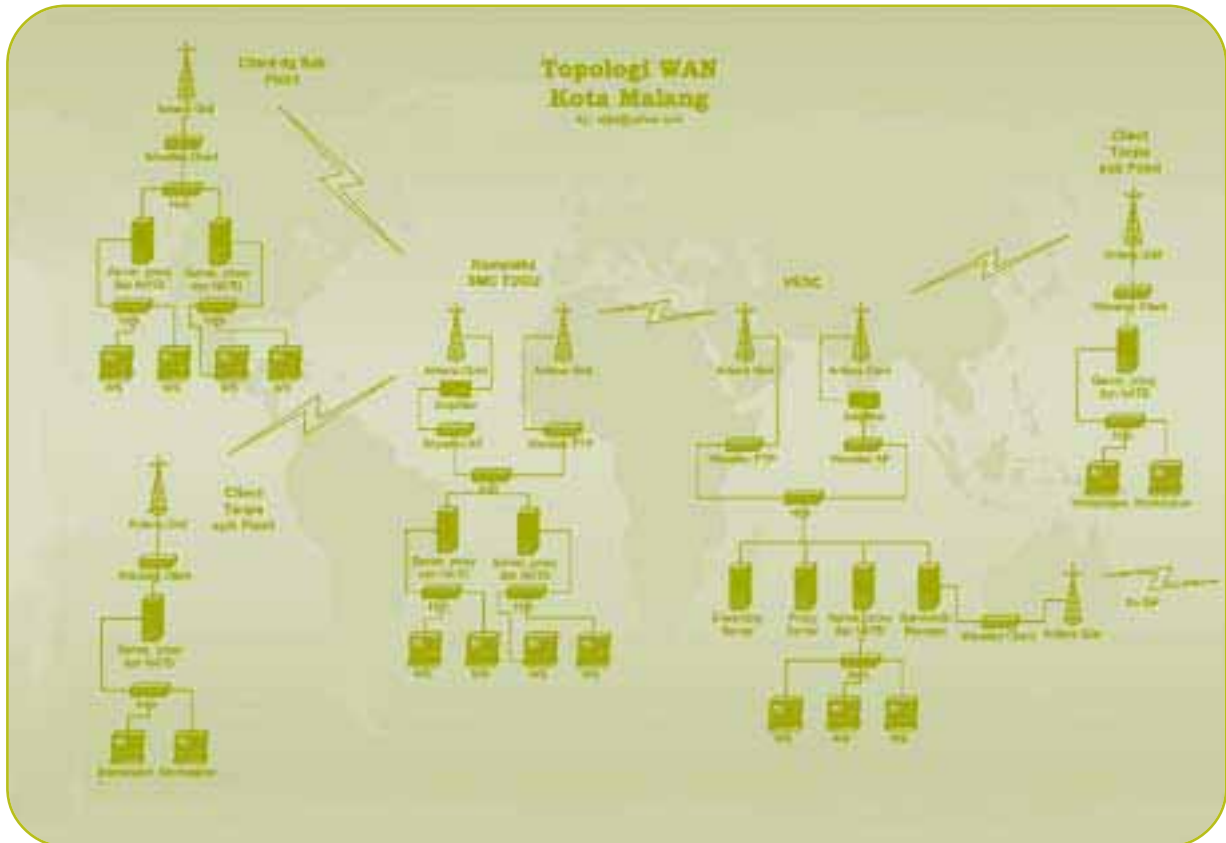
Figure 3.3: Three network models for connecting schools

Thailand's EDUNET
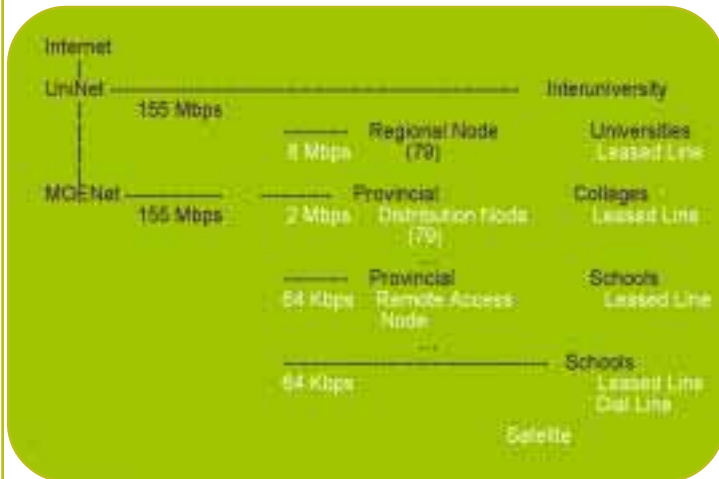
Malaysia's Smart School Network

Indonesia's WAN Kota

[Simplified or redrawn diagram of above city wireless network]

An important factor to keep in mind is that of IP addressing. IP addresses are allocated globally in large blocks by regional Internet registries (see boxed text below on getting started with IP networks) to ISPs and other large networks, which assign them to clients. Normally, this means that if a school or schoolnet changes their upstream ISP, they are required to change all their IP addresses to a new range.

Large or potentially-large educational networks can avoid the effort and expense of having to renumber IP addresses at some stage in the future by using one of two methods:

▸ Obtaining so-called portable address space from a regional registry, which remains assigned to the network no matter which upstream ISP is being used

▸ Using private addressing (possibly over a VPN), where all external connections to the Internet are handled through one or more firewalls and application gateways.

Getting Started with IP Networks

The **Network Startup Resource Center (NSRC)** is a non-profit organisation that has worked since the late 1980s to help develop and deploy networking technology in various projects throughout Asia/Pacific, Africa, Latin America and the Caribbean, the Middle East and the New Independent States. The NSRC provides technical and engineering assistance to international networking initiatives building access to the public Internet, especially to academic/research institutions and NGOs: *www.nsrc.org/*

The **Asia Pacific Network Information Centre** (APNIC) is one of four regional Internet registries currently operating in the world. It provides allocation and registration services which support the operation of the Internet globally. It is a not-for-profit, membership-based organisation whose members include Internet service providers, national Internet registries and similar organisations. APNIC represents the Asia Pacific region, comprising 62 economies, and handles requests for portable IP address space and autonomous system (AS) numbers: *www.apnic.net*

An alternative to obtaining portable IP address space for large networks is to use the **private address space** defined in RFC 1918. These address range (e.g., 10.0.0.0/8) can be used by anyone, but is not routable on the global Internet, so are best used in VPNs and other situations where Internet access for an entire network is provided through a firewall or application gateway which proxies requests or does network address translation: *www.faqs.org/rfcs/rfc1918.html*

Networking equipment vendors often have useful information on networking technologies, in the form of white papers, technology overviews, case studies, training materials or product documentation. The two vendors with the largest market share in routing equipment are currently Cisco Systems (*www.cisco.com*) and Juniper Networks (*www.juniper.net*).

Infrastructure for online services

Online services can be delivered in a number of ways, listed here from least hands-on to most hands-on:

▸ **Outsource the entire service:** Enter into an agreement with an outsource partner to provide a service using their own connectivity, infrastructure, technical and development expertise.

▸ **Rent space on a shared server from a managed hosting solutions provider:** The hosting company is responsible for the server hardware, operating system, and applications such as Web servers, and provides the schoolnet with Web space and related facilities such as access to back-end databases.

▸ **Rent one or more dedicated servers, located in a server hosting facility:** The hosting company is responsible for the server hardware, but the schoolnet deals with all configuration and support issues from the operating system up.

▸ **Buy one or more servers, hosted in a server hosting facility:** The hosting company is responsible only for the Internet connectivity to the server(s) and physical environment such as security and a stable electricity supply.

▸ **Buy one or more servers, located at the Schoolnet's premises:** Here the Internet connection is to the educational network or ISP.

Schoolnet services can rapidly become essential services used by a large number of people on a daily basis, and so uptime, reliability and fast access to the server by users are all important factors. Hosting servers in ISP hosting facilities is therefore attractive in many situations, unless the schoolnet itself has similar facilities with fast Internet connectivity, an uninterruptible power supply and a controlled physical environment.

Examples of Schoolnet Infrastructure Supporting Online Services

Korea
EDUNET, which began in 1996, houses a digital library of instructional materials and is the central Web site where experts and novices meet and share ideas and information. The active participants in the learning community are usually teachers themselves.

Any school can join and have the access to the EDUNET service free of charge. In April 2002, the total number of EDUNET subscribers was over 5.1 million. All schools countrywide are connected to EDUNET at speeds from 256 Kbps to 2 Mbps.

EDUNET operates with more than 50 servers, including three Web servers, nine mail servers, 11 user connection servers, 19 database and content servers and seven community servers. Each server has a different function according to service type.

Singapore
Edu.MALL started out as a collaborative project between the Ministry of Education, the Kent Ridge Digital Labs (KRDL) and National Computer Board (NCB), with participation from the industry. In 1999, the management of the project was passed on to CHAPTER-E.com, the venture company of National Computer Systems (NCS) and Panpac Media.com.

Armed with the ICT infrastructure and capability of NCS and the content and pedagogical expertise of Panpac Media.com, CHAPTER-E.com is able to continually push the possibilities of acquiring and constructing knowledge in creative ways through interactive activities in a learning community. The company has also partnered with other education industry players to enhance the breath and depth of edu.MALL. This includes an e-procurement drive that equips students with an online debit facility to shop online in edu.MALL for education-related products.

Malaysia
The Smart School Portal, BESTARInet, was launched in June 2001, as part of the Smart School Pilot Project. The pilot schools communicate with each other and the Educational Technology Division through the portal. The portal also allows parents to access their children's records online. In addition, an online forum, e-mail, search engines and other online services were made available on the portal.

The users of BESTARInet are mainly the school heads, teachers and students of the pilot schools. Parents and the Smart School Development Team officers also use the portal extensively. As of 2003, about 8,000 teachers and 90,000 students from the pilot schools were using the network.

For the Smart School Pilot Project, three servers to handle communications, databases and applications were placed at the data centre located in the Ministry of Education's Educational Technology Division, Kuala Lumpur. The data centre is connected to the COINS broadband network through a 2 Mbps leased line. Schools connect to COINS at speeds ranging from 128 Kbps to 512 Kbps.

The team has started a research and development project to examine the potential of open source software and is experimenting with open source software for the e-mail messaging service.

Getting started

Schoolnets can start up new services at relatively low cost by using open source software. Open source platforms are widely used for providing Internet services. For example, according to Internet measurement company Netcraft, the open source Apache Web server has just over two-thirds of the market share for Web servers.[8] Open source platforms are also highly customisable and can be evaluated or deployed without incurring any initial or subsequent licence costs.

The reference model outlined here presents a sample set of choices for an operating system and applications which can provide all of the online services described above.

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resources

A Reference Model for Providing Online Services

Here is a sample configuration for providing a range of online services for a small to midsize Schoolnet community (e.g., up to 2,000 schools). The server uses easily available hardware and a suite of open source software. The hardware cost should be no more than USD 7500, and there are no software licence costs. Such a server can support hundreds or thousands of concurrent connections, depending on the applications being used.

Hardware
- 2 or 4 Intel Xeon processors
- SCSI RAID 5 disk controller, with 3 x 80G drives (for 160 G usable space)
- 2-4G RAM
- Tape backup drive

Open source software

Operating system components:

Linux or FreeBSD	*www.linux.org/www.freebsd.org*
bind dns server	*www.isc.org/bind/*

Web caching:

squid proxy cache	*www.squid-cache.org*

Web and database services:

apache	*www.apache.org*	ldap server	webalizer
php	*www.php.net*	www.openldap.org	www.mrunix.net/webalizer/
mysql database	*www.mysql.com*		

Mail services:

exim MTA	*www.exim.org*	imap/pop3 server	asg.web.cmu.edu/cyrus/imapd/
Taylor uucp	*www.airs.com/ian/uucp.html*	IMP webmail	www.horde.org/imp/
odmrd	*www.plonk.de/sw/odmr/*	mailman list server	www.list.org

Discussion forums: one of

phpBB	*www.phpbb.com*
W-Agora	*www.w-agora.net*

Content management systems and community sites: one of

postnuke	*www.postnuke.com*	typo3	www.typo3.com
TikiWiki	*www.tikiwiki.org*	Plone	www.plone.org
Drupal	*www.drupal.org*		

Learning management systems: one of

ATutor	*www.atutor.ca*
ILIAS	*www.ilias.uni-koeln.de/ios/index-e.html*
Moodle	*www.moodle.org*

Instant Messaging:

jabber server	*www.jabber.org*

Creating schoolnet communities

The value of communities

A sense of community is at the core of most schoolnets. Schoolnets that form through grassroots initiative are created from a spirit of collaboration for mutual benefit. Schoolnets that are centrally planned, top-down programmes that distinguish themselves from other models of education service provision by focusing on promoting sharing, communication and collaboration. Communities are inherent in the idea of a network: communities are people networks, and schoolnets are people networks enabled by ICTs.

Where schoolnets are connectivity providers, belonging to a schoolnet need not only be about Internet access or using the schoolnet's services. Schoolnets can foster a sense of community beyond the set of services that the schoolnet may provide, emphasising a sense of identity and ownership as a collective of schools and teachers, rather than being just a service-provision entity.

Professional communities are important for teachers because of the rapid pace of change in ICTs and the new educational paradigms and opportunities for teaching and learning that they introduce. Active communities can contribute to:

▶ Building social capital – defined as "the degree to which a community or society collaborates and co-operates (through such mechanisms as networks, shared trust, norms and values) to achieve mutual benefits."[9] Social capital helps to build the basis for effective learning in learning communities and is important element in the sustainability of ICT projects.

▶ Harnessing the collective energy and abilities of people to achieve extraordinary results – for example the creation of digital libraries of teaching materials.

▶ Sharing tacit knowledge held by practitioners such as teachers. Tacit knowledge is knowledge embedded in practice that often has not been formalised in written resources or training materials, for example.

▶ Supporting professional development programmes through encouraging peer learning, reflection and feedback.

▶ Providing day-to-day peer support mechanisms for teachers.

At a strategic level, schoolnets can use active communities as two-way communications channels for keeping in touch with the evolving needs and concerns of teachers and with what is happening in classrooms and schools and to promote participation in schoolnet activities and projects. A conceptual

basis for the role and function of communities in organisations has been established in literature on communities of practice and learning communities. Etienne Wenger highlights the value of building communities to promote learning and organisational performance:

> *"For organisations...learning is an issue of sustaining the interconnected communities of practice through which an organisation knows what it knows and thus becomes effective and valuable as an organisation.*
>
> *"...If we believe that people in organisations contribute to organisational goals by participating inventively in practices that can never be fully captured by institutionalised processes... We will have to value the work of community building and make sure that participants have access to the resources necessary to learn what they need to learn in order to take actions and make decisions that fully engage their own knowledgeability."*[10]

Vibrant communities arise from the willing interaction of participants and need to be fostered or nurtured. Community-formation can be encouraged by:

▸ Providing communication tools and online community and collaboration environments

▸ Promoting collaboration by design in various schoolnet and teaching activities

▸ Organising events and activities that promote networking and professional and social interaction

What Are Communities of Practice?

Communities of practice are based on the following assumptions:

▸ *Learning is fundamentally a social phenomenon.* People organise their learning around the social communities to which they belong.
▸ *Knowledge is integrated in the life of communities that share values, beliefs, language and ways of doing things.* These are called **communities of practice**. Real knowledge is integrated in the doing, social relations and expertise of these communities.
▸ *The processes of learning and membership in a community of practice are inseparable.* Because learning is intertwined with community membership, it is what lets us belong to and adjust our status in the group. As we change our learning, our identity—and our relationship to the group—changes.
▸ *Knowledge is inseparable from practice.* It is not possible to **know** without **doing**. By doing, we learn.
▸ *Empowerment—or the ability to contribute to a community—creates the potential for learning.* Circumstances in which we engage in real action that has consequences for both us and our community create the most powerful learning environments.

Adapted from *www.funderstanding.com/communities_of_practice.cfm*

Stages of Development of Communities of Practice[11]

Developing a schoolnet Web site

A schoolnet Web site is the starting point for developing a schoolnet community. The schoolnet site is the public face of the schoolnet organisation or initiative, and it should be one of the primary communication strategies used by the schoolnet to stay in touch with its constituency of teachers, schools, students, parents, partners and other members of the education community.

Here are some guidelines for schoolnet Web sites:

▸ Choose a simple URL that is easy to remember (e.g., *www.pilipinasschoolnet. org* or *www.school.net.th*).

▸ Make clear who the Web site is for: identify the primary readership (e.g., teachers) and secondary readerships, and design the site accordingly.

▸ For teachers and schools, promote participation on Web site for schoolnet activities and other online projects, and advertise the schoolnet's services.

▸ If the schoolnet is an organisation in its own right (rather than part of the Ministry of Education or another organisation), present a corporate overview on the Web site (e.g., information about the organisation and its objectives and governance, and a profile that will appeal to potential funders and partners).

