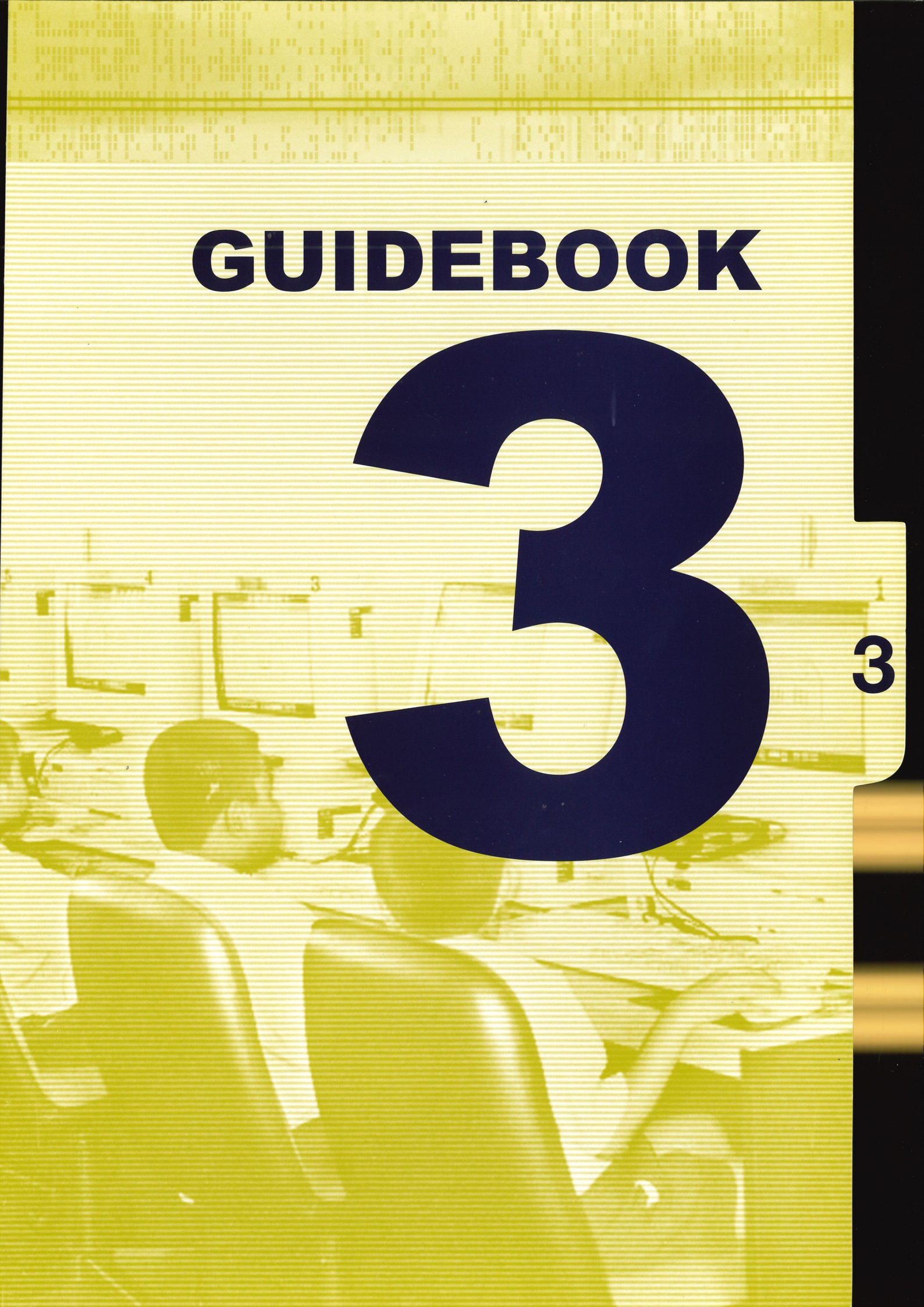


GUIDEBOOK

3

3



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.

