Capacity Building of Thai Education Reform (CABTER)– Learning technologies (Stage1)

THAI LEARNING TECHNOLOGIES 2010

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1 Executive Summary

This report provides advice to assist the Royal Thai Government to promote social and economic development through the effective and efficient introduction of learning technologies into all sectors of education and training. The strategies and initiatives proposed in the report are designed to facilitate access to learning technologies and to promote the development of knowledge, skills and understanding that will enable people of all ages and in all areas of Thailand to embrace a culture of lifelong learning.

It is recommended that a National Advisory Committee on Learning Technologies in Education Reform be established and be responsible for developing the *Thai Learning Technologies 2010 Masterplan* based on the advice provided in this report and Thai education policies.

1.1 The Vision

The Thai vision for the implementation of technology in education is that learning technologies will improve access to educational opportunities and improve outcomes for Thai students in the 21st century. A key aim is to transform Thai society into a learning society, able to take advantage of the opportunities available by connecting with the global knowledge economy, while gaining a greater understanding and appreciation of Thai culture and society. The learner is at the centre of these education reforms.

1.2 Implementing Learning Technologies in Education

The report recognises the need for action programs in relation to educational technology infrastructure, human resource development, the provision of high quality digital learning and teaching materials and change management processes. Experience around the world has shown that in order to realise the full benefits offered by learning technologies these factors must be adequately addressed. If any of these is missing the benefits of technology will be limited.

1.2.1 Routine access to ICT infrastructure

Students and teachers need routine access to technology in order to develop the skills and attitudes necessary to participate in a knowledge society.

1.2.2 Human resource development

Teachers and leaders require training and professional development to ensure they are able to effectively use technology in their work, and have the capability to capitalise on the potential of technology to enhance the processes, content and outcomes of teaching and learning. It will also be necessary to develop the level of ICT skills in the community to support the initiatives.

1.2.3 Access to high quality digital learning materials

Students and teachers must have access to high quality digital information and tools that exemplify the ways in which technology can add value to the learning process.

1.2.4 Change management

Implementation of learning technologies in schools and communities on the scale foreshadowed in the Education Act 1998 will involve major changes in the education and training sectors.

Leadership is central to the effective implementation of learning technologies. Resource allocation, staff training and development, classroom layout, and teaching and learning require new approaches. The increased use of learning technologies may also lead to change in the relationships between students and teachers. Planning is required at system and local levels to ensure adequate access to infrastructure, human resource development and optimal allocation of resources. Implementation and communication strategies are required to ensure that plans are understood and effective.

It is vital to acknowledge the importance of enlightened leadership in the change process. Leaders at all levels must understand the potential of ICT to improve teaching and learning and to support reform generally. Leaders also require skills to mobilise colleagues and staff. Specialised training and support will be required for leaders as part of the change process.

Above all, it is essential that the impact of changes are monitored using systematic evaluation procedures so that modifications are based on evidence concerning the impact of learning technologies on student learning.

Figure 1 illustrates the key components of the proposed reforms in learning technologies in Thailand.

Thai ICT Masterplan Vision Staged Implementation 2001-2010

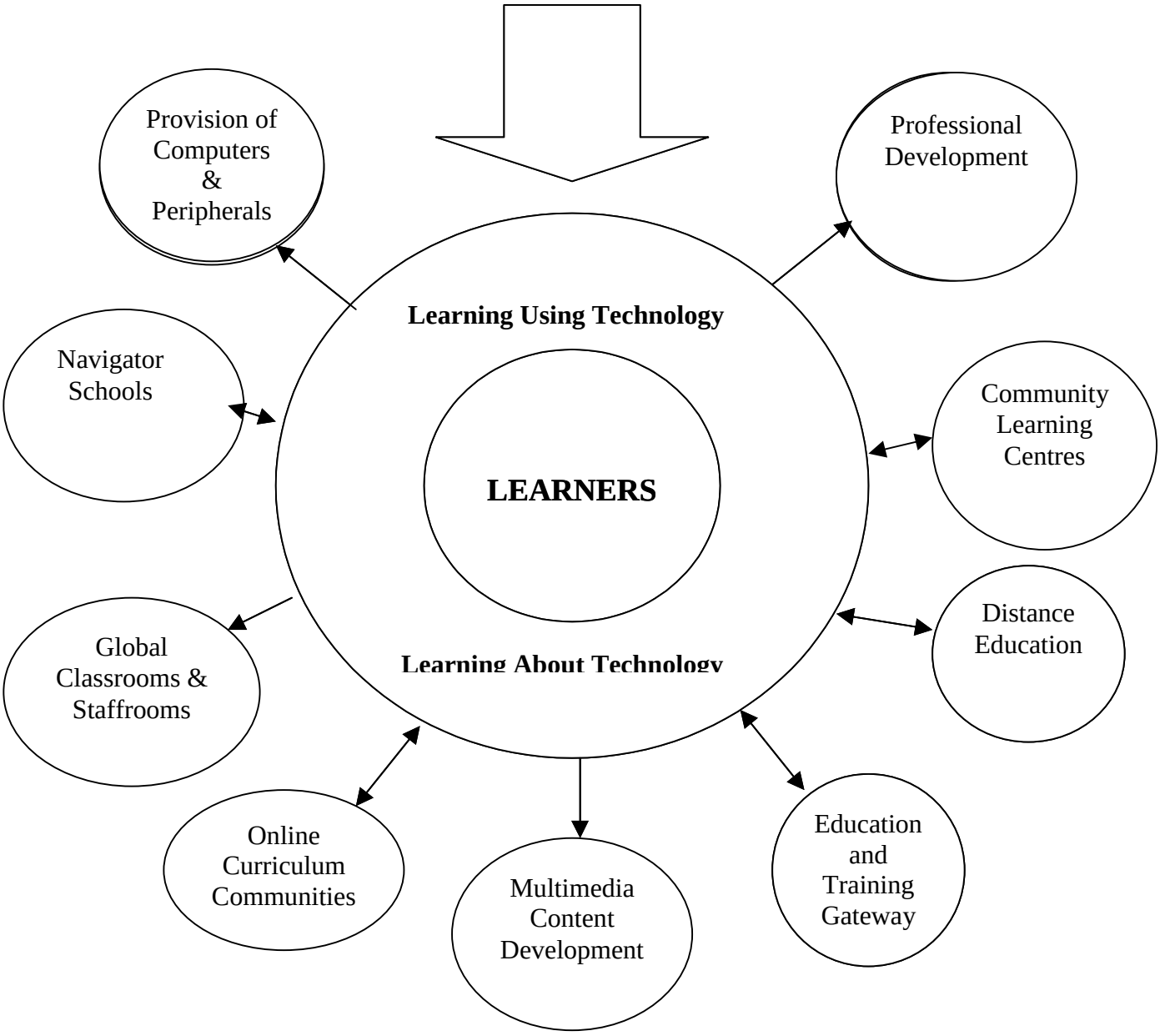
Thai Learning Technologies 2010 Masterplan