▸ Consider having the schoolnet Web site serve as a central directory of online schools, providing links to their Web sites.

▸ Update news, features and resources on the Web site regularly so there is an incentive for readers to come back to it often. Update the look and feel periodically but less often (e.g., every year or two years).

▸ Allocated people and time to the Web site: there should be at least one person directly responsible for updates and editorial oversight. All of the projects run by the schoolnet should have some presence on the site; contributing material to the Web site should be everyone's responsibility.

▸ Use a content management system to make the job of updating the Web site less time-consuming and to preserve a consistent look and feel.

▸ Promote the Web site and make it visible by registering it with popular search engines and by requesting related organisations to provide a link to it from their Web sites. Ideally, the Web site should appear within the top 10 search results on search engines if a user searches on the schoolnet or Web site's name.

▸ If there is a separate education portal or online community environment, consider the relationship of the schoolnet Web site to those other

environments. For example, do they form part of the schoolnet Web site, or have distinct branding ? Are the sites clearly related?

▸ If there isn't a separate resource directory and content repository available, provide links to resources for teachers and host content contributed by teachers.

▸ Provide clear contact details and ways to give feedback

The Pilipinas SchoolNet Home Page

www.pilipinasschoolnet.org

The Pilipinas SchoolNet Web site includes a vision, news and features, a list of schools, tele-collaborative projects, resources for teachers, links to external resources, information about the schoolnet and how to join, information about the schoolnet's partners and contact details.

Further down the page (not shown) is a log in button for SchoolNet Web mail, a search facility, a navigation bar at the bottom of the page including links to a privacy policy and terms of use, and a link to FIT-ED, the organisation that runs Pilipinas SchoolNet.

The Web site is hosted on a Linux server using PHP and the Apache Web server.

Conferences and workshops

Conferences, workshops and other special events which bring together teachers can play a major role in speeding up the acceptance and adoption of ICTs. Conferences help shared interests coalesce into shared action, and of course face-to-face interaction is the traditional way in which relationships and a sense of community are developed.

Conferences can be used to:

▸ Showcase grassroots activities (ways in which teachers use ICTs on a day-to-day basis)

▸ Introduce new projects, opportunities, technologies and products to large numbers of teachers

▸ Provide immersion experiences for teachers, exposing them to a range of uses of ICTs in a supportive and creative environment

▸ Allow teachers and schools to benchmark their activities and progress against others, and gauge prevailing attitudes to ICTs

▸ Provide indications for policymakers, funders and the education community of the extent of involvement by teachers and schools in using ICTs

▸ Support teachers' perceptions of the educational value of ICTs, through the involvement or endorsement of high-profile leaders.

Some ideas for schoolnet conferences are:

▸ Make the conference less formal to encourage participation (e.g., allow informal presentations in slide-show format, without requiring presenters to submit a full paper)

▸ Emphasise demonstration and sharing best practice

▸ Provide hands-on experience where possible in computer labs

▸ Make sure teachers have enough time for informal interaction and to network with each other and with presenters – a large part of the value of the conference

▸ In addition to the planned programme, provide time and facilities for "birds of a feather" meetings – ad hoc special interest groups

▸ Provide online conferencing facilities such as Web forums, running before and in parallel with the conference

▸ Publish the conference proceedings online; the collection of papers, presentations and other resources submitted by presenters can in itself be a valuable resource for years afterwards

Conferences are often an attractive proposition for corporate sponsorship as they provide wide exposure for sponsors to teachers and schools and generate media opportunities. Corporate partners can also often contribute in-kind resources and operational support. By securing sponsorship and making use of volunteers and the resources available in the schoolnet network, schoolnets can also keep registration costs low, further encouraging participation.

In between staging major events such as conferences (which can be run every year or second year), schoolnets can maintain interest and momentum by running smaller events which don't require the organisational overheads of conferences, such as seminars or one-day workshops.

The Schoolnet Conference in Korea

The first Schoolnet Conference in Korea was held in 1998, inspired by the INET Conference held in Kuala Lumpur the previous year. Since then, the conference has been held annually.

When the idea first arose, e-learning was in its infancy, and not many people knew how to apply ICTs to education. The conference brought together various professionals, including educational technologists, computer scientists and content experts to understand the best ways of applying ICTs to education.

The objective of the Schoolnet conference is to provide opportunities for sharing information and experiences among educators, students and vendors in order to understand how to enhance education through e-learning. Teachers describe instructional methods of using ICTs, and new instructional materials and educational software that they have used.

The conference grew from 300 delegates in 1998 to 800 delegates in 2001, when the conference also hosted the ICCE international conference. However, since then attendance has been declining slightly, as there is now a range of conferences and events, each focusing on ICT applications within specific subject areas, which teachers are more interested in. Teachers now also actively participate in the many online communities provided by EDUNET and private companies: *www.schoolnet.or.kr*

Software Fairs in Korea
Since 1998, educational software exhibitions have been held to show new educational software to teachers and to allow software developers to advertise their products. The 5th Educational Software Fair in 2002 toured through four major cities from 14 March to 6 April 2002, and about 425,000 people visited the exhibitions.

Online communities

In some cases, online interaction can be a simple extension of community interaction established in conventional environments. ICTs provide ways for people to keep in touch between and beyond face-to-face interaction. However, using ICTs for communication can also lead to online communities that are different in many ways to face-to-face communities. For example:

▶ ICTs can free communities from being geographically bound – communities can extend across cities, countries and time zones.

▶ ICTs make it easier for people with special interests to form a community, even if the participants are widely dispersed.

▶ Online communities can provide encouragement, interaction and support for individuals who they may not otherwise receive in their immediate environment.

▶ It is relatively easy to participate in many different online communities.

▶ ICTs provide a wider range of ways in which to engage with people (e.g., using e-mail, instant messaging or Web forums). Each mode of communication has its own conventions and forms.

▶ Online communication is less bound by external social factors, and it also needs a different set of conventions to replace face-to-face cues such as body language or tone of voice.

▶ Online communities can be significantly larger than offline communities, although there may often be a small core of active participants and a much larger group of "lurkers" who participate infrequently, but remain interested in and associated with the community.

Online communities therefore need not only the right environments and technologies, but also some degree of planning and management. Schoolnets can identify and train online community facilitators who help to organise and develop online communities for particular purposes.

Getting Started with Online Communities

Here is an overview of the steps it takes to build your own virtual community:

▸ Identify your community purpose or goal.
▸ Identify your target audience.
▸ Think about which interaction tools would serve your purpose and audience and how to structure the space.
▸ Think about how you want to host or facilitate your community
▸ Build it
▸ Draw in the members
▸ Go and nurture it!

From "What is a Virtual Community and Why Would You Ever Need One??", Full Circle Associates, *www.fullcirc.com/community/communitywhatwhy.htm*

See also: www.fullcirc.com/community/communitypurpose.htm
www.fullcirc.com/community/communitytypes.htm
www.fullcirc.com/community/conferencestructure.htm
www.fullcirc.com/community/communityfacilitation.htm

Communication tools

Communication tools allow two people to communicate with each other, or multiple people to communicate in a shared space, synchronously (at the same time), or asynchronously (participating at different times).

The focus here is on Internet-based communication tools (i.e., tools that work on Internet-connected networks). Of course there are other non-Internet communications systems which have been used by schools, such as telephones, faxes and ISDN videoconferencing. However, these are often too expensive for extensive use, especially across long distances.

Internet-based communications technologies are usually low cost (they run on existing Internet infrastructure, with users paying only for local Internet access costs), and can easily be used on a large scale.

Table 3.2 summarises the types and applications of most communications tools.

Table 3.2: Internet-based communications tools

Tool	Type	Applications
E-mail	Asynchronous, online or offline	Effective and convenient for person-to-person communication and perhaps the most practical technology for users who have slow or expensive Internet connections.
Mailing lists	Asynchronous, online or offline	Effective as a push technology. Mailing lists work well for low-volume forums (e.g., fewer than 20 messages a day), but high-volume mailing lists can be difficult for users to manage. Mailing lists can also be archived on a Web site.
Web forums	Asynchronous, online	Web forums provide flexible ways of organising and participating in discussions, such as using multiple topic areas and threads. They work well for both low- and high-volume discussions. However, users need to return to the Web forum frequently to view new postings. Some Web forums also integrate with e-mail (e.g., to e-mail replies to messages to the user who posted the message).
Instant messaging (IM) and presence awareness	Synchronous, online	Instant messaging allows users to send short messages which immediately appear on the recipients desktop. Multiple users can participate in online conferences or chat sessions. Presence awareness allows users to see if other nominated users are online and available.
Audio and video calls and conferencing	Synchronous, online	Audio and videoconferencing requires a fast Internet connection, but if usable, can add visual and audio cues to communication between people. Useful for person-to-person communication or conferencing with a few participating sites.
Text messaging (SMS)	Asynchronous, offline	Not strictly an Internet technology, but can easily be integrated with online and e-mail environments using Internet-SMS gateways. Text messages to users with mobile phones can be used for automated alerts, or as a fallback means of communication.

Different communication tools are appropriate for different types of communication. For example, instant messaging is useful for short messages that need an immediate response from someone, and live chat sessions using IM can quickly establish a sense of community and participation. However, for interaction that benefits from more thoughtful, considered responses, it can be better to use asynchronous tools such as e-mail and Web forums. Each tool, therefore, has appropriate roles, depending on the nature and purpose of the communication and online community.

Community environments

Communication tools describe how people communicate in technology terms, whereas an online community environment can be thought of more as a "space" or a "place" – somewhere that people return to often and that takes on a life of its own.

Most community environments are Web applications, which use an underlying database. Common features include:

▸ User registration (user names, passwords, user preferences and forum or topic subscriptions)

▸ A discussion engine for Web forums

▸ First-person publishing options such as blogs and journals

▸ Integration with e-mail

▸ News posting and syndication systems

▸ Content management features and resource databases

▸ Collaboration systems

▸ Access control to create both private (restricted) and public discussions and areas.

▸ Instant messaging.

Many of the features in community environments overlap with those in portal systems or content management systems, and often the difference is simply a matter of emphasis.

Collaboration environments

Collaboration environments are online spaces where a group of people (large or small) can work together to collectively build a product or assemble information in meaningful ways to create knowledge.

Whereas community environments emphasise discussion and interaction, collaboration environments (which can form part of a broader online community system) emphasise a shared workspace and the creation of a product. In a schoolnet context, this could be a teaching resource or a set of training materials. Features can include:

▸ Is Web-based (i.e., based on a Web site, and users can access and update content through a Web browser)

▸ Supports read and write (update) access by multiple authors, possibly with granular access controls (specific authors may update specific parts of the resource)

▸ Maintains a version history so that it is possible to see the evolution of a document and revert to previous versions if necessary

▸ Provides a flexible structure where it is easy to add pages or sections

▸ Supports multiple types of content (e.g., text, images)

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resources

Exploring Online Collaboration with A Wiki

"A Wiki is a Web site where anyone can edit the pages through an HTML form. Linking is done automatically on the server side; all pages are stored in a database. This may sound rather simplistic, but a Wiki is a very unique way to collaborate on the Web. The addictive quality of a Wiki is that *making pages is as simple as making a link to them.* If they don't yet exist, the page link will be followed by a hyperlinked question mark; follow that link and you can define the new page."

Adapted from *http://phpwiki.sourceforge.net*/

Wikis are indeed a very simple way to start building shared Web sites, the and expose users to some of the concepts of online collaboration and content management systems. Wikis come in many flavours – more complex Wikis have features such as user authentication and storing the revision history of pages.

Wikis are used for collaboration by corporate teams, research groups and software developers, and some large public knowledge enterprises, such as the Wikipedi (*www.wikipedia.org*), "a multilingual project to create a complete and accurate free content encyclopedia."

Available Wiki software includes phpWiki (*phpwiki.sourceforge.net*), and TikiWiki (*tikiwiki.org*). Visit the WikiWikiWeb at *http://c2.com/cgi/wiki* to find out more.

Integrating communication strategies

Each of the above communication methods and tools and community activities and environments has its own strengths and value. Where schoolnets have a particular objective in promoting community participation (e.g., as part of a professional development course), then a mix of strategies should be chosen appropriate to the participants and purpose. For developing schoolnet communities in general, schoolnets should develop an integrated communication strategy that uses as many communication channels as possible.

Different people will prefer different communication styles. For example, some may be happier using e-mail than instant messaging. An integrated approach allows people to participate as and when they wish, using the tools with which they are most proficient and comfortable.

Finally, it is important to allow "passive participation" (e.g., by inviting people to subscribe to an opt-in news and announcements list). This should keep everyone up to date on the schoolnet's activities and opportunities for online interaction so that people can become more involved whenever they choose to do so.

resources

Further Resources on Online Communities

Wenger, Etienne. *Communities of Practice: Learning, Meaning and Identity.* Cambridge University Press, 1998.

Wenger, Etienne. "Communities of Practice: Learning as a Social System," *Systems Thinker* June 1998, *www.co-i-l.com/coil/knowledge-garden/cop/lss.shtml.*

Naidu, Som. *E-Learning: A Guidebook of Principles, Procedures and Practices*. The Commonwealth Educational Media Centre for Asia, 2003, *www.cemca.org/e-learn.htm.*

Full Circle Associates, *www.fullcirc.com.*

Funderstanding: "Communities of Practice," *www.funderstanding.com/communities_of_practice.cfm.*

Educational software and content

Approaches to online resources

With the rapid expansion of the Web over the last decade, the rich set of Web-based content available has become of the Internet's greatest attractions. For educational networks, improving access to educational content is a large part of the rationale for investing in ICTs (although not the only one – content should not overshadow other uses such as using the Internet as a communication and collaboration medium, and using software tools to support productivity, administration and management).

Schoolnets do have the option of simply providing Internet connectivity to schools, on the assumption that there is already some good educational content available online and that increasing access to the Internet will stimulate increased production of digital resources through the operation of normal market forces. However, there may also be strong strategic reasons for schoolnets to adopt much more proactive approaches. These can include limited accessibility or suitability of existing content (through language barriers, or poor alignment with curriculum needs), or a desire to speed up the rate of adoption of ICTs, or fill certain gaps which market forces may not ordinarily address.

Schoolnets can start by surveying the range of existing content and content producers on the Internet, and then consider various approaches for optimising content production and use (or supply and demand). In this context, "content" refers to any digital educational resource, including software. Educational content producers include:

▸ The private sector: the traditional publishing industry and new media companies (A number of companies targeting youth markets have also established educational portals, for public benefit reasons as social responsibility initiatives, building brand awareness and loyalty, or to attract people into an online environment with marketing and e-commerce opportunities.)

▸ Schoolnets and Ministries/Departments of Education.

▸ Teachers and other practitioners in the education system

▸ Students

▸ Third parties such as universities and cultural and scientific institutions such as museums

There are many approaches to content development (see Table 3.3). These vary in respect to the expertise or capacity used to produce the content, the upfront versus. variable costs involved, who assumes any financial risk involved and who retains the copyright and intellectual property rights for the content.

Table 3.3: Approaches to content development

Method	Advantages and Disadvantages
Develop content directly	This can be expensive and time-consuming because of the range of skills required (instructional design, content knowledge and technical). However, this can make available a body of resources to meet targeted needs that is freely available at low distribution cost to a potentially large number of users.
Buy or license content	Quality educational resources, especially those developed for global markets, may be easily obtained without significant upfront costs. The private sector retains the copyright and assumes all of the risks involved in producing the resources. Limited economies of scale may be possible through negotiating bulk purchases or licence agreements
Contract other institutions to develop content	Uses content knowledge and development capacity already existing in other institutions, while retaining copyright and the ability to make the content freely available.
Adapt, reversion or translate existing sets of content	Content development costs can be lowered by adapting either free or commercially licensed content. The licensing conditions of the original content may impose restrictions or licence costs for use of the adapted material. Adapted material may also not be as authentic or appropriate as custom-developed material.
Support the content production industry, and promote industry partnerships	Helps to build country capacity for continued development of educational content. Can result in educational content available in the market being more appropriate and relevant for local needs.
Promote grassroots content production by teachers	Harnesses the creative capacity of the country's teachers, and allows sharing of tried-and-tested, practical resources. May be more useful for some types of content (e.g., lesson plans) than others, as in general teachers may not have the range of skills required for developing complex content resources. A quality-assurance system may be needed to select the best contributions.
Promote favourable intellectual property rights	Existing copyright regimes usually favour the creators or producers of content, and limit the extent to which resources can be reused or adapted. Alternate licensing conditions can promote reuse.

An Integrated Educational Content Strategy in Korea[12]

Educational content plays an important role in reforming various educational activities and methods. KERIS has actively participated in developing and disseminating educational content:

The *development of new multimedia educational materials* began with the adoption of new textbooks in accordance with the Seventh School Curriculum. It focused on developing a common basic textbook for each grade. Multimedia educational materials have been available on EDUNET since May 2001. As of June 2002, material has been developed for all elementary school, grades and for some subjects and grades in middle and high schools.