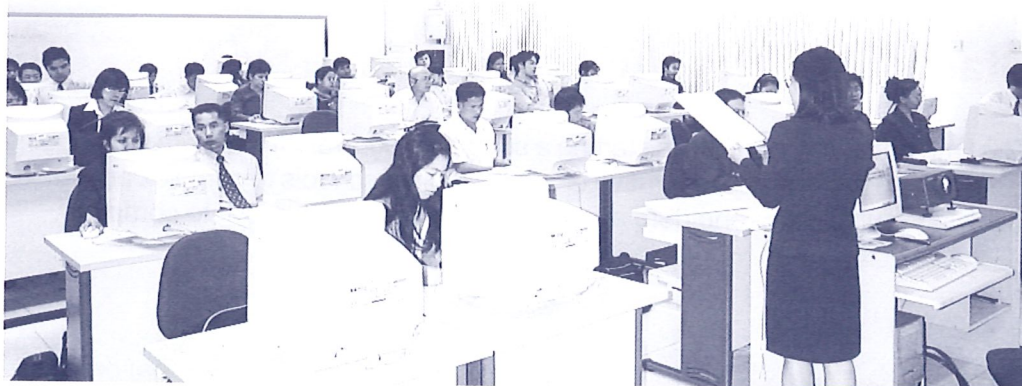
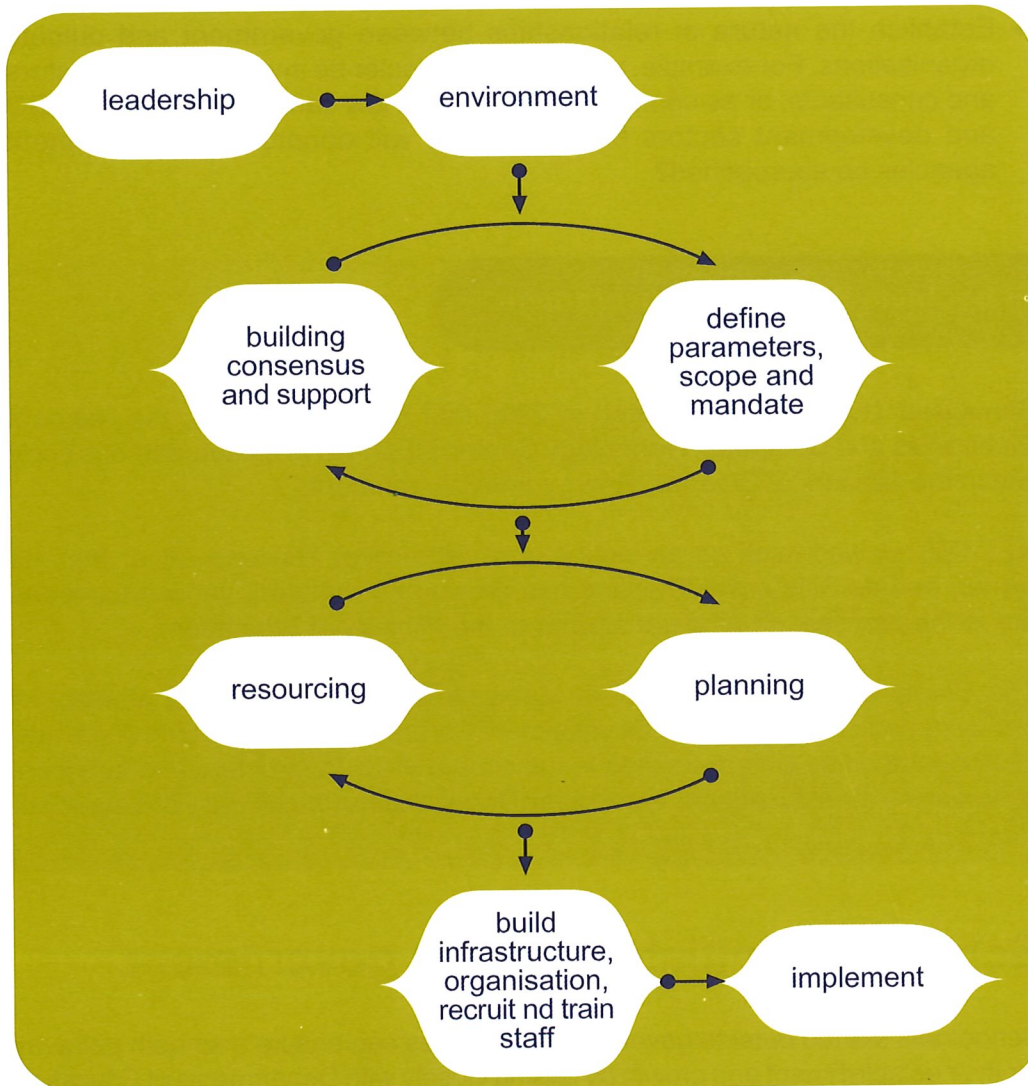


Figure 3.1: The schoolnet start-up process



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:

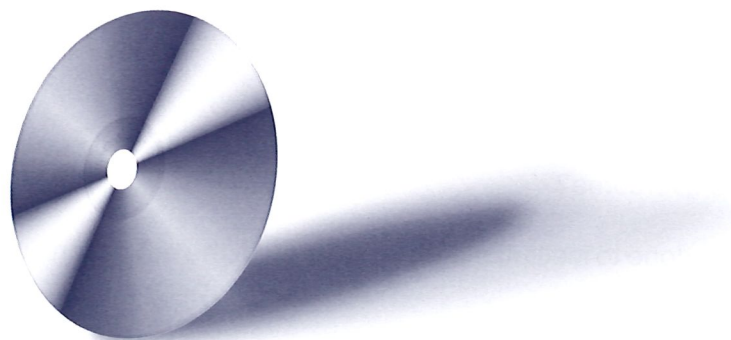
- ▶ How can one achieve impact on a large scale?
- ▶ How can seemingly intractable problems such as poor telecommunications infrastructure be overcome?
- ▶ What needs to be done to institutionalise ICTs through the education system?

- ▶ 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
 - Any 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.

resources

Business and Project Planning Resources

Quality Leadership Center, Inc., "Activity Based Costing (ABC): What Is It and How Can Reengineering Teams Use It?"
www.prosci.com/abc1.htm

Project Management Institute
www.pmi.org

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:

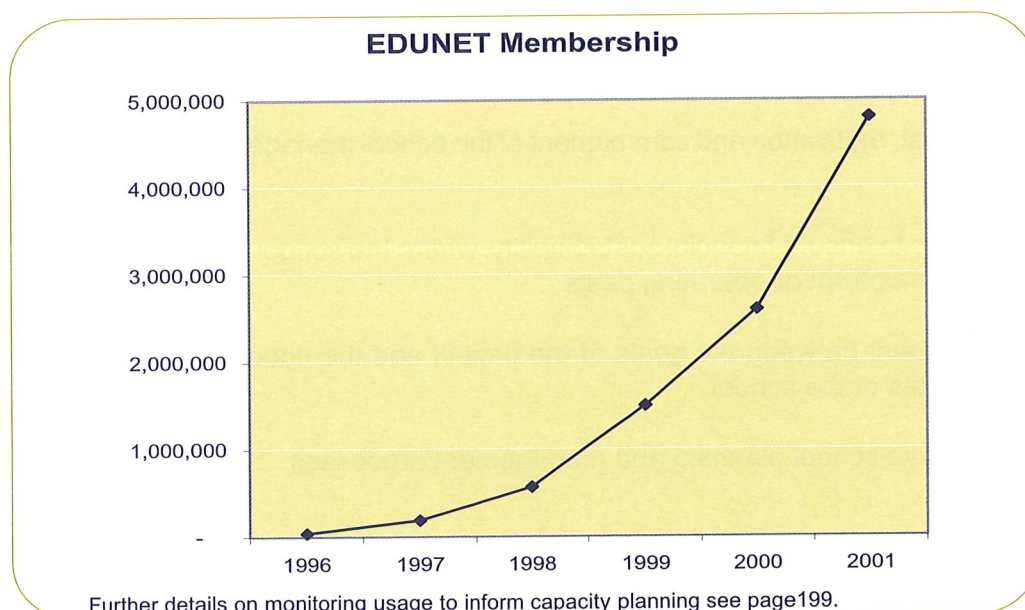
- ▶ **Infrastructure:** Where schoolnets are providing network access or network-based services, network infrastructure needs to be expanded as the number of users increases. This can include bandwidth, access infrastructure such as dial-up lines and server hardware. Smaller networks are more vulnerable 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



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 Selecting Schools 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 be 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.”¹⁵

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.

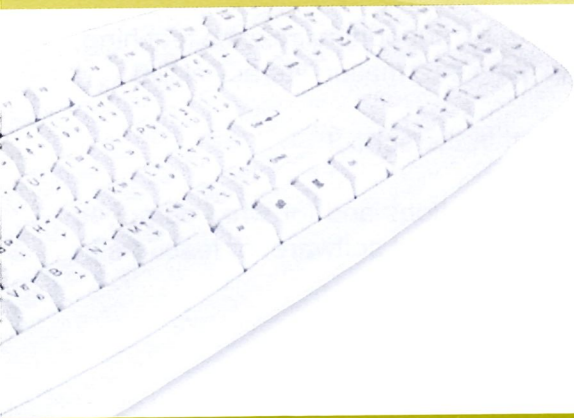
Since the government implemented a new civil service scheme in 2001 which encourages and rewards civil servants who acquire competencies in specific areas, there is now greater motivation on the part of teachers to acquire ICT skills and knowledge.