Stage 1 – 2001–3 Policy Development, Planning, Strategic Initiatives

Stage 2 – 2003–6 Major Rollout

Stage 3 – 2006–10 Embedding Practice

Infrastructure	Software and Content	Human Resource Development	Change Management



1.3 Systemic Reform

Good management of the change process at the government, agency, learning institution and community level will underpin successful systemic implementation. Successful change management begins with an understanding of the current situation and the development of a shared vision of what education institutions and classrooms will be like when the change has been implemented. Plans must be devised to move from the current situation to the desired situation.

Plans must acknowledge the critical roles played by individuals, as leaders and change agents, as well as the need to address the diverse needs of individuals involved in the change process. Similarly, the processes should recognise the threats posed and opportunities afforded to groups of stakeholders by technology driven change. The capability, through the use of ICT, to facilitate knowledge sharing and collegial support amongst people in different physical locations can assist not only the implementation of learning technologies, but education reform more broadly.

1.4 Lifelong Learning for All

The report contains recommendations and suggested strategic initiatives that, if implemented, will build on existing Royal Thai Government plans and programs to develop Thai communities. Learning is highly valued and is an ongoing activity. The focus is on developing partnerships between key stakeholders and maximising resource allocation through collaborative national, district and local projects. For example, it is recommended that the development of digital learning materials and the establishment of learning centres are geared to optimising access to technology for schools, universities and members of the broader community.

1.5 Staged Implementation

It is recommended that the *TLT 2010 Masterplan* program should be implemented in stages. Timing of the stages will depend on the availability of financial and human resources, and may in some cases overlap.

1.5.1 Stage 1: 2001–3 Policy Development and establishment of lead programs

During this stage, policies and *Masterplans* will be developed in consultation with key stakeholders. The visions and plans will be promoted and communicated and the need for coordination across all areas of education reform highlighted. These reforms are occurring in a range of areas, including curriculum and assessment, teaching and learning practices, accountability and organisational structures.

During Stage 1, activities will include the establishment of the education network, the introduction of the Navigator school program, professional development and teacher training programs, commencement of procurement processes and development of digital materials. Reforms such as online collaborative projects, website competitions and teacher support networks can be established, encouraging early adapters across the country to engage directly within the reforms.

Stage 1 will build upon what has been learnt in successful system-wide and local implementations elsewhere in the world. Consultants can assist in this process, but capacity will

be built by Thai education officials, school leaders, teachers and students who experience the application of learning technologies first hand and are able to promote ICT initiatives and successful strategies at the 'grass roots' level. Teams will be established in educational institutions to coordinate the process of learning technology implementation. Teams must have a deep understanding of the role of ICT in education as well as other aspects of educational reform, change management, human resource development, and student-centred learning.

1.5.2 Stage 2: 2003-6 Major rollout of hardware, software and training programs

Resources and training programs will be provided to support Thailand's education leaders and teachers in all aspects of learning technologies. A diverse range of programs is needed, addressing the broad array of interests and individuals needs. Programs are required to develop the quality of leadership at all levels while encouraging ownership by all stakeholders to facilitate change and empower individuals as change agents. While computer skills training is needed, the success of the program will be dependent upon developing teachers' ability to integrate the technology into mainstream teaching and learning. Collaborative networks should be developed to share successful practice and provide collegial support. All major targets should be met by the end of Stage 2.

1.5.3 Stage 3: 2006–10 Embedding of practice and commencement of renewal cycles

Having been provided with infrastructure, training, and content, teachers and learners will have embedded the use of technology in mainstream learning. Education institutions and individuals will generate new applications during this process and achieve secondary targets. The upgrade and replacement of infrastructure provided in Stage 2 commences during this period.

1.6 Strategic Initiatives

The following proposed Strategic Initiatives are elaborated in Section B of the report. Some are large-scale capacity building programs, some are designed to pilot and lead innovation, while others link specifically to existing Thai ICT initiatives in progress. It is not a comprehensive list of programs designed to address all areas of need in the application of learning technologies. The proposed Strategic Initiatives will provide the basis for discussion and planning of the proposed stages of education technology innovation in Thailand. The initiatives are:

- Navigator Schools Program
- Online Curriculum Communities
- Distance Education Projects
- Community Learning Centres
- Education and Training Gateway
- Multimedia Content Development
- Networks in Thai Education
- Provision of Computers and Peripherals
- Technical Support Program
- Professional Development Programs
- Global Staffroom
- Global Classrooms
- Organisational Structures Reform
- Resourcing Strategies for ICT Initiatives
- Research and Evaluation – Towards Continuous Improvement

Section A
Context: The Need for Effective and Efficient Implementation of Learning Technologies in Thailand

2 Introduction

Thailand has undergone significant social, political and economic change over the past fifty years. The process of democratisation was followed by a period of economic growth and a significant increase in the literacy rate. Since the Asian economic crisis and a slump in the value of the currency, it has become clear that Thailand must take steps to further modernise and engage with the global knowledge-based economy.

Reform of the education system and a focus on the use of technology to improve education access and outcomes is seen as central to the advancement of Thai society and has been enshrined in the Education Act (1999).

This report has been developed to provide advice for assistance in the development of a strategic plan for the implementation of information and communication technology (ICT) in education. Learning technologies may be used as a tool for improving the quality of education provided for Thai students of the 21st Century. The objectives of the strategic plan are to use technology to enhance the quality of education and training, to increase the effectiveness of education and training delivery systems, and to increase the efficiency of education and training management.

This requires the implementation, in each sector, of professional development programs, technological infrastructure, research and development projects concerned with content resources, models of learning technology programs and change management and leadership strategies.