The *teaching learning plan using ICT* is a plan to develop and distribute current teaching plans and materials in multimedia formats. A development guide and a service system for these materials have been constructed by KERIS, and the model schools have been refining their content since 2001. The Ministry of Education and Human Resources Development has designed various types of materials so that teachers can choose, revise or supplement appropriate materials on their own for their particular classroom.

The *teaching software development plan* is a plan to develop the software and other supporting teaching materials necessary to support class activities using ICT. Each of the 16 Offices of Education in cities or provinces was in charge of developing software for a particular subject. The software is designed to meet the demands of specific school levels, grades or curriculum, and is distributed through EDUNET. Over 3,500 applications had been developed by May 2002.

The *educational software development plan* is a plan to develop software and self-study materials to facilitate a self-directed learning environment in which elementary and secondary school students can study independently. This material makes it possible for students to pursue more in-depth study or to supplement class material through the Internet.

The *dissemination plan for educational software developed by the private sector* seeks to improve both teaching methods and the growth of the software industry. The Ministry of Education and Human Resources Development and the Offices of Education have operated the Authentication of Educational Software programme to help consumers identify reliable educational software, and they have subsidised schools in purchasing approved software.

The *operation of model schools using ICT* is a plan to apply a teaching learning model using ICT and to develop and disseminate a teaching learning plan using ICT. There are 16 model schools selected by the ministry, and 21 model schools selected by Offices of Education. The results of the operation of model schools will be stored in an educational information database and will be available to teachers as useful educational content through EDUNET.

The *construction of an educational information network* includes a plan to share, through metadata, educational content among Offices of Education in cities and provinces, training institutes and schools, and thus to promote education using ICT. KERIS and the Offices of Education constructed the educational information network to simplify searching for and using educational content. Users are able to get information quickly and easily, because the original materials remain in educational institutions such as schools or Offices of Education, while metadata exists on an information network such as EDUNET.

Some strategies for promoting content use are:

▸ Index appropriate content on resource directories or education portals so that it is easy for users to locate.

▸ Guide users towards appropriate content by formal or informal evaluation methods, such as providing official endorsement of approved packages, or collating informal feedback from end-users.

▸ Develop the use of metadata to describe content, increasing the ability to accurately index, search for and share content resources.

▸ Encourage affordable pricing of commercial content, and explore ways of reducing licensing costs such as purchasing schoolnet-wide or regional licences.

▸ Use low-cost methods for packaging and distributing large volumes of content to schools and teachers, such as CDs, DVDs or broadcast technologies.

Evaluating educational resources

The volume of educational resources available in digital form is large and increasing. Schoolnets can undertake four specific activities to promote evaluation and selection of appropriate resources for teaching and learning purposes:

1. Develop or adapt a framework for evaluating educational resources. This could be in the form of a rubric or set of criteria for quality, curriculum relevance and other factors, and should be usable by software producers, teachers and schools alike.

2. Develop the ability of teachers and school managers to evaluate software effectively, by including resource evaluation in training programmes, using the resource evaluation framework as a guide.

3. Review selected educational resources and approve or endorse resources that meet the criteria.

4. Encourage feedback from teachers on which digital resources they have found helpful, and make this feedback available in a structured form to other teachers.and free resources: *www.teem.org.uk*

The Authentication of Educational Software in Korea

As hundreds of educational software programmes are produced every year and the quality of these vary, it is not easy for teachers, students or parents to evaluate them. They cannot try a large number of programmes, nor can they choose appropriate ones by depending on advertising.

To address this situation, KERIS has been authenticating educational software since August 1998 to help consumers get reliable information and to guide developers by providing direction for software development and improvement.

Each year, KERIS designates about 100 software programmes as "acceptable" through an authentication mark which is printed on the final product for sale.[13]

An Online Educational Software Review Site
Teachers Evaluating Educational Multimedia (TEEM) is a service of the UK's Department for Education and Skills. TEEM "provides teachers with free access to independent, classroom-based evaluations of educational multimedia. Because TEEM-trained classroom teachers write these evaluations, readers can be sure that they are receiving impartial, thorough and reliable advice."

TEAM also organises resources by subject area and key stage and indexes both commercial

Using metadata

Metadata is data about data, or structured information that describes an item of content or software. Metadata standards are helpful because they allow resources to be indexed and searched in a consistent way, and they promote the ability of resources to be shared or used in different environments.

In an educational context, the advantages of establishing metadata standards shared by everyone involved in producing and using content are:

‣ New educational resources can easily be included into portals and resource directories, using the metadata information that is provided with the resource.

‣ Metadata promotes searchability and indexability, as there is a common way of describing content understood both by producers and users.

‣ Learning objects that are packaged with appropriate metadata can be used in any learning management system that supports the underlying metadata standard; metadata therefore promotes content portability and increases software choice.

‣ Metadata can support distributed architectures, where resources may physically be located anywhere on the Internet, but can be described and indexed centrally in a central metadata repository (such as a portal or resource directory).

Schoolnets may be appropriately placed to support the use of metadata in two key ways:

1. Defining and adopting an appropriate set of metadata for describing educational content at a country level. This is most commonly done through a consultative process with stakeholders, by adapting and extending one or more existing "parent" metadata sets, to preserve interoperability with existing metadata systems. The principle reason to become involved in such a standards-generating activity – rather than simply adopting an existing international standard – would be to increase the ability to describe resources in terms of national curriculum frameworks and learning outcomes, which may not be adequately reflected in generic metadata sets.

2. Encouraging or enforcing the use of the adopted metadata standards. This can be done in more or less prescriptive ways, depending on the relationship with content producers and the leverage that the schoolnet has to require compliance. For example, teachers contributing content to a digital archive could be asked to fill in metadata information when they submit

3. A resource, or adherence to metadata standards could be required for any content or software purchased or endorsed by a schoolnet or Ministry of Education.

Metadata Standards for Educational Resources

EdNA Online (Education Network Australia) provides a resource site on METADATA, runs a metadata tagging mailing list for discussion about metadata use and has constructed a metadata set for Australian use:

"The advantage of using a metadata standard is that your data will interoperate with others that use the same standard...Within Australia the EdNA Metadata Standard is agreed across all education sectorsÉin each state and territory. The EdNA Metadata Standard is based on Dublin Core and is interoperable with AGLS, and Australian Standard, and The Learning Federation Metadata Application Profile which was developed to provide a framework for describing learning objects in the school education sector." (See *www.edna.edu.au/edna/go/pid/333*)

Some of the key e-learning metadata organisations and standards are:

Dublin Core Metadata Element Set
NISO, the National Information Standards Organization, a non-profit association accredited by the American National Standards Institute (ANSI), identifies, develops, maintains, and publishes technical standards to manage information in our changing and ever-more digital environment: *www.niso.org*

IMS Global Learning Consortium
The IMS Global Learning Consortium develops and promotes the adoption of open technical specifications for interoperable learning technology. IMS is a worldwide non-profit organisation that includes more than 50 contributing members and affiliates. The consortium provides a neutral forum in which members with competing business interests and different decision-making criteria collaborate to satisfy real-world requirements for interoperability and re-use: *www.imsglobal.org*

IEEE LTSC
The Learning Technology Standards Committee (LTSC) is chartered by the IEEE Computer Society Standards Activity Board to develop accredited technical standards, recommended practices and guides for learning technology. The LTSC co-ordinates formally and informally with other organisations that produce specifications and standards for similar purposes: *ltsc.ieee.org*

SCORM
The Sharable Content Object Reference Model (SCORM) defines a Web-based learning Content Aggregation Model and Run-Time Environment for learning objects. The SCORM is a collection of specifications adapted from multiple sources to provide a comprehensive suite of e-learning capabilities that enable interoperability, accessibility and reusability of Web-based learning content: *www.adlnet.org*

Intellectual property rights and open content

Intellectual property rights (IPR) is an umbrella term which refers to various protections that may be granted by law to the creators of forms of "intellectual property" (although some argue that the term "property" in this context is a misleading analogy to physical property).[14] IPR is regulated by national and international legislation and agreements on copyright (for created works), patents (for innovations) and trademarks (for recognisable brands).

The Internet has focused renewed attention on IPRs. As digital material is easy to copy and modify, there is both concern about copyright being ignored online and interest in new ways of applying copyright for more flexible and open use of online resources.

The copyright holder of a work may determine how that work is used, distributed and adapted through the associated licence conditions. Content producers often have an incentive to retain copyright, as this maximises their potential to earn revenue from the resource. Schoolnets or content purchasers have an incentive to obtain copyright to any commissioned material, as this maximises the usefulness of the resource – in particular, it can then be widely used without further cost, and subsequently adapted if necessary.

An appropriate position on copyright therefore involves balancing the financial incentives to content producers with the degree of freedom associated with the resulting material. Typically, it is more expensive to obtain the copyright to commissioned material rather than simply limited rights of use. Schoolnets should therefore do a cost-benefit analysis when deciding whether to acquire copyright for commissioned resources.

Schoolnets can also use copyrights and flexible content licences to promote the "digital commons": the shared set of online resources that are freely available for use or adaptation by others (see the boxed text below on Creative Commons licences for one example).

An intellectual property rights strategy for schoolnets should therefore include the following elements:

▸ Where the development of educational resources is publicly funded with no profit motives on either side, schoolnets should acquire copyright to all materials and consider making the materials available under flexible licence conditions which favour end-users.

▸ Where resources are being funded in whole or in part with a profit motive, schoolnets should negotiate for the most favourable copyright and usage terms.

▸ Where resources are contributed by teachers on a voluntary basis, schoolnets can ensure that copyright is assigned to the schoolnet, granting the schoolnet

the ability to license, distribute and modify the resource as needed, or the resource is licensed by the creator under a flexible licence such as Creative Commons.

▸ Encourage the use of open and flexible content licenses by third-party content producers who are creating content in the public interest. In the best case, such licences should allow anyone to distribute and create derivative works for non-commercial purposes.

For more information on educational software and content, seesection on Online Content and Software in Guidebook 2.

Creative Commons Licences

Creative Commons is a project devoted to expanding the range of creative work available for others to build upon and share. It does so by making available licence options that content producers can use and combine, described as "some rights reserved" licences. These help to "build a layer of reasonable, flexible copyright in the face of increasingly restrictive default rules."

An example is the "share alike" option, which permits anyone to create a derivative work based on the licensed work, provided that it is available to others under the same terms as the original (i.e., other people can also use and adapt the derived work).

See *http://creativecommons.org/*

Professional development

Introduction

Schoolnets should consider three broad target groups for training and support:

▸ School managers (see the section on ICT leaders and managers earlier in this guide)

▸ School ICT managers (see the section on training ICT co-ordinators earlier in this guide)

▸ Teachers (discussed in this section)

Of course, there are also other constituencies such as students, parents, school communities and officials in management and support roles in the education system for which schoolnets may also design or run training programmes, but these are beyond the scope of this chapter.

For teachers, ICT professional development seeks to do the following:

▸ Use ICTs to improve the day-to-day efficiency of teachers (e.g., by using word processors and spreadsheets for common administrative tasks)

▸ Use ICTs to support existing teaching practice (e.g., by locating and adapting online teaching resources)

▸ Change teaching practice over a period of time (e.g., by introducing new pedagogies enabled by ICTs).

Clearly training programmes need to go far beyond ICT skills training (developing the competency to use standard applications), to address the role of ICTs as an integral part of teaching and learning practice in the classroom (often described as curriculum integration).

However, it should be realised that whereas supplying technology to schools can turn a school from a no-technology zone to a high-technology zone overnight, teachers take time to become familiar with, adopt, apply and adapt new technologies, and the process cannot usually be fast-tracked. Professional development programmes therefore need to be designed to support these processes and to provide the right types of support at the right time.

Table 3.4 outlines some strategies for the different states of professional development.

Table 3.4: Effective strategies for the stages of learning/adoption

Developmental Stage	Effective Strategies
Stage 1. Teacher as Learner	
In this information-gathering stage, teachers learn the knowledge and skills necessary for performing instructional tasks using technology.	Time for training; demonstrations of promising practices; ongoing professional development by peers rather than one-shot workshops by outside experts; in-service sessions that stress the alignment of technology with curriculum and standards.
Stage 2. Teacher as Adopter	
In this stage, teachers progress through stages of personal and task management concern as they experiment with the technology, begin to try it out in their classrooms, and share their experiences with their peers.	Online resources, help desks, and other forms of readily accessible technical support; mechanisms to deal with technical problems as they arise; in-building technical specialists; other technology-savvy teachers who can mentor new users and provide them with care and comfort as well as information; open lab workshops at school sites to solve specific technical problems.
Stage 3. Teacher as Co-learner	
In this stage, teachers focus on developing a clear relationship between technology and the curriculum, rather than concentrating on task management aspects.	Workshops and online resources with strategies for enhancing instruction and integrating technology into the curriculum; collegial sharing of standards integration; exemplary products and assessment ideas; use of students as informal technical assistants.
Stage 4. Teacher as Re-affirmer or Rejecter	
In this stage, teachers develop a greater awareness of intermediate learning outcomes and begin to create new ways to observe and assess impact on student products and performances, and to disseminate exemplary student work to a larger audience.	Administrative support; an incentive system that is valued by adopting teachers; awareness of intermediate learning outcomes such as increased time on task, lower absenteeism, greater student engagement, and increased meta-cognitive skills; evidence of impact on student products and performances; dissemination of exemplary student work.
Stage 5. Teacher as Leader	
In this stage, experienced teachers expand their roles to become action researchers who carefully observe their practice, collect data, share the improvements in practice with peers, and teach new members. Their skills become portable.	Incentives for co-teaching onsite workshops; release time and other semi-permanent role changes to allow peer coaching and outside consulting; support from an outside network of teacher-leaders; structured time for leading in-house discussions and workshops; transfer of skills if teacher goes to another school.

Reprinted with permission from the February 2000 issue of T.H.E. Journal.[15]

Planning a professional development process

Here are five planning steps for setting up an ICT training programme for teachers:

1. Situate the training within the school context and a broader professional development process:

   • Ensure that there is adequate support from school management. This should include processes such as schools establishing a technology plan and doing a school technology assessment as a starting point (see boxed text on technology self-assessment frameworks and tools below).
   • The training programme should provide sustained support to teachers, rather than being a once-off event. Ensure that teachers see the training programme as developing their long-term skills and abilities.
   • Ensure that there is Education Department support for the training programme. This is especially important if the schoolnet is a non-governmental organisation.
   • Align the schoolnet training with any other training programmes under way (e.g., in new curricula), both so that training messages reinforce each other and are complementary, and that there are no logistical clashes.

Teachers as Adult Learners[16]

As adult learners, teachers have a specific context and needs. Some of the relevant characteristics of adult learners are:

▶ They are autonomous and self-directed. They more readily accept responsibility for learning. They want to work on projects that reflect their needs and interests. They want to work at their own pace.
▶ They have a great foundation of experience and knowledge that includes work related activities. They want to connect learning to this experience.
▶ They are goal orientated. They are interested in the goals of a learning activity and how this relates to longer-term learning pathways.
▶ They are relevancy-orientated. They want to see the reason for learning and how this relates to their work. They need to be able to choose contexts that are relevant to them.
▶ They are practical and prefer learning by doing. They perceive even greater benefit when they learn skills and create products that help them in their work.

The implications of this are that learning for teachers should:

▶ Be flexible in terms of pacing and content
▶ Be modularised
▶ Not be generic
▶ Include the teachers' specific contexts
▶ Be practically orientated, preferably situational.

2. Establish or adopt an ICT competency framework (see the boxed text on ICT competency frameworks below). This should underpin the design and content of training programmes and provide a roadmap for schools and teachers, so that the objectives of training and support programmes are clear. This will also allow teachers to evaluate their own progress and choose their own learning pathways as needed.

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resources

School Technology Self-Assessment Frameworks and Tools

North Central Regional Educational Laboratory (NCREL) *enGauge* Online Assessment:
www.ncrel.org/engauge/assess/assess.htm

CEO Forum School Technology and Readiness (STAR) Chart:
ww2.iste.org/starchart/

Christopher Moersch's LoTi framework:
www.learning-quest.com/software/loti.pdf
www.lotilounge.com

ICT Competency Frameworks
International Society for Technology Education (ISTE) National Educational Technology Standards for Teachers: *http://cnets.iste.org/teachers/*

International Curriculum & Assessment Agency Group (ICAAG): *www.icttg.co.uk*

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3. Establish school needs and constraints. For example:

- What is the existing level of ICT skills among teachers?
- When and for how long are teachers available for face-to-face training (e.g., during school hours, after school hours, on weekends, only during school holidays), and for online training models, how much time are teachers able to commit to participation and completing activities during a typical week?
- What support systems are available to teachers onsite or nearby (e.g., is there a school ICT manager available to assist teachers and resolve problems; how effective are technical support mechanisms)?
- What are the technical and cost constraints at school level (e.g., is access to the Internet limited or expensive, which suggests a preference for e-mail, or are there any constraints imposed by the level of hardware and software in the schools)?