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 of 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.

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.

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

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	Installation 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 coordinating 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 optimised). 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 same 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 Thailand⁷

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

resources

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.

resources

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.

resources

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

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 well, 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 usually 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

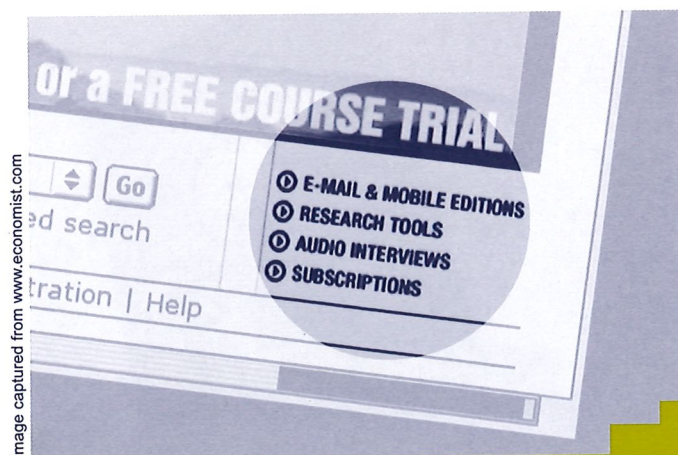
The Development Gateway is “an interactive site for information on sustainable development and poverty reduction” built by the Development Gateway Foundation. The Development Gateway allows users to register and subscribe to particular topic areas such as e-learning.

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.



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.

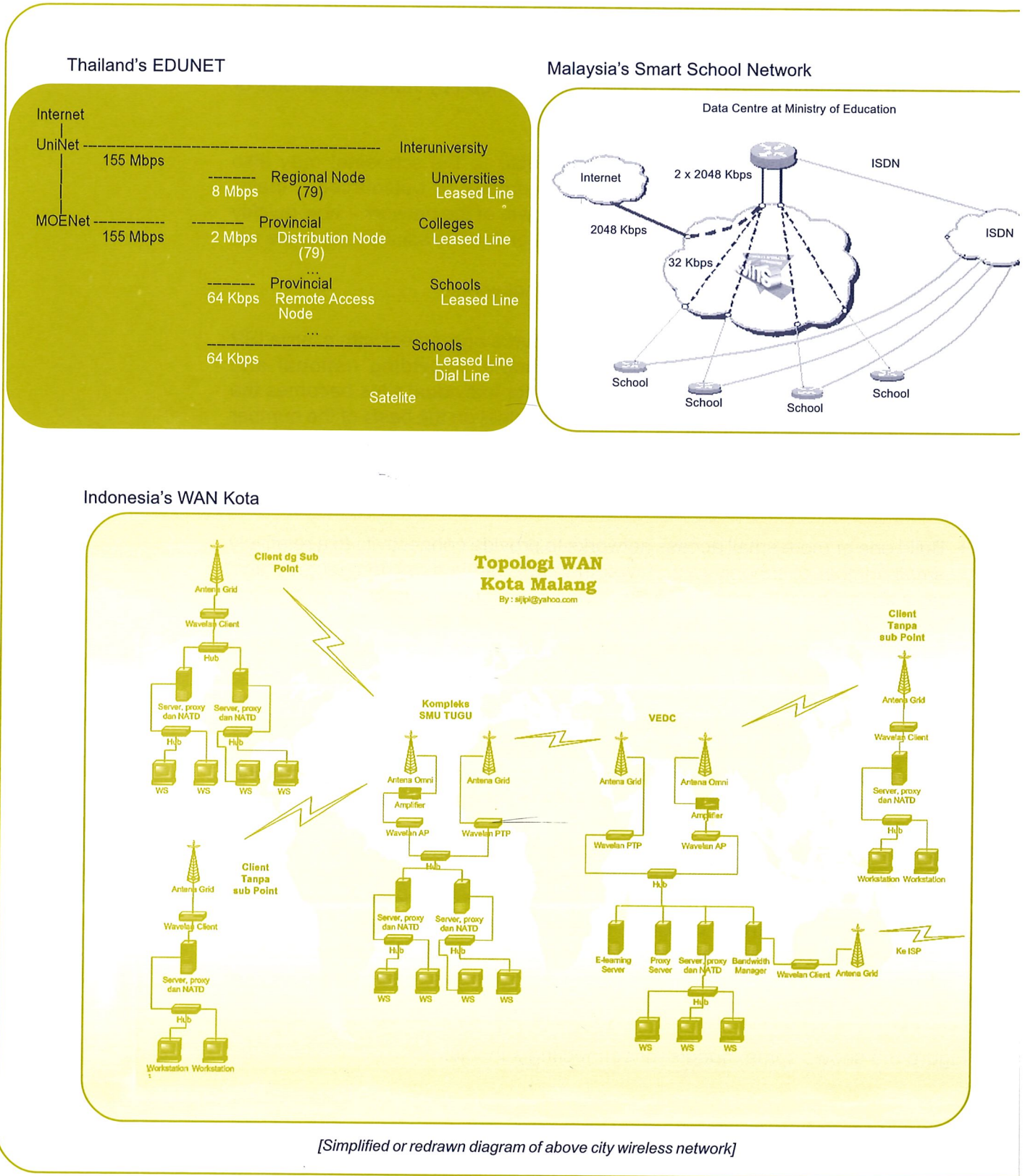
The operational capacity and expertise available to the schoolnet may also determine whether services are provided internally or outsourced. Finally, schoolnets should consider the prospective growth of the network – how quickly new schools will be connected – and the ability of various solutions to 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