The implementation of new learning technologies in educational institutions and systems is linked to stimulating and supporting changed Stages in learning and teaching that result in improved student outcomes and focus in particular on student centred learning. Thus, the introduction of learning technologies is part of a set of broader educational reforms. When broad changes directed towards educational improvement are introduced into an educational system, it is necessary to orchestrate system-wide policies and strategies around a common set of purposes. Studies of systemic change during the 1980s point to the requirements of integrating separate policies, attending to strategies of policy sequencing, involving the public and professionals in change, balancing central leadership with local flexibility and investing in professional development.

The introduction of information and communication technologies in the Thai education system needs to be coordinated with other initiatives in the Ministry of Education, Religion and Culture so that overall effectiveness and efficiency is maximised. Moreover, to promote technology based innovation and improvement in electronic education, there needs to be a linking between the Ministry of Education, Religion and Culture's program with other Thai Government programs such as e-Society, e-Commerce and e-Industry that together will support the development of Thailand's knowledge-based economy.

There are three broad and interconnected ways in which information and communication technologies can improve the output of the education system, stimulate development of the

knowledge economy and impact on the quality of education experienced by students. The first is enabling students to learn about technology so that they know how to use appropriate technologies and how it affects their lives. The second is enabling students to use these technologies in their learning so that they can experience more student-centred forms of teaching that improve learning. The third is to improve access to education and training for all members of Thai society and consolidate a culture of lifelong learning.

2.1 Aims of the Study

This study is part of a Thailand-Australia Capacity Building Facility that is intended to assist the Royal Thai Government to develop a strategy for learning technologies with a focus on the role of information and communication technologies and e-learning. It aims to exchange information on the use of learning technologies in Australia with Thai educational policy makers and educators, and to establish a network of education reform agents to facilitate future cooperation.

2.2 Methodology and Sources of Information

The purposes of the first Stage of Module 3 of the Thailand-Australia Capacity Building Facility are to assist the Royal Thai Government to develop strategies for learning technologies, to exchange information about learning technologies in Australia with Thai officials, to design further technical assistance on learning technologies and to establish a network of educators to enable future cooperation in policy formulation, implementation and evaluation. This project utilised a combination of inter-related methods.

An appreciation of the current use of learning technologies in Thailand was compiled from several sources. One was a review of official documents including the *ICT for Education National Masterplan*, the document *Education in Thailand* (published by the Office of the National Education Commission), a paper *Quality Improvement in Education: Thailand Experiences* presented to the International Forum on Quality Education Policy by the Deputy Permanent Secretary of the Ministry of Education, the Report of the Second International Technology in Education Study (Pelgrum & Anderson, 1999), and other planning documents provided by the Office of the National Education Commission. Another was the series of briefings with key staff in a number of organisations. These included officials from the:

- Office of the National Education Commission, Dr Rung Kaewdang (Secretary-General), Dr Wannapa Pliansri (Director of the International Relations and Cooperation Center), Dr Kulvitra Bhangananda (Director of the National Institute for Technology in Education), Siritorn Tadthi (Educational Officer), Putisar Akkapoo (Director of the Lifelong Group), Dr Rie Atagi (consultant to ONEC), Dr Pruk Siripbanpitak, Faculty of Education, Chululogkorn, Teacher Development (Consultants);

- Department of General Education, Ministry of Education, Dr Suwat Saktrisoon (Director of the Planning Division);

- Institute for the Promotion of Science and Technology, Dr Pisarn Soythurum (President), Dr Pornpun Waitayangkoon (Director of the Information Technology Division), Ms Naree Wongsirojkul (Head of the Computer Division), Dr Sunee Klainin (Senior Specialist in Science Education);

- National Science and Technology Development Agency, Dr Kanchit Malaivongs (Vice President and CIO);

- National Electronics and Computer Technology Centre, Dr Taweesak Koanantakool (Director) and Dr Pensri Guntasopatr (Policy Research Section);

- The King Mongkut's University of Technology Dr Paron Isarasen ana Ayudthaya, Thonburi (President of Suksapattana Foundation, and Chairman of the University) and Dr Pichet Durongkaveroj (Advisor to the President)

In addition, visits were made to the Vajirathamsatit School and the Pathai-udomsuksa School.

A systematic review of major reviews of research was conducted using electronic databases and supplemented by prior knowledge of the project team. A review of documents on Australian policies and practices in information technologies, at Federal and State level, was conducted by searching published records electronically indexed on the Australian Education Index, by searching the web sites of Commonwealth and State authorities (including the Education Network of Australia) and by using the personal knowledge of the project team to access unpublished information. Members of the project team had been directly involved in the implementation of many of the policies and practices in Australia and could bring perspectives from that involvement to the project.

Generating potential strategies involved bringing together information from the Australian experience of information technologies, information about educational provision in Thailand and knowledge of the possibilities within emerging technologies that might offer cost-effective opportunities for the provision and use of learning technologies. In generating these potential strategies, the focus was on the educational applications of the technologies in promoting student-centred learning rather than the technologies themselves. That focus was maintained by referring to the experience of Australia and other countries that have also attempted to use information and communication technologies to support educational development.

2.3 Role of CABTER in Reform

2.3.1 Capacity Building Facility Aims and Objective

The Thailand-Australia Capacity Building Facility (CBF) is an initiative of the Australia-Thailand Development Cooperation Program. It is a flexible delivery mechanism established to provide Australian technical assistance to help Royal Thai Government agencies to develop and implement policies consistent with Thailand's economic and social reform agenda. The National Education Act of 1999 emphasises the use of technologies for education as part of a knowledge-based society. There is therefore a need to develop and implement a strategic plan for learning technologies.

2.3.2 Modules of the Capacity Building for Thai Education Reform

There are three modules in the CABTER. The first is concerned with school autonomy and financing, the second with quality assurance and program evaluation in higher education and the third is concerned with learning technologies. The three modules are related in the sense that each is concerned with an aspect of educational improvement that will result in better outcomes for learners and an enhanced capacity for systemic development. They are also related in other ways. Information technologies can provide important tools for school management and support student learning more directly. Learning technologies are also relevant to higher education. Higher education, in many countries, is making increased use of multimedia teaching to provide wider access to courses, materials and distance learning. These forms of educational delivery are

used for on-campus as well as off-campus students and are seen as providing valuable learning resources. The three projects are also linked in sharing aspects of methodology in that they show information and perspectives between two cultures.