4. Establish certification and accreditation requirements. How will participation in the training programme be certified? If completed training modules will be accredited by a third-party, what assessment requirements will there be?

5. Determine the operational requirements and capacity needed to deliver the training programme:

   • What expertise will be needed on the part of trainers, facilitators or mentors? Is this expertise readily available?
   • What geographical coverage is involved (where are schools that need training)?
   • What training materials will be required, and in what languages?
   • What infrastructure will be needed to deliver training programmes (e.g., Internet-connected computer labs at schools or centrally, a training Web site or learning management system, training administration and tracking database, etc.)?
   • Over what time period will the training programme operate?
   • What scheduling and selection methods will be used (e.g., will individual teachers be able to opt-in to training courses at any time, or will all teachers at a school be required to participate together)?
   • What are the budget constraints and key cost-drivers?

Training models

Common training models fall under these categories:

▸ **Face-to-face model:** This usually involves an experienced trainer training teachers in hands-on workshops in a computer lab. It can be delivered either centrally (teachers travel to a training venue), or if numbers permit, at the teachers' own school. While easy to implement, the disadvantages of this model include relatively high cost, lack of flexibility (all teachers must attend training at the same time, and it is often difficult to secure enough continuous face-to-face time with teachers), and poor retention rates, as the model tends to compress a lot of "just-in-case" information into intensive sessions with limited follow-up support.

▸ **Cascade model**: This model, also known as "fan" or "echo" training, is sometimes used to achieve large-scale impact using face-to-face training. It involves training a core group as trainers, who then go on to train others (and possibly repeat the process). Advantages are that teachers are trained in the context of their workplace by more experienced peers. Disadvantages include possible dilution of training quality if the second-tier of trainers are not as proficient in practice as the original trainers, or do not have time to assimilate new concepts, values and skills before being required to pass them on to others.

▶ **E-learning model:** This model provides training to teachers using ICT-enabled distance education, with various interaction and support systems built in. Typically teachers are placed into groups and work through a set of Web-based materials and activities. Group members communicate with each other and the group facilitator or mentor through e-mail or online Web forums. The group facilitator oversees progress through the activities, encourages interaction, provides support to group members, and may also have an assessment role. This training model is asynchronous – teachers participate in their own time, although each course takes place over a defined time period, with activities due on certain dates.

E-learning programmes are easier to scale up because there are fewer logistical and scheduling constraints, and they make more efficient use of skilled trainers (who act as group mentors or facilitators). They also provide more flexible learning pathways for teachers, who can choose which courses to participate in. The disadvantages are that they depend on reliable and stable connectivity and technical infrastructure, and they require teachers to be self-motivated, disciplined and to already have basic ICT skills (such as being able to use e-mail).

▶ **Self-study model:** this model uses computer-based training (CBT) software or multimedia applications for teachers to work through by themselves at their own pace. These are most commonly used to support skills training (developing application competencies).

▶ **Blended learning model:** This approach combine the above models as needed in a training programme.

In practice, most e-learning programmes introduce e-learning as a second phase, after some basic ICT skills have been acquired in face-to-face training. Participants in e-learning programmes can also be supported in various ways, such as by follow-up onsite training visits, and by colleagues at the same school.

Some International Teacher Development Programmes

Intel Teach to the Future
Intel Teach to the Future is a worldwide effort to help both experienced teachers and pre-service teachers integrate technology into instruction and enhance student learning.

Teach to the Future uses a cascading, face-to-face training model. Participating teachers learn from other teachers how, when and where to incorporate technology tools and resources into their lesson plans, and how best to create assessment tools and align lessons with educational learning goals and standards. The programme incorporates use of the Internet, Web page design and student projects.

Launched in 2000, Intel Teach to the Future has trained teachers in 30 countries. Intel often collaborates with ministries of education or other government entities to adapt the curriculum for each location. See *www97.intel.com/education/teach/*

World Links
World Links is a global learning network linking thousands of students and teachers around the world via the Internet for collaborative projects and integration of technology into learning. The core "value added" of World Links is its training programme, designed to help teachers and students learn to use ICTs (particularly the Internet) to improve teaching and learning.

World Links' face-to-face teacher professional development materials comprise five 40-hour-modules which combine pedagogical instruction in the use of educational technology with practical hands-on skills development and teacher-teacher collaboration. The training materials are created in flexible modular formats that can be adapted to specific country needs.

World Links' eLearning uses simple and scalable technology to reach thousands of teachers, students and community members at less cost than other methods. It builds upon World Links' wealth of experience from providing face-to-face professional development for teachers, and it takes into account the existing information infrastructure in developing countries, as well as the need to keep training content aligned with curricula and educational goals. See *www.world-links.org.*

iEARN
iEARN is a non-profit global network that enables young people to use the Internet and other new technologies to engage in collaborative educational projects that both enhance learning and make a difference in the world. iEARN workshops are designed to cover the technical, collaborative and organisational skills needed to participate fully in a global, collaborative Internet-based learning environment. iEARN offers both face-to-face and online professional development workshops and courses for educators seeking to integrate online global project work into their classrooms.

iEARN's online courses are asynchronous. This means participants work in their own time from home or school to complete weekly assignments. However, courses are very interactive and communication is continuous during the course period. Each course has 25 participants and two facilitators. Teachers communicate with one another through the iEARN discussion forums to discuss assignment and readings, and can expect frequent feedback from facilitators and participants throughout the course period. Lessons and assignments take participants step by step through the process of integrating an online collaborative project into their classroom. See *www.iearn.org/professional/online.html.*

Identifying training programmes and providers

The three main elements in training programmes are:

▸ Training materials (whether print-based or Web-based, online or offline)

▸ Trainers, facilitators and mentors

▸ Delivery systems (such as training administration, tracking and assessment systems, and online environments for e-learning such as learning management systems)

Schoolnets can adopt various approaches to putting in place these training elements, including:

▸ Creating a customised training system from the ground up (this can be expensive and time-consuming)

▸ Working with local institutions that have some or all of the training capacity in place

▸ Customising or adapting programmes from other schoolnets and education ministries

▸ Working with international programmes

Well-known international programmes include World Links, Intel Teach to the Future, and iEARN (see boxed text on previous page). These programmes are usually customised or adapted for local conditions through some form of country agreement, so should be seen as a starting point, rather than as "drop-in" solutions.

Locating in-country training capacity may be difficult for schoolnets in the first few years of operation if they are introducing new concepts and approaches that are not yet widely understood or accepted elsewhere in the education system. In this situation, schoolnets can develop custom programmes on a small scale or adapt international programmes, while also working to develop ICT training capacity in existing teacher-training providers.

Teacher Professional Development in Thailand

Thailand has used several training approaches as the schoolnet programme has grown and developed. In 1996, NECTEC provided introductory training courses for participating schools at NECTEC's facilities in Bangkok.

However, as the number of member schools increased around the country, it became obvious that centralised training was no longer practical. Rajabhat Institutes emerged as Thailand SchoolNet's training partner, with campuses nationwide able to offer Internet training courses.

Educational personnel development is now one of the four important strategies of the Ministry of Education ICT Master Plan, which aims to develop all educational personnel (teachers, faculties and staff, educational administrators and personnel of all institutions within the ministry) in the following areas:

1. Basic knowledge and understanding of information technology system and Internet for educational administration and management
2. Basic skills for the use of computers and network system, Internet, network administration and management, and software tools
3. Application of ICT tools to the development and production of instructional materials in digital format, including software development for educational administration and management
4. ICT vision development in instructional and learning management and administration, including the implementation of the vision
5. Specific training in collaboration with international ICT for Education projects and exchange programmes.

There are also special training courses designed for ICT teachers run by the Institute for the Promotion of Teaching Science and Technology (IPST). Most of the courses aim to prepare master trainers to provide training for teachers to effectively implement the newly established ICT curriculum at all school levels, both pedagogy and content.

The Training Programme for the Pilipinas SchoolNet Coca-Cola Ed.venture Pilot
The Open University of the University of the Philippines (UPOU), the leading state-run higher education institution in the country, is Ed.venture's primary professional development partner. UPOU is involved in curriculum and materials development, training delivery, post-training support and trainee performance monitoring and evaluation.

World Links conducted trainers' training on tele-collaborative learning for the core trainers of the Ed.venture pilot, and has also provided access to its professional development materials, piloted in over 20 developing countries around the world.

The Instructional Use Training Program is in three phases: basic computer and internet skills, information literacy and tele-collaborative learning, and ICTS and curriculum integration.

Phase I was delivered as a 48-hour graduate level course for teachers, in partnership with UPOU and the University of Cebu (UC). This course focuses on computer fundamentals, productivity tools, Web search and e-mail. Phase II is a 35-hour workshop that builds on the fundamentals learned in Phase I. It focuses first on information literacy, or the ability to locate, evaluate and use information properly. The workshop then introduces the concept of tele-collaborative learning and takes participants through the tele-collaborative project cycle — project design, implementation, dissemination and assessment. The expected outputs for this workshop are tele-collaborative project designs ready for implementation in class.

In Phase III, the focus is on two Web-based instructional activities, the online treasure hunt and the Web quest. Participants are asked to make online treasure hunts and Web quests for specific lessons in the curriculum covered by the E-Learning Club project. Emphasis is also given to formulating rubrics for assessing student performance in each activity.

Delivering and managing training courses

Here are some of the operational steps needed to move from training programme design to successful implementation:

▸ Develop or adapt training materials:

  • Allow sufficient time for localising, adapting or translating materials before training implementation (typically three to 18 months).
  • Pilot the materials with a small group of teachers before finalising them for large-scale use.

▸ If working with external training providers:

  • Agree on the curriculum and training design.
  • Formalise the agreement with a written contract, which details training deliverables and outputs.

▸ Identify, recruit and train trainers and online facilitators:

  • Define the minimum requirements for trainers and facilitators (such as prior experience).
  • Recruit trainers and facilitators by advertisement or other methods.
  • Run training courses for trainers and facilitators which model the mode of delivery that will be used (e.g., facilitators who will provide training online should themselves go through a similar training course online).
  • Draw up and sign a detailed written contract with trainers and online facilitators, which sets out the tasks that they are required to perform, and on what basis payment will be made.

▸ Build and/or implement any delivery systems that may be required. These could include:

  • Training administration systems, which keep track of training sessions (which trainers have been assigned to which sessions) and any related information (such as attendance data).
  • E-learning platforms, such as learning management systems, mailing list systems or Web forums.

▸ Communicate with participating schools. If appropriate (e.g., for schools in a particular project), establish a written agreement with schools concerning their responsibilities and teachers' participation. For example, schools may be required to ensure that a certain number of teachers participate in the training programme, or that participating teachers are given time off from other duties.

▸ Advertise the training courses to teachers to attract participation. Even if teachers are required to participate as part of a project, they will benefit from feeling invited. The communication with teachers should set out:

- The objectives of the training programme, and overview of course contents
- Prerequisites if any for participation (some advanced modules may require prior modules or certain skills; e-learning courses may require a face-to-face course to be completed first)
- The duration of the course, the time commitment that will be required of participating teachers and any other obligations (such as to support other teachers)
- The incentives for participating in and completing the course (completion certificate, accreditation for further study, etc.)

▸ Set up training evaluation systems (e.g., design feedback mechanisms such as course evaluation forms or online comment facilities).

▸ Deliver the training programme. While training courses are underway:

- Ensure as far as possible that technical and other support systems are in place and working well. E-learning programmes depend heavily on reliable connectivity, and technical problems can badly disrupt a training course.
- Track participation in training courses, and respond proactively to poor participation. For face-to-face courses, participation is reflected in course attendance, and for e-learning courses, e-mail traffic and activity completion can be monitored. Poor participation could be a result of technical or organisational problems at schools which need addressing.

▸ Implement a robust quality-assurance system. As training programmes scale up, it is possible to lose quality and therefore impact and effectiveness.

▸ Periodically review and revise the training materials and approach based on feedback from teachers and any formative and summative evaluation.

Finding the Right Mix of Skills: Training Teachers for Curriculum Integration in Thailand

Based on IPST's experience in curriculum development and teacher professional development, key personnel that have to be involved in the working process are subject content specialists at university level, experienced teachers in each subject area, science and mathematics educational supervisors, science equipment designers and educational technologists.

Undertaking ICT education activities is similar, but even more difficult. An example can be seen from the current teacher professional development programme of IPST, which aims to train science and mathematics teachers in integrating ICT into their subject areas.

Integrating ICT tools into teaching and learning process requires knowledge of the subject matter, ICT skills and pedagogical skills. It is difficult to find three-in-one instructors to accomplish the goals of the training programme. IPST curriculum developers have to work in collaboration with science and mathematics master trainers and educational technologists from universities or Rajabhat institutes for effective delivery of training courses.

Supporting teachers

One of the most important components in ICT professional development programmes is to provide ongoing support to teachers, especially since one of the goals is to produce long-term changes in teaching practices.

Appropriate training design can contribute to supporting teachers by:

▸ Providing modular training opportunities over a period of time

▸ Providing training courses that extend over a number of weeks or months (allowing teachers to integrate new concepts and course activities with classroom practice)

▸ Providing additional support resources in training materials that teachers can consult as and when needed (such as tip sheets and how-to guides)

▸ Providing computer-based training (CBT) applications to support acquiring basic applications skills

Teachers may need both technical and pedagogical ad hoc support. In the best case, support should be available to teachers as and when they need it. Such support could be in the form of:

▸ Help from colleagues, the ICT co-ordinator or onsite technical support staff

▸ A central help desk, which can respond to telephonic, e-mail or online queries

▸ Online mentors, who can provide support to teachers during or beyond training courses through e-mail or Web forums

Lastly, teachers need appropriate support from school management: they should have sufficient time to participate in training programmes (especially e-learning programmes which require involvement in the teacher's own time over an extended period), access to ICT facilities when needed,\ and encouragement and recognition.

For more information on professional development, see section on Professional Development in Guidebook 2.

Feedback, assessment and evaluation

Introduction

Evaluation is an important but complex area for schoolnets. A number of evaluation issues are discussed in Guidebook 2, including:

▸ Reasons for conducting evaluations

▸ ICT indicators for measuring progress in ICT adoption and diffusion

▸ Self-assessment tools that teachers and schools can use to gauge their level of technology use

▸ Macro-economic indicators and their relationship to Internet use in the education system

▸ Evaluation and assessment components

This chapter focuses on the more practical aspects of assessing and evaluating schoolnet activities.

Measuring activity and participation

At a concrete level, schoolnets can measure ICT activity and participation through gathering a range of quantitative usage data that can be automatically logged. Schoolnets providing Internet services typically have first-hand access to such data; in other situations, data can usually be obtained on request from the service providers involved, or be collected from individual school networks. Types of usage information include:

▸ Internet traffic throughput, possibly broken down by type of traffic (e.g., e-mail, Web page requests, audio- and videoconferencing)

▸ Web page requests, analysed by volume of requests, and the most frequently accessed sites

▸ Number of e-mail messages sent and received

▸ Number of active e-mail users (distinct e-mail addresses in use)

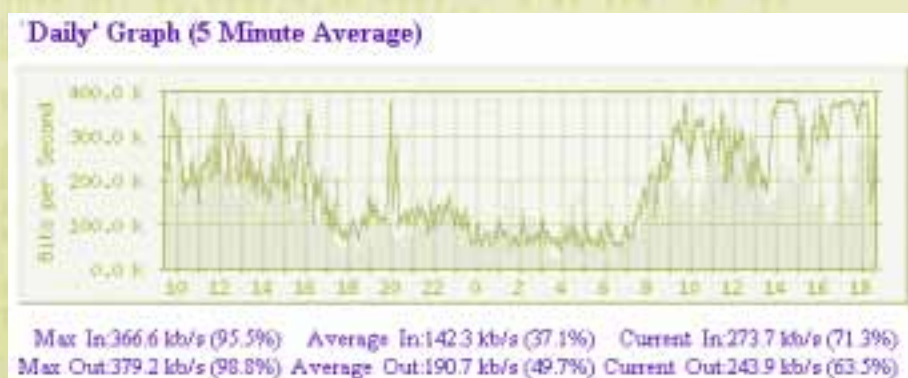▸ Mailing list volumes (number of messages posted to particular mailing lists from schoolnet participants)

▸ Activity on specific Web sites such as education portals or learning management systems (e.g., number of registered users, frequency of visits, number of visits per day and areas of the site most frequently accessed)

While this type of data is relatively superficial and provides few clues about how ICTs are being used or for what purpose, it can accurately show the extent and type of usage. Conversely, if indicators such as those above show that there is little ICT activity taking place, the higher-level educational benefits of ICTs are most likely not being realised.