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.

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
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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
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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



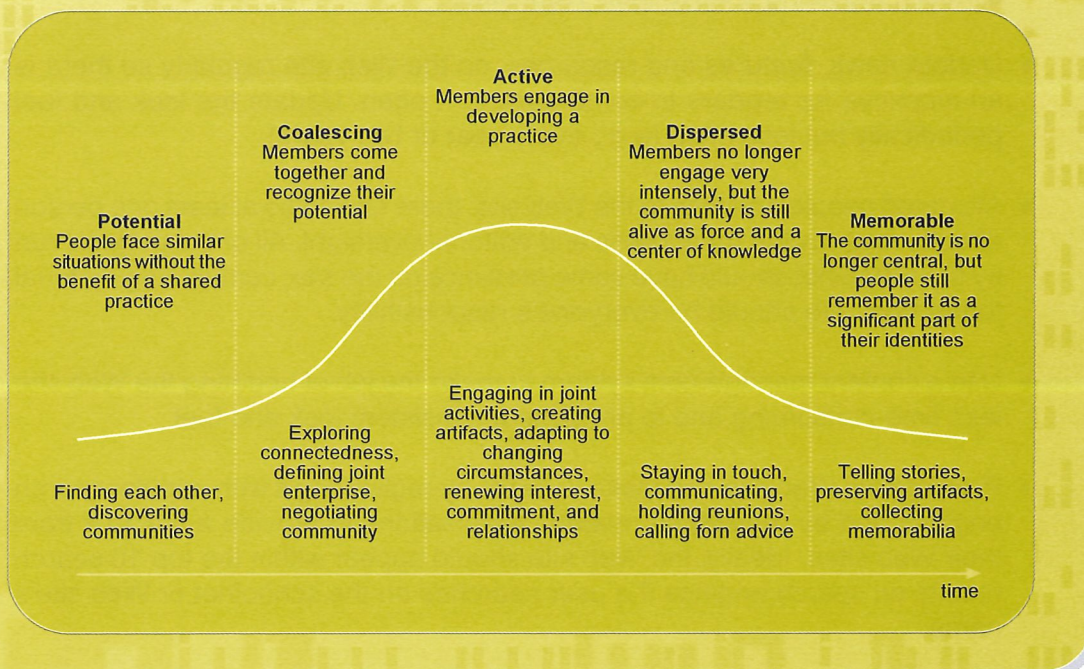
What Are Communities of Practice?

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 Practice¹¹



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

The screenshot shows the Pilipinas SchoolNet Home Page in a Mozilla Firebird browser window. The browser's address bar displays <http://www.pilipinasschoolnet.org/>. The page layout includes a navigation menu on the left with links for HOME, WHAT'S NEW, NEWS & FEATURES, SCHOOLS, TELECOLLABORATIVE PROJECTS, RESOURCES, LINKS, HOW TO JOIN, ABOUT US, ABOUT OUR PARTNERS, CONTACT US, and EMAIL LOGIN. The main content area features a 'Welcome' message with a photo of a child and a vision statement: '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 the Filipino youth to meet the demands of the knowledge economy. Pilipinas SchoolNet is committed to addressing the Digital Divide within the country--between those who have access to the Internet and those who do not--by promoting the effective and sustainable use of computers and the Internet in schools, particularly those in underserved communities.' Below this, there are sections for 'What's New' and 'News And Features'. The 'What's New' section includes a post dated 2003-04-03 about resources for teachers and students, and a post dated 2003-03-21 about the website. The 'News And Features' section includes a post dated 2003-05-15 about ed.Venture Centers and a post dated 2003-05-14 about ed.Venture Principals completing ICT Strategic Planning Workshop.