2.4 Overview of the Thai Education system

2.4.1 Statistics: Size and Organisation

Thailand has an area of 513,500 square kilometres and a population of approximately 62 million people. Between 1990 and 2000, the age distribution of the population shifted towards a greater proportion of people in older age groups. Some 22 per cent of the population is aged 13 years or younger. The majority of the population is Thai, but there is a range of other ethnic groups. Educational provision in some provinces needs to take account of language differences and differences in access to resources between urban and rural populations. After stagnation in 1997 and decline in 1998, the Thai GDP expanded by 4.2 per cent in 1999 and achieved 4.5 per cent in 2000. In terms of employment opportunities, there appears to be a shortage of skilled vocational and technical labour such as craft workers and engineers.

Formal education has four major sequential levels: pre-primary, primary, secondary and higher education. A six-year primary schooling is compulsory, followed by three years of lower secondary and three years of non-compulsory upper secondary education. Enrolments in primary and secondary school levels have declined in recent years for demographic reasons. However, there was an expansion of enrolments in higher education, especially in diploma courses. Some 15 per cent of enrolments were in private institutions (being around 20 per cent in higher education and pre-primary and between 10 and 13 per cent primary and secondary education).

The total number of students participating in formal education in the year 2000 was 14.2 million. There has been an expansion of educational participation in recent years, so much so, that the average years of education for people over 15 years of age increased from 6.6 years in 1996 to 7.1 years in 1999. Among those aged between 15 and 21, the average number of years of education is 9.4. Participation in primary education is nearly universal (apart from those who live in remote areas) and for secondary education participation has risen to 68 per cent.

In 2000, the transition rate from primary to lower secondary education was 88 per cent (a decline from 91 per cent two years previously) and from lower secondary to upper secondary education the transition rate was 80 per cent (also a decline from two years previously). The decline in the transition rate to upper secondary education was more pronounced for the vocational studies stream. Overall, a little more than half (54 per cent) of the relevant age group participates in upper secondary education.

A little less than one quarter (23.6 per cent) of 18-21 year olds have access to formal higher education. In the year 2000, some 89 per cent of upper secondary school graduates progressed to higher education. Non-formal education provides an important and diversified further education program of general and vocational education. In 1999 around 3.8 million people participated in these programs.

2.4.2 Performance

National educational quality assessments are conducted at grade 6, grade 9 and grade 12. In the grade 6 assessments, 18 to 20 per cent of students had good performance and 62 to 69 per cent had fair performance. Performance was best in Thai language. There were differences in

educational standards among the educational regions in Thai, English, Mathematics, Physical Education and Management.

Among lower secondary students, the quality of educational achievement was judged to be favourable in Thai writing, English language, and science, but in need of improvement in English writing, mathematics and social studies. There were substantial variations between regions in Thai writing.

In the upper secondary level it was judged that student achievement was not satisfactory in English, mathematics and the sciences, but there were significant variations among regions.

The most recent figures for retention rates in 2000 are 87 per cent in primary school, 96 per cent in lower secondary and 82 per cent in upper secondary (being 87 per cent in general and 75 per cent in vocational programs). In 1998, dropout rates were 2.5 per cent in primary, 3.6 per cent in lower secondary and 8.7 per cent in upper secondary.

In the 1999 Third International Mathematics and Science Study, Thai students from grade 8 performed at a level similar to the international average in science but below the international average for mathematics (Martin et al, 2000a; 2000b). In Science, Thai students had similar achievement levels to students from Malaysia, higher achievement levels than students from Indonesia and the Philippines, but lower achievement levels than students from Singapore and Hong Kong. In Mathematics, Thai students had higher achievement levels than students from Indonesia and the Philippines, but lower achievement levels than students from Malaysia, Singapore and Hong Kong.

2.4.3 Targets

The *ICT in Education National Masterplan* sets targets for information and communications technology. It sets targets ratios of computers to learners of 1:40 at primary level, 1:20 at secondary level, and 1:10 in higher education. It aims to increase opportunities for learners to use ICT and to develop standards of competency in ICT skills at grades 6, 9 and 12.

There is a target that by 2004 80 per cent of secondary school teachers should attain foundation level knowledge and skills in ICT and 50 per cent should attain intermediate level skills. The corresponding targets for elementary school teachers are 50 per cent at foundation level and 30 per cent at intermediate level. In addition, it sets targets for 2007 that all teachers have access to ICT for education at their schools, that all new teachers develop ability and skill in applying ICT to education, that ICT standards be developed for teachers and that evaluation instruments be developed for teachers and used in certification of ICT teachers.

In terms of administration, by 2004 system and school administrators should be able to integrate and use ICT in administration. School administrators should also develop strategies to enable teachers to adopt ICT in education.

It is intended that, in the period from 2003 to 2005, all schools should have access to a high speed network for educational applications and be connected to a national network for accessing information and knowledge.

There is also a target for parents to understand and see the benefit of ICT in education. Research is to be encouraged to develop the form and content for each subject area using ICT with supporting incentives is to be encouraged.

2.5 Thai Education Reform

2.5.1 Principles of Reform

The main purpose of the National Education Act of 1999 is to provide quality basic education for at least 12 years and to rate the quality of education to ensure Thailand is able to compete internationally. According to the Act, education shall be based on three guiding principles: lifelong education for all, participation by all sections of society in the provision of education, and continuous development of the bodies of knowledge and learning processes. In addition to reforms in administration and management, it also focuses on promoting changes in teaching and learning processes that promote more active student-centred learning, curriculum revisions that result in content more related to the community and the world of work, and teacher professional development.

Key elements of the education reform addressed by this study are as follows:

2.5.2 Student-Centred Learning

The Education Act stipulates a number of aspects intended to focus on student-centred learning. This includes basing a greater amount of learning on activities that reflect learners' interests and aptitudes. It also includes the development of thinking processes and management that enable students to adapt to various situations and apply knowledge to solve problems. Activities are to be based on authentic experiences so that learners can apply learning in real-life settings. It incorporates a balanced integration of cognitive and affective development and the development of meta-cognitive skills. Changes in teaching and learning are to be supported by reforms in assessment and evaluation. This involves a shift from multiple-choice instruments to authentic assessment involving students' assignments. Achievement will be referenced to curriculum standards and benchmarks.

2.5.3 Decentralization

In addition to integrating educational agencies under the Ministry of Education, Religion and Culture, it is intended that authority for administration and management will be decentralized to local authority offices. This involves establishing educational service areas, each of which will include an Area Committee for Education. It is intended that decentralization will result in a more responsive, efficient and effective system of educational management.