Measuring activity in this way can be a valuable part of a proactive support strategy, and also provide valuable data to differentiate between technical and other factors in evaluations of ICT use. For example, teachers may drop out of an e-learning programme for many reasons: some as a result of technical problems and some related to motivation, available time or the difficulty of the course. A technical history of the school's connectivity or the participant's e-mail activity can help to differentiate technical and non-technical phenomena.

mrtg: A Flexible Graphing Tool

mrtg is a free open source software package which maintains daily, weekly, monthly and yearly activity graphs that can be viewed on a Web page. mrtg is designed to graph Internet traffic by collecting data from routers, but it can also be used to graph almost any time-based information (such as the volume of Web traffic through a proxy server).

'Daily' Graph (5 Minute Average)

Max In:366.6 kb/s (95.5%)   Average In:142.3 kb/s (37.1%)   Current In:273.7 kb/s (71.3%)
Max Out:379.2 kb/s (98.8%) Average Out:190.7 kb/s (49.7%) Current Out:243.9 kb/s (63.5%)

In this example, the graph shows an Internet data circuit of 384 Kb/s. Outgoing traffic (shown by the top line on the graph) is reaching the peak of the circuit's capacity and the circuit should be upgraded to a higher capacity.

mrtg can be found at *http://people.ee.ethz.ch/~oetiker/webtools/mrtg/*.
Another good graphing application is Cricket, available from *http://cricket.sourceforge.net*.

Feedback and informal evaluation

Schoolnets can use a range of informal evaluation methods to understand better the successes, difficulties and impact of schoolnet projects and continuously improve project implementation. A number of ICT-enabled mechanisms can be used to gather feedback on a continuous basis without significant overheads, and the information gathered can be digitally archived for later review or further analysis. ICT-based feedback systems include:

▸ Online polls on frequently visited Web sites

▸ Online evaluation forms (for training courses, online materials or any other activity or resource)

▸ Feedback buttons on Web pages (e.g., "how useful did you find this resource?")

▸ E-mail messages: solicited or unsolicited feedback and archives of specific mailing lists

▸ E-mail messages, journals and work portfolios generated as part of e-learning programmes or in learning management systems

One weakness of ICT-based feedback is that it produces information from a self-selecting sample of active participants and does not record the views of teachers or students who are not using the ICT platforms, for whatever reason.

Online evaluation systems therefore need to be complemented with offline strategies that include school visits, interviews and observation (e.g., of computer lab use). Schools and teachers can also be required to maintain records of various sorts, such as:

▸ The extent and nature of computer use in the school on a daily or weekly basis

▸ Operational records relating to technical support issues and operating costs

▸ Portfolios of work by teachers and students that involve ICT components

image captured from www.yahoo.com

Formal evaluation

Formal evaluations usually serve a different function to informal evaluation activities. In addition to guiding programme implementation, a formal evaluation may be used for:

▸ Research purposes

▸ Accountability to external funders or stakeholders

▸ To make decisions on the nature and scale of further investment in ICT programmes

Formal evaluation processes are therefore constructed more rigorously than informal evaluations, and often involve external agencies or independent evaluators to establish a greater level of objectivity and credibility. Unlike informal

Evaluation Activities in the Pilipinas SchoolNet Coca-Cola Ed.venture Pilot

Being a pilot programme, one of Ed.venture's main components is monitoring and evaluation. A variety of strategies have been employed to monitor the progress of the pilot and to collect both quantitative and qualitative data from the field pertaining to all aspects of the programme. A number of tools have also been developed to facilitate monitoring and evaluation.

▸ All school administrators, centre managers (CMs), and assistant centre managers (ACMs) are subscribed to an electronic mailing list, *cokeedventure@yahoogroups.com*, through which operational issues are raised, discussed and hopefully resolved. All messages are archived and analysed.
▸ CMs/ACMs are required to keep a centre use log, or CUL (which tracks user type, purpose of use, and duration of use), and a centre manager's journal (CMJ) for narrative documentation of issues/problems related to operations, actions taken and the corresponding response times. CMs/ACMs are also required to submit to FIT-ED a quarterly summary of the CUL and the CMJ.
▸ Twice yearly school visits are scheduled; additional school visits are made as needed. Typically, structured interviews are conducted with school administrators, CMs, ACMs and teachers during these visits. Some focused group discussions with students have also been conducted.
▸ CITE and FIT-ED technicians are also required to submit reports on each site visit made.
▸ Trainers are required to submit post-training evaluation reports. Training participants are also asked to accomplish a post-training evaluation form.
▸ School administrators are required to submit a statement of pre-operational costs and a summary of centre-related monthly expenditures every quarter.
▸ Teachers are required to archive all offline and online communication and output related to curriculum integration activities. They are also expected to submit regular progress reports to FIT-ED.

evaluation, which can be ongoing and incremental, formal evaluations are usually limited in scope and time and result in an evaluation report and set of data.

A range of accepted evaluation methodologies can be applied, with data subject to careful analysis and interpretation. Formal evaluations can include both formative (during the project) and summative (retrospective) assessments.

In cases where formal evaluations are needed, schoolnets should work with an external agency to either conduct the evaluation or to provide a research design and train inhouse staff in evaluation methodologies. The evaluation process itself can require significant ongoing resources and time. Even where schoolnets completely outsource the evaluation process, schoolnet staff will need to be actively involved in working with the evaluating agency to formulate the evaluation approach, provide information and comment to the evaluators, and engage with the evaluation findings at various stages.

‣ FIT-ED is often subscribed to project e-mail lists and can archive communications directly. Project Web sites are also a convenient repository of project information.
‣ A new set of tools have been developed to document the experience of the e-learning clubs. These have been designed for the use of both teacher moderators and student members.

Some of the quantitative indicators of ICT diffusion, teacher adoption and learner impact used are the number of teachers and administrators trained, usage of the computer centre for various purposes and participation in collaborative projects, online treasure hunts, Web quests and e-learning clubs.

Implementing Ed.venture's monitoring and evaluation plan, however, has not been easy. Some of the difficulties have been these:

‣ There was initial confusion in some schools on how to properly log data on the utilisation of the Ed.venture Center
‣ An attempt was made to introduce a more detailed utilisation assessment tool, but this proved too complicated and time consuming for the schools to adopt. Ed.venture is developing a more user-friendly instrument that will capture the levels of utilisation more accurately.
‣ Some CMs and ACMs were initially not conscientious about documenting the day-to-day operations of their Ed.venture Center.
‣ While it makes sense to use online channels for monitoring and evaluation, the fact that school administrators and teachers have not yet developed the habit of checking their e-mails regularly limits the usefulness of this method.
‣ Teachers need to be constantly reminded to religiously document their ICT-enhanced activities and to submit progress reports on a regular basis.
‣ Ed.venture continues to grapple with the issue of how and when to assess learner impact. While evidence of the positive impact of ICT integration on learner engagement has already been gathered through interviews and focused group discussions with teachers and students, a design for determining whether students actually learn more and/or better, and the tools that will enable rigorous measurement, are still under study.

ICT Indicators

ICT indicators can be seen as an evaluation approach that combines the strengths of informal and formal evaluation methods. Indicators are variables reflecting various aspects of ICT adoption and use that can be measured periodically in a transparent and consistent way. (See the section on ICT indicators in Southeast Asian countries in Guidebook 2 for an example.)

Well-defined indicators thus provide some of the rigour of a formal evaluation, while being measured continuously over a period of time, providing ongoing

Overview of Evaluation Prototypes[17]

Planning Evaluation
A planning evaluation assesses the understanding of project goals, objectives, strategies and timelines. It addresses the following types of questions:

▸ Why was the project developed? What is the problem or need it is attempting to address?
▸ Who are the stakeholders? Who are the people involved in the project?
▸ Who are the people interested in the project who may not be involved?
▸ What do the stakeholders want to know? What questions are most important to which stakeholders? What questions are secondary in importance?
▸ Where do concerns coincide? Where are they in conflict?
▸ Who are the participants to be served?
▸ What are the activities and strategies that will involve the participants?
▸ What is the intervention? How will participants benefit? What are the expected outcomes?
▸ Where will the programme be located (educational level, geographical area)?
▸ How many months of the school year or calendar year will the programme operate? When will the programme begin and end?
▸ How much does it cost? What is the budget for the programme? What human, material and institutional resources are needed? How much is needed for evaluation? For dissemination?
▸ What are the measurable outcomes? What is the expected impact of the project in the short run? The longer run?
▸ What arrangements have been made for data collection? What are the understandings regarding record keeping, responding to surveys and participation in testing?

Formative Evaluation
A formative evaluation assesses ongoing project activities. It consists of two types: implementation evaluation and progress evaluation.

feedback and direction. Schoolnets can work to develop appropriate ICT indicators and seek to embed these in the data collection methodologies used for educational statistics at a national level, so that ICT-related data is routinely collected from schools as a matter of course.

For more information on this topic, see also the section Evaluation and assessment in Guidebook 2.

Implementation Evaluation

An implementation evaluation assesses whether the project is being conducted as planned. It addresses the following types of questions:

▸ Were the appropriate participants selected and involved in the planned activities?
▸ Do the activities and strategies match those described in the plan? If not, are the changes in activities justified and described?
▸ Were the appropriate staff members hired and trained, and are they working in accordance with the proposed plan? Were the appropriate materials and equipment obtained?
▸ Were activities conducted according to the proposed timeline? By appropriate personnel?
▸ Was a management plan developed and followed?

Progress Evaluation

A progress evaluation assesses the progress made by the participants in meeting the project goals. It addresses the following types of questions:

▸ Are the participants moving towards the anticipated goals of the project?
▸ Which of the activities and strategies are aiding the participants to move towards the goals?

Summative Evaluation

A summative evaluation assesses project success—the extent to which the completed project has met its goals. It addresses the following types of questions:

▸ Was the project successful?
▸ Did the project meet the overall goal(s)?
▸ Did the participants benefit from the project?
▸ What components were the most effective?
▸ Were the results worth the project's cost?
▸ Is this project replicable and transportable?

Introduction

This guidebook is for teachers and school managers who are using or starting to use ICTs in an educational context, with an emphasis on using the Internet and participating in online schoolnet communities.

The starting point is schools and teachers who already have access to computers and an Internet connection, so it does not include how to get connected to the Internet, or the technical details of planning and building a computer network at a school.

An enormous amount has been written and published online about using computers and the Internet in education. This guidebook should be seen as an introduction to this rapidly evolving field, rather than as a comprehensive or exhaustive reference. Readers are therefore invited to explore the online resources listed in each chapter, which contain more information and further links.

School plans and policies

Developing a technology vision and plan

Although it is quite easy to begin using ICTs without much forethought, when ICTs start becoming an important part of a school's teaching and learning processes, a good technology vision and plan can help to make full use of ICT facilities and use them in a cost-effective way.

A technology plan should be developed with the involvement of all affected staff, and include these elements:

▸ An assessment of the school's current ICT position, possibly informed by a SWOT (strengths, weaknesses, opportunities and threats) analysis

▸ The vision for the educational use of ICTs

▸ Staff professional development, including:

- What training may be required for which staff over what time period
- What support will staff have to participate in training (e.g., reduced workload or extramural activities during the training period)

▶ A roadmap of the curriculum integration process

▶ An ICT use policy (also called acceptable use policy), including measures to promote child safety online.

▶ Physical access to ICT facilities (who will have access when; how will it be managed)

▶ Management of ICT facilities (who will manage ICT facilities on a day-to-day basis, and what training and support they would need)

▶ Technical support (what outside technical support systems will be used)

▶ Financial sustainability, including:

- Estimates of operating costs
- Provision for replacing and upgrading equipment over time
- Strategies for revenue generation

▶ Information security measures and policies to protect against viruses and loss of data, and to restrict access to confidential data

In practice, if your school is new to technology, it may be difficult to come up with a detailed technology plan immediately, and it may be helpful to start with a relatively simple plan and develop it over time as more experience is gained. It may also be beneficial to involve outside stakeholders (e.g., from the parent community) and resource people such as educational ICT experts.

resources

School Technology Self-Assessment Frameworks and Tools

These are some tools that can help your school in the technology planning process:

North Central Regional Educational Laboratory (NCREL) enGauge Online Assessment: *www.ncrel.org/engauge/assess/assess.htm*

CEO Forum School Technology and Readiness (STaR) Chart : *ww2.iste.org/starchart/*

Christopher Moersch's LoTi framework: *www.learning-quest.com/software/loti.pdf; www.lotilounge.com*

Formulating an acceptable use policy

There are many ways that computers and ICT facilities can be used in schools: for activities that serve the educational purpose for which the facilities were provided, for incidental entertainment or personal use or for uses that may be considered inappropriate, harmful in various ways, unethical or illegal.

An acceptable use policy (AUP) allows a school to set out clearly the ways in which ICTs should be used. AUPs may include:

▸ The broad purpose of the facilities

▸ Physical access to facilities

▸ What type of applications can be used

▸ What types of user data can be stored on the network

▸ Appropriate behaviour when using communications tools such as e-mail

▸ Security policies relating to user names and passwords

▸ Measures to prevent viruses and other information security aspects

▸ What activities or files may be monitored, and for what purpose

▸ Child safety guidelines (see below)

▸ Any restrictions on accessing inappropriate content (see below).

The AUP should be communicated to all ICT users. It may also be appropriate to require students and/or parents to sign the AUP.

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resources

Information on Developing Acceptable Use Policies

"Developing an Acceptable Use Policy" (UK National Grid for Learning)
http://safety.ngfl.gov.uk/schools/document.php3?D=d56

"BECTA ICT Advice Timesaver: What Is an Acceptable Use Policy?"
www.ictadvice.org.uk/downloads/aup2_overview.doc

Limiting inappropriate use of the Internet

The Internet is a large public network which spans many countries and cultures, with few limits on what types of content can be placed online. It is, therefore, comparatively easy for students to come across or find content online that they or others may regard as offensive, objectionable or inappropriate. Such content may transgress accepted cultural or ethical boundaries, and could also be a violation of copyright or media laws in the country in which it is being viewed. Examples include pornography and extremist or deliberately misleading Web sites.

Schools can pursue social, educational and technical approaches to the problem. Social and educational approaches involve discussing the parameters of Internet use with both students and parents, and then relying on students to use the Internet responsibly and legally and on parents to guide students in this. Technical approaches involve using software to restrict access to sites based on various criteria and monitoring user activity (such as sites visited).

Technical approaches do not provide a perfect solution. Filtering software either does not block all potentially offensive content, or it blocks too much, and can be circumvented by determined users. In addition, there are many cultural assumptions which determine what may be acceptable or not, and technical solutions can easily introduce unwanted bias or needless restrictions.

Content filters should therefore be applied carefully only when necessary and regarded as a first line of defence, with the primary strategy being education and awareness.

Education of Internet safety issues both at home and in school should be an integral part of parenting, as well as teaching and learning activities. Education about the dangers of the Internet offers better protection than any software or hardware devices.

Therefore, rather than worrying unnecessarily, schools and parents should guide students surfing the Interne, and discuss Internet issues with them. Schools should also allow children to share their experiences online and give them opportunities to teach the teachers and parents what they know.[1]

Internet Blocking Software

These are some of the most common packages used for restricting access to Internet content:

SafeSurf: www.safesurf.com
CyberPatrol: www.cyberpatrol.com
NetNanny: www.netnanny.com

The contrary view
A number of organisations believe that restricting access to content is practically unworkable or inherently wrong in educational contexts. For example, the article "Why Blocking Technology Can't Work,"by the Online Policy Group, presents 10 arguments against blocking technology and provides links to other statements and opinions. *(See www.onlinepolicy.org/research/blockcantwork.shtml.)*

Support Groups Promoting Responsible Internet Use in Singapore
There are organisations that support parents, teachers and students in dealing with Internet issues such as pornography, misinformation, chat room dangers and privacy. Two such organisations are the Parents' Advisory Group for the Internet (PAGi) and TOUCH Community Services (TCS). PAGi *(see www.pagi.org.sg/)* is a volunteer organisation set up as a support network for parents and guardians concerned about the online safety environment in which children surf. As a volunteer group, they depend on volunteers to assist them in various activities such as exhibitions, workshops, talks and production of useful references such as handbooks and VCDs on online safety. These activities are usually carried out in the public libraries, community centres and schools.

TCS is a non-profit voluntary welfare organisation and is member of the National Council of Social Service. In 2001, TOUCH Youth Services launched Project CRuSH (Cyberspace Risks and where u Seek Help), a public education effort commissioned by the Inter-Ministry Committee on Youth Crime (IMYC) to inculcate safe surfing values in youths. Project CRuSH *(see www.planetcrush.org/maincover.aspx)* is committed to informing youth of the benefits, risks and dangers of the Internet, mentoring youth to adopt positive values and safe behaviour in the cyberworld and developing youth to become positive influences on peers and juniors in cyberspace. It organises road shows, a Cyber Wellness Exposure programme, parenting talk, online discussions and a peer-mentoring programme. The Project CruSH team has been working closely with students and teachers in schools and trainee teachers and lecturers in the National Institute of Education (NIE).