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.



resources

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)

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, 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 Korea¹²

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 sectors—in 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.

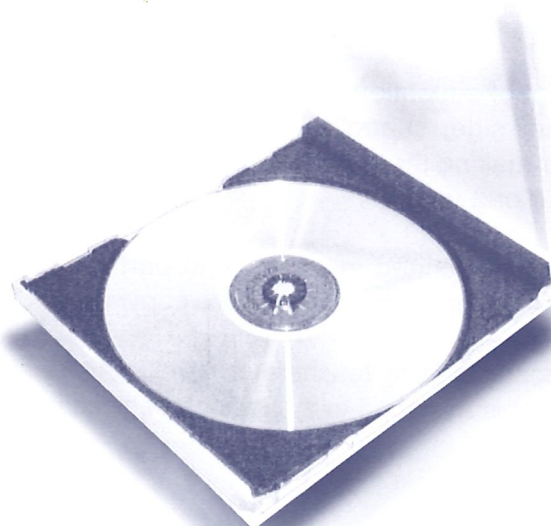
For more information on educational software and content, see section on Online Content and Software in Guidebook 2.

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	
<p>In this information-gathering stage, teachers learn the knowledge and skills necessary for performing instructional tasks using technology.</p>	<p>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.</p>
Stage 2. Teacher as Adopter	
<p>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.</p>	<p>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.</p>
Stage 3. Teacher as Co-learner	
<p>In this stage, teachers focus on developing a clear relationship between technology and the curriculum, rather than concentrating on task management aspects.</p>	<p>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.</p>
Stage 4. Teacher as Re-affirmer or Rejecter	
<p>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.</p>	<p>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.</p>
Stage 5. Teacher as Leader	
<p>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.</p>	<p>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.</p>

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 Learners¹⁶

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.

resources

School Technology Self-Assessment Frameworks and Tools

North Central Regional Educational Laboratory (NCREL) *enGauge* Online Assessment:

www.ncrel.org/engage/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

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:

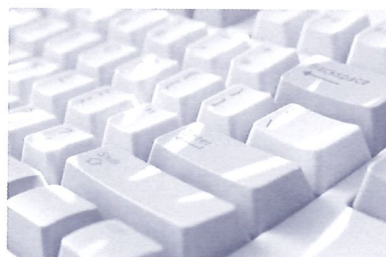
- ▶ Providing modular training opportunities over a period of time
- ▶ Providing training courses that extend over a number of weeks or months (allowing teachers to integrate new concepts and course activities with classroom practice)
- ▶ Providing additional support resources in training materials that 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)

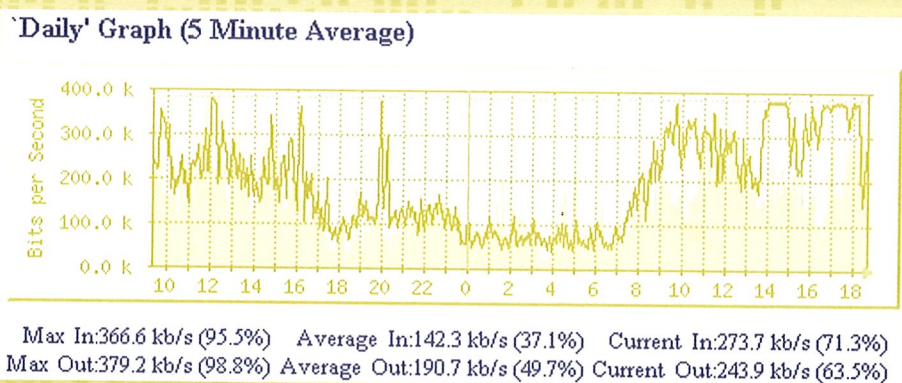
- ▶ Activity on specific Web sites such as education portals or learning management systems (e.g., number of registered users, frequency of visits, number of visits per day and areas of the site most frequently accessed)

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).



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



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 Prototypes¹⁷

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?