2.5.4 Linking to the Global Information Economy

Education reform is linked to the national information and communications technology policy. This is based on national infrastructure development, human resource development and the development of an information system for government. A key element in the national education technology policy is the education of skilled personnel and a wider community of informed users of technology. In addition to producing a skilled workforce, it is necessary to generate a wider range of skills in the population so that these may participate in the information economy. Five complimentary strands of activity are foreshadowed in the knowledge-based economy in Thailand – e-commerce, e-government, e-society, e-industry and, supporting the other four, e-education.

2.5.5 Appreciation and Promotion of Thai culture

Formal education provided in school does not provide sufficiently for learning about Thai culture. Many people who are capable of transferring this special knowledge are not widely available and are aging. Their knowledge and skills need to be made accessible. Technology can be used to widen contact with Thai culture so that people can access heritage sites that they might not be able to visit, and have access to other resources central to Thai culture.

2.5.6 Learning Technologies

Student learning is central to the reform process and information technologies are a key tool in changing teaching and learning processes so that they are more student centred and develop higher order skills. Information and communication technologies can provide for more effective communication between teacher and student, allow for the creation of more effective learning environments and increase access to information, increase learner engagement, allow access to authentic learning experiences, and improve learning efficiency and effectiveness.

2.5.7 Supporting Change and Improvement

Changes resulting from the introduction of information technologies require the support of a range of interconnected policies. These should deal with building the technical infrastructure, the provision of skilled technical support and the development of the skills of educational managers and teachers.

2.5.8 Transparency

It is important that the processes for allocating resources be open for all to see and that the basis for allocation be clear and unambiguous. This does not preclude the development of special projects, but imposes the requirement that the rationale for those projects be clearly stated.

2.5.9 Equity

To decrease social and economic inequalities, it is essential to provide access to high quality education. This will ensure that talent is not wasted and also promote social cohesion. Special attention will also need to be given to those in poverty and those living in remote areas without access to educational resources.

2.6 Role of Technologies in Reform

2.6.1 Improving the Quality of Learning and Teaching

Technology is a means of improving the quality of teaching and learning. This is possible through its impact on pedagogy which support the shift to more student-centred approaches that enable students to learn from direct investigation (discovery learning) and develop the capacity to interpret and integrate new learning with their current understandings (constructivism). The integration of technology will need to be supported by the development of curriculum and assessment materials. Teacher expertise needs to be developed in new pedagogies, as well as in the use of information and communication technologies.

2.6.2 Approaches to Resourcing and Dissemination

Without careful planning, the introduction of information and communication technologies can reinforce inequalities. In order to avoid deepening the divide between the equity in information rich and the information poor, it is important to develop strategies to ensure greater access to information technology so that learning technologies could fulfil their potential to widen the access to education and training.

2.7 Thai Wisdom and the Roadmap for Reform

The National Education Act (1999) has specified Thai wisdom as an integral part of the Thai education system. This is to ensure that national development will be in line with the Thai way of life and Thai culture. Thai wisdom forms an essential basis for human development and its cultural dimension. The establishment and promotion of Thai wisdom into the Thai education system requires dynamic vision that is relevant to the lives of the people in everyday life. Research is needed on how learning technologies can improve learning about Thai wisdom. It will be important to identify Thai wisdom teachers who are eligible to teach at both formal and non-formal institutions, and to encourage teachers to incorporate Thai culture into learning activities. The policy for promoting Thai wisdom education should be relevant, appropriate and in accordance with the learning needs of people living in both local and urban communities.

Information and communication technology has the potential to play a significant part in the promotion of Thai culture. The publication of cultural knowledge on the Internet will help people in Thailand and elsewhere gain a deeper understanding of Thai heritage. Conversely, the Thai tradition of sharing local wisdom creates a valuable precedent for the sharing of best practice amongst those involved in the education reforms.

3 Learning technologies in Thailand

3.1 Current Status

3.1.1 Infrastructure

According to the Second International Technology in Education Study in 1998, there was a ratio of 62 students to one computer in Thai schools. This was higher in primary schools (84:1) and lower in secondary schools (53:1). Only 20 per cent of these computers could be used with multimedia. Approximately 52 per cent were Pentium based, 43 per cent had 386 or 486 processors, with the remaining machines being older 8-bit or 16-bit machines. Computer use was recent (less than three years) for 85 per cent of primary schools and nearly half (45 per cent) of secondary schools. Access to the Internet and the World Wide Web is also recent. The SchoolNet project of the National Electronics and Computer Technology Centre (NECTC) commenced in 1995 to extend Internet services to secondary schools. In 1998 more than half of the secondary schools used their computers as stand alone machines, only one third of secondary schools (32 per cent) had a local area network and few secondary schools (less than 7 per cent) had a connection to the Internet. Most (63 per cent) primary schools had computers located in a separate computer laboratory rather than in classrooms.

3.1.2 Content

Most software used in schools is general software such as word processing, spreadsheets and data processing programs. Other software is concerned with special information and communications technology subjects. Availability of software was identified as a major issue in the Second International Technology in Education Study (1998) and in a 1998 survey of schools. The Golden Jubilee Network project is providing educational content in Thai language on the web. A range of educational software applications has been introduced in some schools. These include computer assisted instruction (CAI) packages in the teaching of language, Lego Logo, and Microworlds, which support development and design (robotics, computer measurement and control) and higher order thinking skills generally.

3.1.3 Professional Expertise

The 1998 surveys also identified a need to provide professional development for teachers, but a significant number (about half) of schools had not provided access to training for their teachers. The Institute for the Promotion of Teaching Science and Technology (IPST) has developed a Masterplan for teacher professional development in ICT use in science and mathematics. The plan incorporates formal teacher professional development based on a set of ICT standards for teachers and uses a two-tiered approach based on a “train the trainer” model. The two-tiered approach will involve providing training for a leadership group in each selected school who will then train other teachers in their school and provide training to neighbouring schools. Informal professional development will be based on the formation of a national association for computer-using teachers. In addition, there will be professional development for IPST staff through collaboration with an overseas expert and exchanges with overseas academics in the field.

3.1.4 Technology Assisted Distance Learning

There are currently four important telecommunication networks: basic telephone and ISDN network, satellite systems, underwater cable systems to other countries and the cellular phone network. Service in rural areas is still a problem and most Internet service providers are located in Bangkok.