Child safety online

Beyond providing access to potentially inappropriate content, the Internet can also be an unsafe place for children in the same way as being alone in a large city can be unsafe. Children can communicate online with strangers with less supervision and support than they would normally have in face-to-face environments, and they can be misled or deceived. In extreme cases, children can be placed in physical danger if convinced to meet an online acquaintance alone.

Child safety online can be promoted through encouraging a set of simple behaviours, such as these:

▸ Do not give out your full name, photograph, address, mobile phone number, school name or password to people online.

▸ Do not meet someone you have met in cyberspace without your parents' permission and only do so when they are present.[3]

Respecting copyright and licence agreements

Copyright protects the right of authors or publishers of content or software to control how their material is used. Copyright is not always restrictive and does not always forbid copies; it usually defines the terms under which copies may be made through a licence agreement.

Schools need to observe copyright requirements carefully in three areas:

▸ Software that is installed or used on school computers should be legally licensed. While open source software usually permits any number of copies to be used, proprietary software limits bought software to a single computer or to be used in accordance with the licence terms (e.g., a site licence which permits unlimited use by the school, or on a certain number of computers).

▸ Material available through the Internet may be subject to copyright. It is therefore a copyright violation to download and use or redistribute the material if the copyright terms do not permit this.

While an initial filter is essential, online safety experts stress the greater importance of education. In a survey conducted by the NIE in 2001, it was found that teenagers generally favoured educational strategies more than control measures. The items "discuss with child the dangers on the Internet" and "learning more about the Internet" were rated as most desirable, and the items "stop child from using the computer" and "complain to Internet service provider" as the least desirable. Parents and teachers should talk to students about the dangers of being misled on the Net and should surf with them or guide them in their surfing.[2]

▸ Copyrighted material obtained through the Internet or another source should not be redistributed from the school (e.g., by placing it on a Web server or through peer-to-peer applications) if the copyright terms do not allow this.

Schools may be held legally liable for copyright violations or illegal use of software, and should:

▸ Ensure that all software installed on school computers is being legally used

▸ Ensure that all users are aware of copyright requirements

▸ Periodically audit all software in use and any other material on school computers that may have copyright restrictions

resources

Child Safety Online

Visit these Web sites as starting points to finding out more about child safety on the Internet:

ChildNet International Safety Advice. *www.childnet-int.org/safety/index.html*

GetNetWise: Kids' Safety. *http://kids.getnetwise.org/*

National Center for Missing and Exploited Children: Child Safety on the Information Highway. *www.safekids.com/child_safety.htm*

ICT integration

What is ICT integration?

Curriculum integration is about exploiting the ability of ICTs to add value to teaching and learning processes by integrating ICT-enabled activities into the curriculum. Such activities can include a wide range of ICT uses, such as:

▸ Using generic software packages (office applications, graphics and presentation packages)

▸ Using specialist software for interactive learning, simulations and content mastery

Curriculum integration is a complex, multifaceted process. It cannot be achieved overnight. It requires experimentation, creativity, patience, commitment, and money.[4]

▸ Using asynchronous and synchronous communication tools for online collaboration and information exchange (e-mail, Web forums, instant messaging, audio- and videoconferencing)

▸ Using the Internet as an information and research resource

In the curriculum integration model, ICT skills are not taught as a distinct activity ("just-in-case" computer literacy), but are acquired "just-in-time," in the context of activity that is meaningful to learners.

Changing roles of teachers and students

Education for ICT utilisation is designed for a co-operative learning environment, rather than lecture-oriented learning. That is, students as a group search for various types of information on the Internet, and actively produce and share the outcomes of learning by utilising the information they have found."[5]

ICTs enable new learning models that can significantly change the traditional roles of teachers and students. For example, Steve Wheeler identifies a number of changes in the roles of teachers, brought about by benefits of ICTs, such as:

▸ Shared learning resources (using video and Internet-based materials shared across schools)

▸ Shared learning spaces (provided by networked computers)

▸ The promotion of collaborative learning (enabled by computer-mediated communication)

▸ A move towards autonomous learning (with students able to direct their own studies to a greater extent)[6]

Wheeler suggests that teachers' roles will change as a result of these benefits:

▸ ICTs will make certain teaching resources redundant (such as overhead projectors and chalkboards).

▸ ICTs will make certain assessment methods redundant (such as content tests).

▸ Instead of imparting knowledge, teachers will need to "encourage critical thinking skills, promote information literacy and nurture collaborative working practices."

▸ Teachers will need to "reappraise the methods by which they meet children's learning needs and match curricula to the requirements of human thought."

A study on the same topic[7] examined 12 case studies of technology-enhanced classrooms in the US, identifying new roles for students engaged in project-based or inquiry learning being:

▸ Self-learner ▸ Knowledge manager ▸ Team member

New teacher roles identified were these:

- Instructional designer
- Trainer
- Collaborator
- Team co-ordinator
- Advisor
- Monitoring and assessment specialist

Implementing ICTs in an integrated way is therefore as much a learning process for teachers as it is for students. This makes it especially important that teachers have access to professional development opportunities, technical and educational support and peer networks through schoolnet communities.

Planning ICT activities

A typical process for an ICT-enabled learning activity should include the following steps:

- Identify the curriculum goal, learning outcomes and skills. This could be a specific learning outcome at a certain grade level within a subject area (e.g., linear equations in grade 12 mathematics), and/or a generic learning outcome (e.g., information literacy).

- Establish what ICT facilities and resources are available (e.g., computers, a spreadsheet package, Internet Web sites, and an interactive mathematical simulation software package).

- Match up the learning outcomes with appropriate ICT resources and activities.

- Design an appropriate teaching approach (e.g., deciding whether the activity will involve a demonstration, group work, individual work, and what the students will be required to do or produce).

- Ensure that students have the appropriate ICT skills to undertake the activity, or have just-in-time support (e.g., if using a spreadsheet to draw graphs, making sure there are tip sheets available or online help to demonstrate how to do so in the package being used).

- Decide how the achievement of the learning outcomes will be assessed, informed by the process students need to follow and the outputs that they produce.

- Carry out the learning activity with students.

- Evaluate the strengths and weaknesses of the methodology and improve it for next time.

Many examples of ICT integration activities have been written up as lesson plans which are available online. Teachers can use and adapt these lesson plans for their own teaching and, of course, create and share their lesson plans with others through schoolnet Web sites and online communities.

resources

Planning Resources for Curriculum Integration

Computers as Tools for Teaching and Learning: A Planning Resource for Schools and Teachers, Department of Education, Community and Cultural Development, Tasmania. *www.discover.tased.edu.au/ec/leaders/ToolsBook.html*

A 10-step process for integrating ICT into units and lessons, Jed Bartlett Associates. *www.jedd.co.nz/ict/integrateICT.htm*

Learning to Teach with Technology: From Integration to Actualization *www.citejournal.org/vol2/iss2/currentpractice/article1.cfm*

Supporting curriculum integration in schools

Every school is different and, hence, should be given some autonomy to determine which ICT resources are most suitable for the teaching needs of their teachers and learning needs of their students. This will ensure a better fit of ICT in the school curriculum and, hence, a better degree of ICT integration in schools.[8]

Meaningful curriculum integration can be supported or constrained by many factors within the school environment. The following are the ways that schools can support integration processes:

▸ Ensure that technology decisions are driven by curriculum and learning priorities. This can include decisions relating to what technology (hardware, software and content resources) are acquired and what support is available to teachers and students.

▸ Construct flexible timetables. Many ICT activities cannot meaningfully be undertaken in the short timeslots traditionally allocated to teaching activities. Teachers may also need more time to prepare teaching materials using ICTs.

▸ Provide flexible access to computer facilities, place computers in a variety of locations (not just in a computer lab) and support "anytime, anywhere" learning (e.g., through portable computers and wireless access).

▸ Change schoolwide assessment practices to reflect new pedagogies enabled by ICTs, and communicate these changes to parents and other stakeholders.

▸ Provide ongoing professional development opportunities to teachers.

▸ Provide supportive leadership for teachers pursuing innovative teaching approaches.

Planning for ICT Integration in Singapore's Schools

After an ICT vision has been successfully created and accepted, the next step is to articulate an ICT integration plan, which spells out clearly how teachers will be expected to integrate technology in their lessons. An ICT integration plan provides a detailed blueprint of the steps and methods needed to translate the school ICT vision into reality. Most schools in Singapore have ICT integration master plans that have been customised for their own school culture and environment. These master plans address the following questions:

▸ What are the priorities for implementation of the ICT master plan (e.g., staff, students, content areas)?
▸ What evaluation standards and benchmarks indicate effective integration of ICT?
▸ Who is ultimately responsible for successful implementation (e.g., ICT committees, administrative personnel, teachers, technical support staff)?
▸ What funds and time are available to implement ICT integration efforts?

Developing ICT integration plans is no doubt a complex and time-consuming affair, but they are usually well worth the time and trouble they may take to put together.

Recommendations
▸ ICT should be integrated into the schools to meet the curricula goals. When ICTs are perceived by teachers as tools to meet curricula goals, they are more likely to integrate it in their lessons.
▸ Different types of ICT tools complement one another to meet curricula goals. For example, the Internet may complement PowerPoint where students are first instructed to search for relevant information from the Internet and subsequently present their findings using PowerPoint.
▸ Different ICT tools offer teachers different opportunities to enhance learning and teaching processes. Teachers must be made aware of these opportunities and learn how to take up these opportunities in their lessons.
▸ When ICT is employed in the learning environment, there will be a shift in teaching and learning strategies.
▸ Orienting activities that support learner autonomy help students to be more engaged in their learning. These orienting activities include introductory sessions to ICT tools, advance organisers and instructional objectives, activity sheets and checklists and ICT and non-ICT tools for post-instructional reflections.
▸ In order to facilitate the effective integration of ICT in schools, students must be equipped with a set of ICT skills. This skill set may include keyboarding 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).
▸ Effective integration of ICT in schools must consider integration issues into both the curriculum and assessment. Curriculum and assessment are interdependent and must be considered together, one supporting the other and consistent with the other.
▸ When ICT is introduced into the assessment process, there is a need to reconsider the assessment approaches. There may be a greater role for formative assessment when ICT is integrated into the assessment process.
▸ The role of the teachers in the integration of ICT in the school curriculum and assessment is pivotal.
▸ In order to carry out this role effectively, the sociocultural factors in the learning environment should support it. These factors include supportive leadership, professional development (both formal and informal) and access to ICT-based resources.

Finding, using and creating online resources

Locating teaching and learning resources

A big attraction of the Internet is the wealth of materials that it makes available. Internet resources are often easier and cheaper to locate than print-based materials and may also be more up to date. However, the size of the Internet can also be a hindrance. It is easy to get lost in volumes of irrelevant or poor-quality Web sites or materials.

Teachers and students can find relevant materials more easily by using:

▸ National or regional schoolnet portals and resource directories, which contain indexed links to materials

▸ Subscription services, which provide reviewed lists of relevant online resources for an annual fee

▸ International education portals

▸ Public Internet directories, which are structured hierarchically by topic area

▸ Internet search engines, which allow keyword searches

Appropriate educational software can be investigated through catalogues from software publishers and Web sites which evaluate educational software and provide reviews by teachers.

resources

Well-known Search Engines and Directories

Google:	www.google.com
AltaVista:	www.altavista.com
Ask Jeeves:	www.ask.com
Yahoo:	www.yahoo.com

An Online Educational Software Review Site
Teachers Evaluating Educational Multimedia (TEEM) is a service of the UK's Department for Education and Skills. TEEM "provides teachers with free access to independent, classroom-based evaluations of educational multimedia. Because TEEM-trained classroom teachers write these evaluations, readers can be sure that they are receiving impartial, thorough and reliable advice."

TEEM also organises resources by subject area and key stage, and indexes both commercial and free resources. *www.teem.org.uk*

Information literacy

The overwhelming size of the Internet has made it increasingly important that teachers and students know how to locate information, assess the credibility and relevance of that information, and use it appropriately. This set of skills has been described as "information literacy."

Information literacy is not only of value as a competency for teachers in navigating through the many resources available online, but should also be seen as a core competency to develop in students to enable them to operate effectively in information-rich environments outside schools, such as the workplace.

Getting Started with Information Literacy

"Information literacy is defined as the ability to know when there is a need for information, to be able to identify, locate, evaluate and effectively use that information for the issue or problem at hand."

National Forum on Information Literacy:
www.infolit.org/

The Big 6: Information Literacy for the Information Age.
"Developed by Mike Eisenberg and Bob Berkowitz, the Big6 is the most widely known and widely used approach to teaching information and technology skills in the world. Used in thousands of K-12 schools, higher education institutions and corporate and adult training programmes, the Big 6 information problem-solving model is applicable whenever people need and use information. The Big 6 integrates information search and use skills along with technology tools in a systematic process to find, use, apply and evaluate information to specific needs and tasks." *www.big6.com/*

Evaluating learning resources

A number of factors should be taken into account when assessing whether a particular digital resource (e.g., a Web site or software package) should be used or purchased. Issues identified by teachers[9] include:

▸ Quality of curriculum

▸ Development of problem-solving skills

▸ Ease of use

▸ Appropriateness for the vast majority of students

▸ Assistance with the improvement of basic skills

▸ Depth and breadth of content

▸ Individualised instruction

▸ Good staff development and training

▸ Price

When evaluating a number of resources, it may be useful to formalise the criteria being used into an evaluation framework. Teachers can develop their own or use an existing framework available from a schoolnet or elsewhere on the Internet.

How to Evaluate Educational Resources

Kathy Schrock has compiled an extensive set of resources on Web site evaluation, both by students and teachers: school.discovery.com/schrockguide/eval.html

"Web Site Evaluation & Internet Lesson Plan Guide" is a simple three-page guide and checklist to help teachers when using Web sites with students: kathyschrock.net/abceval/teacherwebeval.pdf

Pearson Digital Learning, an educational software publisher, suggests some tips for teachers for conducting effective evaluations of instructional software: www.pearsondigital.com/press/evaluate.cfm

Software Design Criteria for the Malaysia Smart Schools Pilot Project
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 as described in the Conceptual Blueprint:

▸ Must cater to the different capabilities of students, for example, their learning styles, multiple intelligences and learning modalities
▸ Be suitable for a variety of learning environments, ranging from teacher-centred environments to student-centred environments
▸ Allow students to practise self-paced, self-accessed and self-directed learning
▸ Must have built-in assessment capabilities so that assessment records can be stored electronically for teachers to monitor their students' progress
▸ Promote values, skills (especially creative and critical thinking skills), knowledge and language across the curriculum
▸ Allow for horizontal integration between subjects and vertical integration between learning areas in a subject

Developing Content

Digital content can be developed in many different ways, which vary in complexity and the skills required. Table 4.1 outlines them, in order of ease of use.

Table 4.1: Developing digital content

Platform	Applications	Compatibility
Common office application formats, such as documents, spreadsheets, slide-show presentation format and databases.	Lesson plans, tests, drawings, graphs and simulations, and templates. Depending on the software products being used, it is also possible to build in some degree of interactivity, include multimedia components such as audio or video clips and hyperlinks to other documents or Internet resource.	Other users may need the same software package that the content was developed in. In some cases, it is possible to convert the content to platform-independent formats such as PDF or RTF.
Specialist educational packages which provide structured content development frameworks (e.g. ,My World, Clicker)	Text, graphics and multimedia content presented in a user-friendly way with structured navigation and hyperlinks.	Other users need the same software environment to use the content.
Template-based Web pages	Allows creating Web-based content through a simpler interface that structures how text and graphics are presented.	Can be used by anyone with a Web browser.
Web pages using HTML	Any text or multimedia content. Some interactivity can be added using JavaScript, forms and other HTML features.	Can be used by anyone with a Web browser.
Macromedia Flash	Allows sophisticated animations, simulations and interactive multimedia content.	Can be used by anyone with a Web browser with the free platform-independent flash plug-in.
Content structured within a learning management system	Course materials that should be presented to users according to a course structure, and where it may be useful to track user activity.	If the learning management system is Web-based, can be used by anyone with a Web browser,
Database-driven Web site	Web sites that interact with users and content in dynamic ways, such as customising the content view based on user information or allowing the content to be searched or presented in different ways.	Can be used by anyone with a Web browser.
Content or applications developed in programming languages (e.g., Java, Authorware, Delphi, Visual Studio)	For specialised applications that cannot be easily developed in any other way.	May require a specific operating system or browser plugin, depending on the application.

Content developers should also take into account these factors:

▸ Localising or adapting existing resources: it may be more time- and cost-effective to seek permission to adapt existing materials than create them from scratch

▸ What software and skills will be needed to develop the content: for example, both instructional design skills and technical skills to implement the desired design concepts

▸ Describing the content with appropriate metadata (such as keywords), so that if it is uploaded to Web sites, it can be accurately referenced

▸ Copyright and licensing conditions: will the author retain copyright to the content, or assign it to an entity such as a schoolnet? Will other users be permitted to use the content without restrictions, or for example only for non-commercial use? Are other users permitted to adapt the content?