The university network (UniNet) includes in its membership 20 universities under the Ministry of University Affairs, four chartered universities, three higher education institutes of the Ministry of Education, two higher education institutes under the Ministry of Defence and one private university. The bandwidth internally is 2 Mbps whereas externally the bandwidth is 12 Mbps. UniNet is used to connect universities and institutes, develop distance learning between main universities and information campuses, develop independent learning centres and to develop information management systems.

The SchoolNet project provides and manages a network for schools. At the end of 2000, there were 2,200 secondary schools in SchoolNet that had connections (three accounts per school with 40 hours per account) and each had a storage capacity of 3 megabytes per school. The project has been involved in the establishment and maintenance of telecommunications equipment at 20 online centres in 76 provinces. Internet workshops for teachers in participating schools have been provided through eight designated institutes, and network volunteers have been recruited. Kasetsart University has been involved in the provision of digital resources in Thai language for Biology, Chemistry, Physics, Environment and Engineering Foundations.

3.1.5 Television and Radio

The Thai Government has supported the development of education television to meet the needs of students in locations where conventional classroom based education is not available. The schools and vocational college at Wang Klaikangwai offer courses for primary and secondary school levels, as well as vocational training in subjects such as home economics and mechanics, that are relayed via Satellite to all parts of Thailand. The Wang Klaikangwai campus of Rajamangula Institute of Technology offers bachelor degrees in a range of disciplines.

These courses are delivered over six satellite TV channels using special dishes and decoders. Since 1999, the service has operated 24 hours per day providing extensive capacity for concurrent transmission of different subject matter, as well as high capacity to program download, using the video recorders to capture programs overnight. Programs have also been made available via the UBC subscriber television network, enabling access for an additional 300,000 home, business and school users. Interaction between students and the course presenters is available in many cases using telephone and fax.

The system has the advantage of simultaneous transmission of video programming to all parts of Thailand, and is especially useful in supporting areas of the curriculum for which there is a shortage of teachers and for reaching remote parts of the country. Disadvantages include the fact that, unless the signal is reticulated around the school, and multiple decoders are used, access is available only to a single class viewing one program at a time. In addition, the level of interactivity between teachers and learners is limited, particularly where the audience includes large numbers of students spread across the country. With the advent of the Internet it is now possible to address some of these disadvantages.

3.2 Related Current and Proposed Initiatives

3.2.1 Asian Development Bank Project

An Asian Development Bank project involves support for the Thai Education Reforms under its Social Sector Program. The project involves three components: refinement of student-learning, continuous assessment and school-based management. It is a large-scale project involving international and domestic consultancy providing specialist services in school reform policy, teacher education and information technology in education.

3.2.2 University for Industry

University for Industry is based on a program in the United Kingdom. It is not a provider or institution in the traditional sense, but an organisation that works with partners to deliver products and services using high quality educational packages. It uses broadcast, Internet and multimedia technology to enable people to learn outside of formal institutions. It is proposed to establish a University for Industry in Thailand under a board chaired by the Prime Minister. It will use a range of learning technologies to create a national knowledge network.

3.2.3 National Education Network

The National Education Network is a proposed project to link existing sectoral education networks so that education and training institutions can be linked and resources shared, to improve support for formal, non-formal and informal education systems and lifelong in all parts of Thailand. The first Stage aims to develop an information infrastructure linking higher education institution networks and extending to primary and secondary schools. The second Stage aims to modernise the present information infrastructure and develop higher education networks to be centres of the information networks for primary and secondary schools.

3.2.4 Thailand Graduate Institute of Science and Technology

The Thailand Graduate Institute of Science and Technology is a virtual institute organised jointly by Thailand's National Science and Technology Development Agency (NSTDA), the Ministry of University Affairs (MUA) and various Thai universities, with the help of collaborating overseas universities. TGIST is to help accelerate the numbers of graduates in high technology specifically at the Masters and Ph.D. levels in by working as a forum in which the universities link their resources and those of NSTDA to produce the "critical mass" necessary for advanced research and education. It will also work as an organisation to link the needs of industry, the vision of government, and the potential of academic research to target the type of human resource development necessary. TGIST operates through the Graduate Research and Education Consortium (GREC), the Centre for Advanced Studies (CAS), Schools of Engineering Practice (SEP), School of Technology Management (STM), Thailand Training Network (TTN), and Science and Technology Electronic Publishing Program (STEP).

3.2.5 Institute for Promotion of Teaching Science and Technology

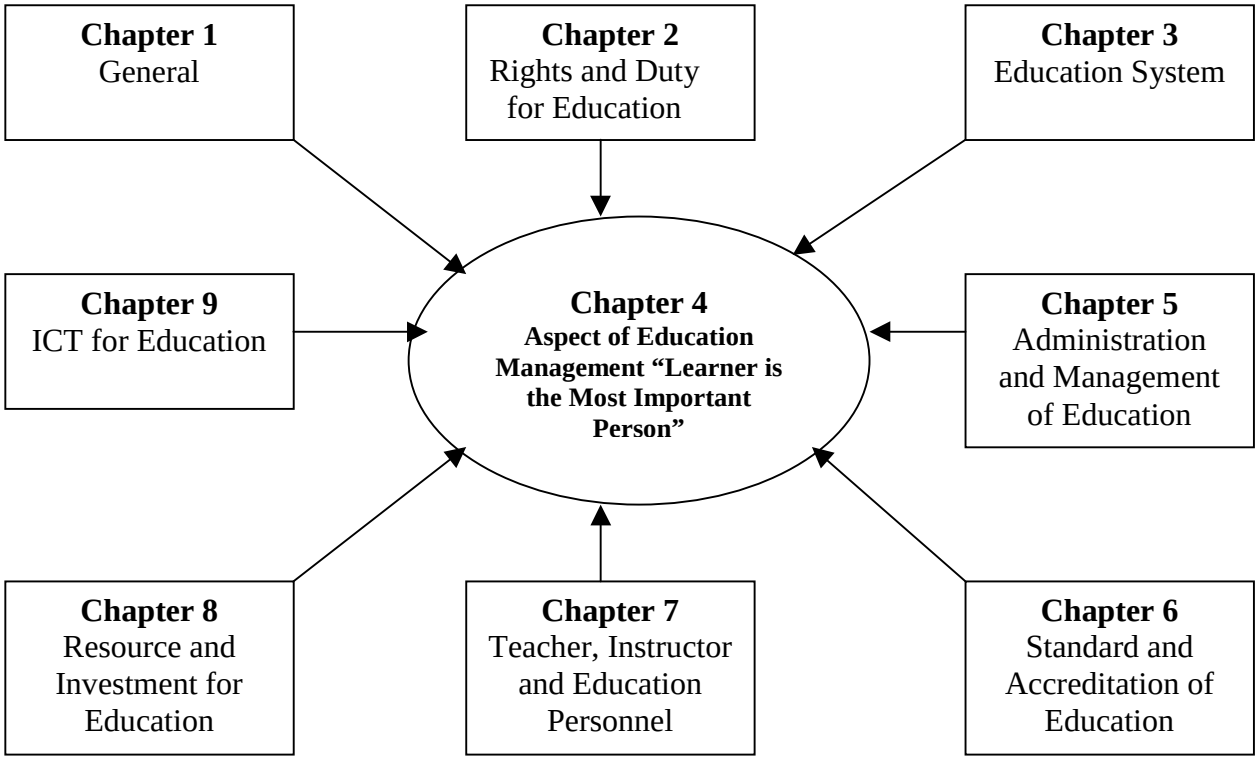
The IPST has developed a Masterplan for teacher professional development in ICT use in science and mathematics. This plan involves a formal program, an informal program, development of IPST staff and coordination. The formal program includes the development of a set of ICT standards with associated online materials, a multi-tiered cascading approach to the training of teachers based on leadership secondary schools and an online teacher professional

development support network (teachernet). The informal program involves the establishment of a national association for computer-using teachers. Professional development for IPST staff involves using an international expert to provide training and visits by IPST to overseas centres. It is intended that this activity be coordinated across the sections of IPST and linked to developments in the Ministry of Education, Religion and Culture, other ministries and industry. Sections 3.1 and 3.2 are adopted from the existing *National ICT for Education Masterplan*.

4 National ICT for Education Masterplan

There is a national vision and objectives for ICT in Education in the *National ICT for Education Masterplan.* The focus is on the development and use of ICT as a tool of learning reform in which the learner is a participant in forming the vision, objectives and targets. In order to achieve the vision, it is proposed that many partners will share the effort, such as teachers, administrators, schools, institutes, learning centres, learning resources, partners, the State and the private sector. The content of the plan covers infrastructure and hardware, curriculum and software, management and operating costs as shown in Figure 2.

Figure 2 From *'National ICT Education Masterplan'*



The *Masterplan* states that Thai society could be transformed into a learning society, if Thais have an opportunity to access lifelong learning and keep up with the changing world of new knowledge and information technology. They will learn how to gain knowledge for themselves. ICT will enable learners to access useful information and ICT for education will harness ICT as a tool for learning, in which every learner has the right and opportunity to access knowledge at any time, any place.

The existing *Masterplan* puts learners at the centre, surrounded by agencies that could develop and achieve the desired outcome. Teachers, administrators, parents, schools, learning centres and learning resources, the state and private sector need to collaborate and share a common vision, objectives and targets for ICT in education.

4.1 Vision of ICT for Education as stated in the *National ICT Education Masterplan*

By 2005 every learner should have opportunity to access ICT for learning at reasonable cost and adequate quality.

4.1.1 Learners

Vision

- That learners are able to use ICT as a tool for learning throughout their lives.

Objectives

- Enable the learner to acquire technology literacy and information literacy at a fundamental level in order to access and make use of ICT to investigate, collect and process data from various sources, as well as to create new knowledge.
- Integrate technological knowledge and information management skills to develop the ability to analyse, think creatively, solve problems and work in teams.
- Encourage the learner to develop positive values, attitudes and ethics as well accountability for using ICT, which will be useful to lifelong learning and analytical thinking processes.
- Increase learners' opportunity for using ICT for learning
- Enable schools to support the learner as the centre of the learning process in ICT-based for learning. The school must adjust its use of technology as well as curriculum to suit the integration of ICT in school.
- Provide learners with opportunities to apply and develop ICT literacy in every course taken.
- Ensure that the learning process is not confined to being within the classroom walls. Learners should have the opportunity to view the wide world through an ICT network, ICT literacy and the development of positive attitudes towards ICT.
- Enable the learner to use ICT through provision of computers and equipment adequate to the learner's needs, as well as increasing efficiency of available computers and equipment.

Targets

1. Requirement of computer to learner ratio:

Elementary level	1:40
Secondary level	1:20
Higher education	1:10

2. Increase the learner's opportunity use ICT for education in various forms.
3. Develop requirements for learner's ICT standard and skills at various Stages, indicating what ICT competency the learner should posess after graduating from grade 6, 9 and 12. A handbook should be developed concerning ICT standards implementation in the classroom in various subjects. Ongoing evaluation should be provided to ensure the quality of teaching necessary for the learner to achieve the required competency.

4.1.2 Teachers

Vision

- Teachers should have a high level of ICT knowledge and skills including an understanding of the development of learning and teaching media for instruction.

Objectives

- Competency in ICT will enable teachers to have a wide range of knowledge, and to be able to guide the learner.
- Computers will be a principal tool for teachers to access learning resources, prepare teaching plans, assign homework and communicate with the learner's parents, other teachers and the administration.
- Teachers should be trained in using ICT and integrating ICT into classroom activities in order to promote analytical and creative thinking skills. Teachers should undergo ongoing professional development to catch up with the advancement of ICT.

Curriculum development for teachers should be classified into 3 levels, They are:-

Foundation level. This would be a requirement for all teachers. It includes basic ICT knowledge, including computer and Internet usage.

Intermediate level. This is an additional course for teachers who seek more knowledge in ICT. These courses should enable teachers to construct teaching media using higher levels of ICT knowledge and skills. For example, teachers should be able to:

- Construct a simple web page using a presentation program
- Transform a presentation program on the Internet to Hypertext Markup Languages
- Construct a simple web page using ready-made modules.

Advanced level. This course is for teachers who seek specialisation in areas such as:

- Maintenance of computers
- Setting up networks
- Setting up internet servers, Web servers, or Mail servers
- Development of Internet and support for teachers via networks.
- The reform of teacher education, requiring graduates from teacher training institutes to be able to integrate ICT into classroom teaching.