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resources

Some Content Development Resources

PDF (portable document format) is a platform-independent format for distributing documents produced in any application. PDF files can be produced by Adobe Acrobat (the creators of the format), or a number of other applications such as OpenOffice. *www.adobe.com/products/acrobat/ www.openoffice.org*

JavaScript is a client-side scripting language for use in Web pages, originally created by Netscape. There are many free JavaScript examples for simple tasks such as online quizzes. Here are some JavaScript resources: *devedge.netscape.com/central/javascript/www.javascriptkit. comjavascript.com*

Flash is a tool for developing interactive content and animations that resembles a programming language in its complexity and power. Macromedia's Studio MX product is used to create Flash animations, which can be viewed in a Web browser using the free Flash plugin. *www.macromedia.com*

*PHP is a server-side scripting language that can be used to build interactive Web sites. It is often used with the free **mysql** database. PHP and mysql both run on many different operating systems. www.php.net www.mysql.com*

*A wide range of **learning management systems** is available. An easy-to-use open source LMS is moodle, which can run on any environment that supports PHP and a database. www.moodle.org*

*The **Creative Commons** initiative is "devoted to expanding the range of creative work available for others to build upon and share, and it provides a range of flexible licensing options that can be used for created content. creativecommons.org*

Schoolnet communities

Sharing and learning from others

A major function of schoolnets is to encourage human networking among teachers, either online through virtual communities or in more traditional face-to-face ways. The use of ICTs in education is evolving rapidly, posing new challenges to schools and teachers.

Schoolnet communities can help teachers share their experiences and learn from other teachers in a field where there may not be many other sources of support or training. Online communities can help teachers by:

▸ Providing information on theory and practice of applying ICTs in schools

▸ Providing peer support and feedback from other teachers

▸ Providing opportunities for collaboration and collectively building shared resources such as digital libraries

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resources

Descriptions of Innovative Use of ICTs

The SITES M2 study (Second Information Technology in Education Study: Module 2) looked at innovative applications of ICTs in a number of schools worldwide. The SITES M2 case reports have been archived online and can be searched according to categories such as grade level, subject area, types of student and teacher practice and technology used. As well, the full text of case reports can be accessed. http:// sitesm2.org/

Participating in online communities

To participate in online communities, teachers need only an e-mail address and an Internet connection. Where it is difficult or expensive to use the Web, teachers can participate in e-mail-based communities run through mailing lists. The Web provides a wider set of options, including community sites that use Web forums.

Teachers can locate online communities by:

▸ Asking the schoolnet or other teachers

▸ Looking on common education portal sites

▸ Using a search engine or topic directory to search by keyword or topic

Participating in an online community is as easy as following the subscription or registration process, and then posting a message on a new topic or responding to messages on topics under discussion. Person-to-person communication can also be extended by using communication tools which operate in real-time (called "synchronous"), such as instant messaging and presence awareness, and audio- and videoconferencing.

What Is a Mailing List?

A mailing list is an e-mail service that sends messages to the mailing list address to all subscribed users. To join a mailing list, one needs to sign up by e-mailing a subscription request to the listserver (the software application that manages the mailing list). Some listservers also allow subscription through a Web page and will then request confirmation by e-mail.

Mailing lists are convenient and easy to use, but are suitable mostly for low-volume communication (e.g., fewer than 20 messages a day).

What Is a Web Forum?
Web forums provide an online space for discussion, allowing registered users to post messages in a number of forums, and within each forum, in a number of topic areas. Web forums are well suited to high volume communication, as it is easy to only read new messages on selected topics, for example. However, they require users to keep going back to the Web site to see what has been added (although some Web forums are also integrated with e-mail).

What is Instant Messaging?
Instant messaging (IM) systems allow two users connected to the Internet to send short messages to each other which appear immediately, and for a number of users to chat in conference mode. They also support presence awareness, which lets users know if other users in their contact lists are online and available or busy.

Instant messaging is useful for teams of people who work together and for short interactions where immediate response or discussion is helpful.

About Netiquette
Netiquette is "the practice of one using technology effectively to communicate with others both personally and professionally with knowledge, understanding and courtesy."[10]

OnlineNetiquette: *www.onlinenetiquette.com/*

Netiquette Home Page: *www.albion.com/netiquette/*

RFC 1855 – Netiquette Guidelines: *www.faqs.org/rfcs/rfc1855.html*

Collaborating online

Online communities and communication tools provide the foundations for online collaboration by teachers and students (often called tele-collaboration). Collaboration can take several forms, such as:

▶ Collaborative projects, which are structured to provide a learning experience for participants over a period of time through exchange of information, resources and points of view

▶ Collaborative enterprises, where participants contribute to building a shared resource (such as a collection of lesson plans)

Collaborative online projects are widely used by schools and schoolnets. Teachers have a choice of joining one of a number of collaborative projects that are run periodically by schools or schoolnet organisations, or creating a new one, possibly adapted from a model that has worked successfully for others.

The SchoolNet Thailand Digital Library Tool Kit

The SchoolNet Thailand Digital Library provides lesson plans and teaching materials for teachers. A Digital Library Tool Kit has been designed to allow teachers, especially those with no knowledge of HTML, to develop Web-based lessons for students.

Teachers enter the name of the resource, an explanation, keywords, the subject and whether for primary or secondary schools. Using forms on the Web site, teachers then enter the text, upload picture, and submit the item. The new resource appears immediately in the Digital Library.

By February 2003, teachers had contributed more than 6,700 titles to the Digital Library.

Collaborative Projects Facilitated by Pilipinas SchoolNet
As part of the Coca-Cola Ed.venture Pilot Project, Pilipinas SchoolNet has provided training to teachers on designing and participating in tele-collaborative projects. These are some of the projects designed by teachers for the English subject area:

▶ **Go, Tell it to the mountain**
   This project will be a collection of descriptive narratives on local yuletide celebrations all over the country. Due to the various cultures and traditions of the Filipino people, they differ in the way they celebrate the yuletide season.
▶ **Figure it out for me**
   The project is about the use of the common figures of speech and expressions premised on the different translations of the student participants. While there is a universal meaning to a specific expression or figure of speech, it will be interesting to learn if the translation makes sense in terms of its structure and meaning.
▶ **Mythical Space**
   Participants will build an online library of unpublished local fables, myths and legends that will showcase the depth of the country's cultural heritage.
▶ **Nature in Focus**
   Students from different schools share information regarding the beauty of selected spots in their locality through an exchange of original poems.
▶ **Philippine Literature**
   This project is a means for students from different regions to share local unpublished literature specifically legends, short stories, and folk tales.

Creating schoolnet communities

Here are some options for teachers who would like to start a new schoolnet community:

▸ Create a mailing list.

▸ Create a community Web site.

▸ Start a collaborative project.

▸ Initiate some face-to-face activities such as special-interest group meetings or workshops.

▸ Encourage participants to use a range of ICT communication tools such as instant messaging.

The online community recipe includes ingredients such as:

▸ Defining the purpose and scope of the community – what is the shared interest of participants, and who is the target audience?

▸ Identifying and setting up whatever infrastructure and tools you need (e.g., a mailing list or Web site)

▸ Inviting prospective participants to join the community by subscribing to the list or registering online

▸ Facilitating community interaction (e.g., by moderating discussion and introducing new topics)

▸ Keeping the community vibrant so there are reasons for people to come back and continue participating
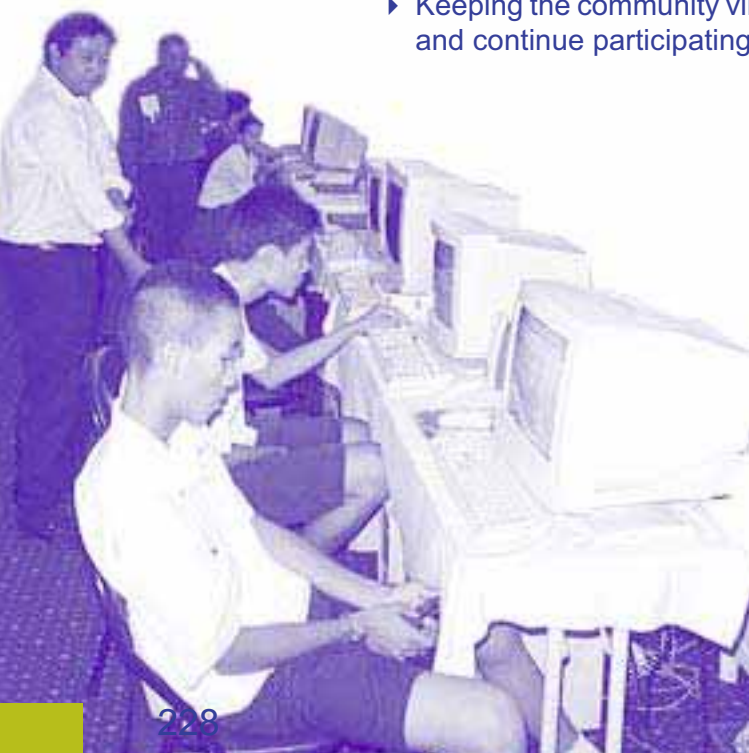
Getting Started with Online Communities

Here is an overview of the steps it takes to build your own virtual community:

"What is a Virtual Community and Why Would You Ever Need One??," Full Circle Associates www.fullcirc.com/community/ communitywhatwhy.htm

"From Workplace to Workspace: Using Email Lists to Work Together," *by Maureen James and Liz Rykert (IDRC 1998, ISBN 0-88936-848-1), "provides practical and useful advice on how to set up an e-mail list, how to launch it,- and how to keep it active and vibrant."* http://web.idrc.ca/en/ev-9369-201-1-DO_TOPIC.html

Some free third-party services

E-mail
Yahoo Mail: *http://mail.yahoo.com*
MSN Hotmail: *http://hotmail.com*

Mailing lists
Yahoo Groups: *http://groups.yahoo.com*

Website hosting
Yahoo GeoCities: *http://geocities.yahoo.com*

Instant Messaging
Yahoo Messenger: *http://messenger.yahoo.com*
ICQ: *http://icq.com*
MSN Messenger: *http://messenger.msn.com*
Jabber: *http://www.jabber.org/user/*

Professional development

Competency frameworks

Using ICTs in a teaching context requires that teachers have a wide range of skills, all the way from competence in using common applications (computer literacy) to adopting appropriate teaching strategies to make the best use of ICT facilities. This range of competencies has been described in a number of competency frameworks, which can be used as a guide for mapping out a professional development process for teachers over a period of time (e.g, several years).

The more localised the competency framework the better – if there is a national framework, teachers should follow that or otherwise work from one of the frameworks developed in countries with extensive ICT use in schools, such as the US, UK or Australia.

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resources

ICT Competency Frameworks

International Society for Technology Education (ISTE) National Educational Technology Standards for Teachers *cnets.iste.org/teachers/*

International Curriculum & Assessment Agency Group (ICAAG) *www.icttg.co.uk*

Professional development options for teachers

Teachers may have a number of options to develop their own skills and competencies. Formal options include:

▸ Training courses run by a national or regional schoolnet programme

▸ Training courses in educational ICT use run a local teacher training institute or university

▸ Courses provided by tertiary institutions that form part of a degree or diploma

▸ E-learning courses offered online

‣ Training courses that cover technical skills run by ICT training companies

Informal options include:

‣ Getting support and advice from colleagues at school or at other schools

‣ Using how-to guides and self-study materials from Internet resource sites

‣ Joining mailing lists or Web forums that cover the specific discipline or area of interest

‣ Using computer-based training applications (best suited for learning application skills)

‣ Attending conferences, workshops and special interest groups

Supporting staff development

Schools can support the professional development of staff in a number of ways by:

‣ Setting targets for staff development in the technology plan (and providing the appropriate support and resources to make these achievable)

‣ Running inhouse training sessions for teachers, using more experienced teachers as trainers

‣ Giving teachers involved in training courses time off for either attending courses or follow-up activities (this could include relieving teachers of extramural duties for a period)

‣ Ensuring that teachers have access to ICT facilities when they need them (during the day or after hours)

‣ Providing technical and educational support to teachers as needed (e.g., by making this one of the functions of the ICT co-ordinator)

‣ Providing financial support for teachers to attend external courses

‣ Recognising the achievement of teachers who successfully complete courses

For more information on professional development, see section on Implementing SchoolNet Programmes in Guidebook 3.

Strategies for supporting ICT use

This section presents some examples from Singapore, Thailand and the Philippines of how ICT use can be promoted in schools and in school communities. The strategies emphasise practical support as well as building and using peer support and communities inside and outside schools.

School leaders and teachers

Peer Mentorship in Thailand

A buddy system approach, where junior teachers work together with senior teachers in a classroom project using ICT, proved effective for developing positive attitudes towards the use of ICT. This attitude is reinforced by the satisfaction received from the improvement in students' achievement and attitudes. IPST, for example, employs this approach in the in-service training provided for teachers in the use of specific programmes in science and mathematics.

When teachers' mindsets have been changed, their behaviours also change. Trained teachers are happy to work together to help each other launch in actual classroom settings what they have been trained on.

Factors contributing to this change are moral support from the school principal, who has high expectations of them to lead other teachers in the use of the same technology. Teachers have to depend on each other: the junior helps the senior learn new technologies, while the senior helps the junior select subject content and an approach appropriate for a particular application of the software. They are both satisfied with the successful experiences gained from the use of ICTs.

The Role of School Leaders in Promoting ICT Use in Singapore

School leaders can lead the way by improving their own ICT competencies through the attendance of staff development with classroom teachers, using ICT in their daily administration and communication tasks, and allowing teachers time to experiment with new teaching methods using ICT. In Singapore, there are many examples of how school leaders have facilitated the uptake of ICT in schools. Many leaders scaffold the process of ICT integration in their schools by:

▸ Sending out all school announcements via e-mails to all the staff
▸ Requiring all teachers to submit their weekly lesson plans via e-mails to the heads of the department
▸ Uploading all forms (e.g., transport claim, leave application, training development application and medical claim) onto the school intranet for teachers to download
▸ Encouraging staff to communicate and share via e-mail and other asynchronous and synchronous ICT tools
▸ Requiring teachers to submit their class daily attendance via the online portal

These scaffoldings ensured that ICT gradually become part of the school culture and helped some "technophobic" teachers to overcome their initial fear of using ICT. As teachers began to use ICT to carry out their daily non-teaching tasks, they open themselves up to the teaching and learning opportunities provided by ICT. They would then begin to explore how ICT could be integrated in their lessons to enhance the teaching and learning process.

Although the Ministry of Education has recommended that 30 per cent of the curriculum time should involve the use of ICT, most school leaders perceived that as a guideline rather than a rule or regulation. An increasing number of school leaders have realised over the last three years that ICT should not be integrated into the curriculum for its own sake. Instead, they believed that teachers should explore ways of integrating ICT into the curriculum to enhance the learning experiences of their students. These leaders adopted strategies such as:

▸ Planning contact time for teachers to share their experiences of using ICT in their lessons
▸ Initiating industry-teacher partnerships to deliver just-in-time ICT training for students and develop instructional ICT-based materials for teaching and learning
▸ Peer-teaching of ICT-related skills based on the apprenticeship model or just-in-time learning
▸ Collaboration with other schools to share expertise and experiences on ICT integration
▸ Equipping each teacher with a personal laptop so that they would explore the opportunities of ICT and make that part of their lives;
▸ Employing more technology assistants to support the teachers in ICT use
▸ Purchasing more laptops so that teachers would not be constrained by the availability of the ICT facilities (such as computer laboratories and media resource rooms).

In order to provide teachers with the administrative and pedagogical support, schools in Singapore have created the position of ICT co-ordinator or HOD (ICT). This person is a staff specialist whose main role is to help teachers to co-ordinate ICT planning and development. He or she provides administrative support by supervising computer facilities, ordering supplies and maintaining hardware and software, liaising with hardware and software vendors, and service personnel, and collaborating with teachers and school leaders in preparing hardware/software budgets, reports and proposals. The co-ordinator also provides pedagogical support by assisting teachers in evaluating and selecting hardware and software and conducting needs assessments to determine what additional hardware or software might be desirable for the teachers' and students' needs.

All these strategies adopted by the school leaders encouraged the uptake of ICT in schools and provided a conducive environment for the effective integration of ICT in the curriculum.

Students

Get students to take ownership of ICT programmes by actively involving them in designing curriculum integration activities, assisting teachers when appropriate, tutoring their peers, helping run the ICT facility, planning for the sustainability of the programme, and generating support for the programme among their peers and in the community.[11]

E-learning Clubs in the Pilipinas Schoolnet Coca-Cola Ed.venture Pilot Schools

Following a suggestion from a teacher that students participate more actively in the Ed.venture programme to act as teacher assistants and as peer tutors, FIT-ED organised an E-learning Club in each school in May 2003. The plan was for each club to have four teacher moderators, one for each year level, and an overall teacher co-ordinator. Ten students from each year level were then selected to be the core members.

Workshops were organised in July 2003 to help each club plan its activities for the forthcoming school year. It was agreed that each year level would have at least one ICT-enhanced project tied to the curriculum, preferably involving the community. This planning workshop was followed by a series of instructional design workshops for the club moderators to help them develop the framework, instructional materials and assessment tools to ensure that the e-learning club projects would be effective learning activities relevant to the curriculum.

Early signs are encouraging. The club moderators have taken the running of their Ed.venture Center in hand, resulting in more efficient scheduling of use and maintenance of the facilities. Some clubs have also started looking at additional ways of generating income to pay for recurring costs as well as upgrades and replacements. The students have injected new energy into the programme. They have eagerly applied themselves to their respective projects, assisting their teachers when necessary and acting as peer tutors to the rest of their classmates.

Parents and school communities

Schools, Parents and Local Communities in Thailand

n most cases, parents, school alumni or PTAs are great contributors to schools in providing ICT facilities. A school committee is often established comprising students' parents and teachers across grade levels to work out ICT plans in relation to students' learning, and put forward proposals for support from the school board or PTA. These parents also become resource people for the schools.

Some private schools offer ICT training to parents so that they can guide their children in the use of technology or even learn together. ICT projects adopted by schools, such as the GLOBE Program, also extend opportunities for students and teachers to work with communities and scientists across the country and the world through local activities and the use of ICTs.

Parents and Community Involvement in Singapore
A wide range of activities that involved parents and community were observed in Singapore schools. This may be due to the school-industry partnership in place and the autonomy given to schools in the ICT master plans. Moreover, with better connectivity linking the school to the home and the community, peers, teachers, parents and other members of the community could play a more active role in the students' learning experiences.

One example was the Learning Village project in Outram Secondary School under the MOE-IBM Collaboration. The Learning Village is a school-community Web collaboration system using the Internet to foster home-school-community connection and partnership. Parents, teachers and students in the school have collaborated in project work, shared information and discussed teaching, learning and parenting issues. By connecting the various stakeholders of education, the Learning Village has mediated the school's effort towards the mission of "An Intelligent School and a Caring Family."

Parents, industry experts and academics were also invited to work with schools to make meaningful contributions to the community. One good example is the service learning programme in Crescent Girls' School (see www.crescent.edu.sg*) where students use ICT in an innovative way to make a difference to 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), 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 site with an e-commerce engine, and the proceeds went to the elderly and the physically and intellectually challenged in these organisations.*

ICT has afforded Singapore schools with better linkages between schools, home and communities that provided teachers, peers, parents and members of the community to play a greater role to enhance the students' learning experiences. These experiences included engaging in authentic problem solving, working with researchers and honing their entrepreneurial skills. The bonds between schools, home and the community were also strengthened through increased interaction and communication

Technology tips

Planning around ICT infrastructure

When dial-up Internet access is the only viable connectivity option, teachers and students must make the most of what they have. This means structuring teaching and learning activities in such a way that an optimum mix of online and offline activities is achieved and that all online activities are purposeful and goal-oriented[12]

In many cases, the ICT infrastructure that is available to teachers in a school – computers, network, Internet access, etc. – is a given, and cannot quickly be improved, either because of cost issues, or the availability of appropriate services (such as high-speed Internet connectivity).

Teachers, therefore, need to take advantage of what technology is available, and find ways to make the best use of it. The most common constraints are:

▸ Slow Internet connectivity, or limited Internet access because of cost constraints

▸ Insufficient numbers of computers, and therefore limited access to computers by students

▸ Older computers that cannot run current multimedia software

Possibly strategies to work around these problems are:

▸ Using Internet materials offline by downloading them on a single computer and then printing them out, putting them on CD or on the local network.

▸ Emphasising Internet activities that don't require extensive online time, such as e-mail-based projects

▸ Organising ICT learning activities so that students work together in groups, with several students sharing a computer, or one of the group members doing the computer work

▸ Distributing computers throughout the school, putting one or two in several classrooms, rather than placing them all in a single computer laboratory

▸ Using data projectors or large-screen TVs to demonstrate applications from a single computer

Different Models of ICT Use in Thailand

Considering the availability of infrastructure and size of the school, the possible uses of ICTs to support teaching and learning can be classified as follows:

▸ Schools with insufficient infrastructure normally use standalone computers and printers and general office software bundled with the machine such as a word processor and spreadsheet. Presentation or graphics software can be used in many subject areas. If a dial-up Internet connection is available, it can be used to search for information. Satellite TV can be used in some remote areas or to supplement ICT infrastructure.

▸ Schools with average infrastructure, at least one computer laboratory connected to a LAN and the Internet, can provide students with the opportunity to use the Internet in the classroom for information search, collaborative projects, product creation and online activities, if the connection allows, in addition to the use of general-purpose software. Satellite Internet links can be used to provide such opportunities to schools without telephone lines.

▸ Schools with sufficient infrastructure are able to mix modes of ICT use. Online or offline can be used to support teaching and learning activities which are more exciting and meaningful in all subjects. The teaching and learning process can be more flexible and can extend beyond the classrooms. Parents and communities will be able to be involved with student learning.

▸ Online technology that requires advanced technology such as broadband connection is still very limited. The combination of online and offline modes seems appropriate and flexible for schools. Online resources should be repackaged to accommodate offline use.

▸ The use of low-cost handheld technology such as graphical calculators, probes and sensors in science and mathematics is very challenging and valuable, particular where ICT infrastructure is very limited or inaccessible. This could be an alternative for poor schools to supplement existing infrastructure.

▸ Classroom settings and the location of computers are important issues that influence the use of ICTs across the curriculum. Computers are still conventionally fixed in computer labs for ICT literacy courses, which does not allow use for other subjects or facilitate students' collaboration.

Total cost of ownership

When planning ICT budgets and making technology decisions, it is important to take into account the total cost of ownership (TCO) of ICTs. TCO is the cost of operating and maintaining computers and the Internet over the life of the equipment.

Understanding TCO can help in two ways:

▸ It is easier to construct realistic budgets which reflect all of the costs that will be incurred.

▸ The value for money of a particular technology (hardware, software, etc.) can be better understood over the long term; some options that initially seemed cheap may turn out to be more expensive (i.e., have higher TCO), or seemingly expensive options may actually be cheaper (lower TCO).

However, determining the total cost of ownership of a technology is not an exact science and depends on estimating the various components as accurately possible.

What is TCO?

Total cost of ownership *[is] a very popular buzzword representing how much it actually costs to own a PC. The TCO includes:*

▸ Original cost of the computer and software
▸ Hardware and software upgrades
▸ Maintenance
▸ Technical support
▸ Training

Most estimates place the TCO at about three to four times the actual purchase cost of the PC (see www.webopedia.com/TERM/T/TCO.html).

Total cost of ownership in schools
Financing the TCO of ICT in schools is a daunting task, especially for schools in small, under-resourced communities. One common mistake of technology planners is to budget only for the initial cost of purchasing equipment and the retrofitting of classrooms. Often overlooked are significant costs over time — such as electricity, telephone and Internet access time, supplies, software and content development, professional development, technical support (maintenance and repairs), and upgrades and replacement —which comprise the bulk of the total cost of ownership.[13]

Donations

Schools may often be offered donations of used computers, software or other ICT equipment – a good example for applying the total cost of ownership test. Schools can ask the following questions when considering whether to accept such a donation:

▸ Is the equipment in working order? If not, what will need to be done to make it operational (e.g., replacing hardware components, reinstalling an operating system and software)?

▸ In the case of computers, does it have a licensed operating system installed? If not, what will the software cost be to install an operating system?

▸ Can the computer connect to the school network and run the software used on other school computers?

▸ Is the equipment likely to fail earlier or more often than new equipment? If so, what will the support and maintenance costs of the equipment be?

Once all of these factors have been considered, donated equipment is not always free: schools can incur significant costs to make such equipment usable and support its operation. This could still be a more cost-effective solution than buying new equipment, but it is not always cheaper.

Open source software

Open source software is software which is distributed with source code, allowing users to modify it. Two advantages of open source software are , therefore, that it is free (although it is possible to buy services and support), and that it can be modified or adapted if needed.

Schools with limited budgets can use open source software to provide applications that would otherwise be unaffordable. In some cases, open source products are as good or even better than paid-for proprietary equivalents.

However, in some situations a particular proprietary software product may be more suitable than an open source product, or an open source equivalent may not be available. Open source software can also be more complex to implement or administer.

Initial cost is therefore only one component of the TCO which should be considered when deciding on which software operating systems and applications to use.

Open Source Software Resources for Schools

Open Office (an open source office application suite) www.openoffice.org/

School Forge ("Schoolforge's mission is to unify independent organisations that advocate, use and develop open resources for primary and secondary education.") http://opensourceschools.org/

Asia Open Source Centre ("Promoting open source and free software in Asia") www.asiaosc.org/

Assessment and evaluation

ICTs are an expensive investment in any school, both in terms of absolute cost and the time and effort invested in becoming familiar with the tools and using them appropriately. It makes sense for schools and teachers to have a good understanding of the extent and nature of ICT use, and the benefits observed.

ICT assessments should be made in the context of the school's technology plan, which should ideally have set out some benchmarks and targets at the start of the ICT implementation process (see the sections on developing a technology vision and plan and on school technology self-assessment frameworks and tools earlier). Table 4.2 presents the components that school ICT assessments commonly include.

Table 4.2: ICT assessment components

Component	Description
ICT facilities	What is the range of ICT facilities available (including hardware, software, and Internet connectivity)?
Operational requirements	What are the running costs (maintenance, support, equipment replacement, consumables) and staffing and time requirements (support staff, management time) to keep the ICT facilities running?
Extent of access	Who has access to ICT facilities, and when?
Extent of use	How many people (staff and students) are actively using ICT facilities (e.g., on a daily or weekly basis)?
Measurable activity	What ICT "throughput" can be measured (e.g., bandwidth usage or dial-up time for Internet connections, volume of e-mail messages sent and received, number of Web pages created on a local intranet or files saved on the server)?
Diffusion	In how many different subject areas are ICTs being used, and what proportion of staff and students use ICTs regularly?
Types of use	What types of activities are ICTs being used to support (e.g., online collaborative projects, preparing lesson plans, interactive simulations, preparing work for presentation purposes)? What spread of applications is being used?
Competencies	What skills have staff and students developed (assessed, for example, according to an ICT competency framework)?
Intangible effects	What other changes can be observed as a result of ICT use (e.g., in attitudes, values, motivation, behaviour or attendance)?
Learning impact	What effect can be seen on the quality of work produced by students and the attainment of learning outcomes?

A wide range of school ICT assessment tools and evaluation frameworks are available online. Schools or teachers can start from one of these or develop their own sets of indicators. Producing meaningful results will require recording appropriate information in a structured and consistent manner over a period of time – at least one year, but preferably longer.

Schools that are the recipients of ICT equipment from donor agencies or other external stakeholders can use ICT assessments to show the value of the donation to the school. Detailed assessments (even when they reveal problems or difficulties) can demonstrate that the school is committed to making the best use of ICTs, supporting the case for continued or additional investment.

resources

Getting Started with ICT Assessment

"Assessment tools for ICT in education" is a detailed list of tools for measuring the impact of ICT in education, compiled by the UNESCO ICT Indicators Project from the Texas Technology Applications Center for Technical Development and the British Educational Communications and Technology Agency (Becta). *www.unescobkk.org/education/ict/v2/info.asp?id=11088*

"A Framework to Articulate the Impact of ICT on Learning in Schools" (Western Australian Department of Education, 2002) considers five dimensions of ICTs in schools: students, learning environments attributes, teacher professional ICT attributes, school ICT capacity and school environment. *www.eddept.wa.edu.au/cmis/eval/downloads/pd/impactframe.pdf*

Critical Views
A number of education writers and studies have asserted that technology does not necessarily improve student performance – the "no significant difference" phenomenon. Many of these critiques are instructive in that they highlight poor applications of technology where the results are worse than using no technology at all.

Education World published two articles in 1999 presenting both sides of the argument:

"Technology in Schools: Some Say It Doesn't Compute!"
www.education-world.com/a_admin/admin121.shtml

"Technology in the Schools: It Does Make a Difference!"
www.education-world.com/a_admin/admin122.shtml

schoolnet*toolkit*

An Overview of the UNESCO ICT Portal for Teachers

The following is drawn from *www.unescobkk.org/ips/ict/ict.htm*.

1. The role of ICT in education

What role should ICTs play in education reform and how can we ensure that their potential to enhance education is fulfilled? Access articles, reports and links to online journals and Web sites which explore these issues and offer guidelines for integrating ICTs into educational programmes.

- ICTs and educational reform
- ICTs in support of education
- Benefits of ICTs in teaching and learning methodologies/pedagogy
- Guidelines and policies for developing programmes on ICT use in education

2. Teachers' Roles in the ICT Environment

What are the real implications of the transformation of education for teachers and what role will they play in the new knowledge societies? Click to articles and Web sites that respond to this question, including common perceptions of the teacher's place in education in the modern world, how ICTs can support and motivate teachers and standards for teacher ICT competency.

- Role of TEACHERS in the ICT ENVIRONMENT
- How ICT supports the new role of teachers
- Teacher standards for competency in ICT

3. ICT Training Strategies and Online Courses

Actual teacher training projects and papers describing them are linked to here. Educators and programme developers outline the working behind their projects, and share their experiences and lessons learnt. Extensive resources for online professional development courses are listed thematically.

- Technology and ICT in teacher education
- Strategies for teacher training in ICTs
- Courses – teacher training in ICTs
    A. General
    B. Various computer applications on one site
    C. Internet and e-mail
    D. Web site development
    E. ICT applications in education
- Best practices

4. Integrating ICT into teaching

This section explores topics surrounding the use of ICTs in classroom teaching and showcases the experiences and opinions of educators as they develop new ways of integrating ICTs into their teaching practice. Links include articles on how to use ICTs in the classroom effectively, tips and ICT-based lessons across the curriculum.

- Integrating ICTs into teaching/learning: definition and concepts
- Integrating ICTs into the classroom
- Successful and innovative practices
- Integrating ICTs into specific subjects

5. Teaching Ideas, Lessons and Curriculum Materials

Numerous links are available here to ready-made lesson plans, activities and teaching materials covering all major curricular areas. Materials are organised into specific subjects, ranging from arts, languages, health and physical education to mathematics, sciences and information technology, among others.

- The arts
- Health and physical education
- Information technology
- Language arts
- Modern foreign languages
- Mathematics
- Science
- Social sciences/studies
- Critical thinking
- Life skills
- Lesson collection on various subjects

6. Educational Software/Courseware

Links here offer downloadable software, freeware and shareware. Most applications are free or low-cost, and many sites offer software for the full curriculum. Click to Web sites that review new and existent share- and freeware, software that enables teachers to put educational materials and student work online and guidelines for evaluating educational software.

- Downloadable educational software - free and cost
- Software reviews and announcements
- Software for putting educational materials online

7. Using Internet Resources

But how can teachers assess the validity and authority of Internet resources? This page provides articles and Web sites that define accepted evaluation criteria, such as appropriateness of content to audience, authenticity and authority of the source, and affiliation of the author. Other sites focus on copyright issues.

- Criteria for evaluating educational materials
- Criteria for evaluating educational Web sites
- Copyright issues

8. Electronic Collaboration

This section supplies links to articles on online collaboration. Strategies for organising online collaboration are outlined, along with relevant pedagogies, useful tools, tutoring and participation. Collaboration projects are linked to, along with information on intellectual property rights and cultural implications of the emerging educational environment.

- Electronic collaboration: what is it?
- Guidelines and procedures for organising electronic collaboration
- Online collaboration projects/activities
- Successful strategies and best practices on electronic collaboration
- Cultural and ethical issues

9. Bringing Your Classroom Online

This page focuses on how to develop online courses, and is presented in five sections. The first contains articles on a host of e-learning topics. Next, there are papers from online course developers on how to create your own virtual course or school Web site, examples of online learning programmes and educational Web sites and free and low-cost software applications.

- Online and e-learning: issues and benefits
- Guidelines for bringing a classroom online/how to manage online classes
- Online learning programmes: real cases/examples
- Software/applications for bringing classrooms online

10. Evaluation Tools and Indicators

To what extent can new technologies be said to enhance teaching and learning? Articles and papers describing recent research into the practical value of ICTs are linked to here. There are then sites containing tools and templates to assess the performance of teachers and students. There are also studies describing ICT performance indicators.

- Measuring the impact of ICT in education
- Evaluation tools and instruments for assessing teaching/learning and ICT readiness
- ICT performance indicators

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UNESCO ICT for Education in Asia and the Pacific
www.unescobkk.org/education/ict/v2/

UNESCO e-learning portal
www.unesco.org/education/portal/e_learning/index.shtml

The Gateway to Educational Materials
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Development Gateway: E-learning
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