Targets

By 2004

- 80% of secondary school teachers will attain ICT knowledge and skills at foundation level.
- 50% of the above secondary schools teachers attain ICT knowledge and skill at the intermediate level.
- 50% of elementary school teachers attain ICT knowledge skill at the foundation level.
- 30% of the above elementary schoolteachers attain ICT knowledge skill at the intermediate level.

By 2007

- All teachers will have opportunity to access ICT for education at their schools.
- All new teachers will possess skills in applying ICT to teaching and learning.
- ICT standard for teachers, appropriately including basic ICT skill and knowledge to support learning will be developed.
- Evaluation instruments will be developed for measuring ICT standards for teachers, to be used in certification and licensing teachers.

4.1.3 Administrators

Vision

- Administrators must have vision regarding management and innovation in using ICT for teaching and learning, both in and out of schools.

Objectives

- Develop leadership qualities and vision of education system administrators and school administrators. They are people who make use of technology, managers of resources, leaders of people and education change agents.
- Develop Internet and support to establish administrator/teacher network, so that they could share knowledge, experience and create school projects. Additionally there should be support for the training of master teachers, mentors and other teachers to create leader-school projects to be an example for others.
- Increase professional development opportunities in an ongoing basis to support the application of technology in the learning process, and in routine work.
- Promote the application of ICT in administration, including support for in-school information administrators. School staff could access knowledge resources from their desks in various forms at any time.

Targets

- By 2004 education system administrations and school administrators should have sufficient skills and confidence to integrate ICT into school administration, and to support teachers to integrate ICT into classroom teaching.
- School administrations must lead and develop a strategy to enable teachers and stakeholders to adopt and adapt innovations and to maximise benefit from using ICT for education.
- Administrators must be provided opportunities for professional development at appropriate times. These professional development projects must respond to various professional development and learning needs.

4.1.4 Schools/Institutes/Learning Centres

Vision

The infrastructure enables the learners to connect and access ICT for education conveniently in schools, institutes and learning centres.

Objectives

- That there are enough computers for teachers, learners and administrators to do their work.
- All schools have LANs and are connected to the Internet.
- Schools' web sites should have material for sharing.
- School are open to the community. The community has an access to schools' technology and equipment. Parents and the community in general could learn about ICT and be able to understand the benefits of ICT.
- Develop new partnerships between schools and the community and between schools and the business sector, in which schools become the centre of the learning network.

Target

- By.2003 all secondary schools are able to access high-speed networks at reasonable cost for ICT for education application.
- By 2005 all elementary schools will also achieve this target.
- Schools/ Institutes/ Learning Centres are connected to a national network for accessing information relevant to a variety of interests and requirements.

4.1.5 Parents

Vision

That parents support their children's engagement with ICT for learning.

Objectives

- Communicate and enable parents to understand the goals of the school in applying ICT as a tool for education to access various knowledge resources and improving student outcomes.
- Facilitate parents participation in the planning and implementation of ICT in school.

Target

Parents understand and see the benefit of ICT for education with some parents acting as leaders in the application of ICT for education.

4.1.6 State Agencies

Vision

All students have access to ICT for learning at appropriate periods of time and for a reasonable cost.

Objectives

- Establish an organisation to formulate policy and plans, and to monitor standards in ICT in education. The organisation will coordinate related agencies to provide services and as assistance to school/institute/learning centre.

- Encourage application of ICT to develop opportunities for quality education and learning as well as developing information systems for administration supporting change.
- Emphasise the linkage between education, ICT, training, working and lifelong learning.
- Support and encourage policy and ICT for Education National Masterplan. Provide resources and create various pilot projects, research, and development production.
- Support private organisations to participate or share in production and development on an ongoing basis.

Target

- Encourage research to develop content of each subject to be taught through ICT, including formal education, non-formal education and informal education.
- Provide incentives such as tax reduction to motivate the private sector to participate in the development of ICT for education.
- Pass new laws and amend old laws, rules and regulations in order to support the development of ICT for education.

4.1.7 Private Sector

Vision

Participate in the development of the ICT industry within the country and set up private organisations to support various ICT development activities.

Objectives

- Participate as volunteers or donate cash/equipment to support ICT for education.
- Coordinate with government sector to encourage and support application of ICT for education in development of infrastructure, production of cheap hardware and software for education.
- Establish organisations and consortia to support various activities, such as collecting used computers for poor schools.

4.1.8 Curriculum and software

Vision

To develop curriculum content and software suitable for the diverse range of education institutions in Thailand.

Objectives

Curriculum

- Curriculum integrates ICT application in learning in all subject areas.
- ICT is a course in the curriculum.
- A curriculum for lifelong learning and self-directed study is developed.

Software

- Develop computer media to study Thai languages which is user friendly, applicable to various subjects, up to date and a responsible cost.
- Develop online curriculum which has learners at the centre as knowledge constructors.
- Encourage cooperation to develop investment in developing information and content.
- Improve content of online curriculum on an ongoing basis.
- Provide and develop legal software.
- Encourage and support teachers and educators to produce software for learning.
- Support computer assisted learning programs in school.
- Develop a standard data collecting system.

4.1.9 Infrastructure and Hardware

Vision

A high-speed telecommunication network connecting education institutes at appropriate cost with related equipment at an economic price.

Objectives

- Develop cooperation at the school and national level to collect data on the state of ICT application, quantity of equipment, capacity for network linkage and other infrastructure to analyse the effect of infrastructure on students' learning.
- Provide access to a high-speed network at a reasonable cost. The infrastructure must be reliable, flexible, and support student learning. The network must access content both within and outside the school.
- Establish benchmarks for planning of infrastructure in the future including achieving PC density, as well as the implementation of ICT for school plan and learning plans.
- Support schools Intranet within the school system and develop Intranet linkages within the country to support learning.

Section B
Learning Technologies in Thailand: Vision and Implementation

5 A vision for the contribution of ICT to the improvement of education and training in Thailand

The Thai vision for the implementation of ICT in education is that learning technologies will improve the quality of outcomes for Thai students in the 21st century. A key aim is to assist in transforming Thai society into a learning society, by ensuring access to opportunities for lifelong learning and connecting Thai society with the global knowledge economy.

Through the new ICT in education initiatives, Thai citizens can become independent learners and improve the quality of their lives by accessing new social and economic opportunities. Importantly, they will have increased opportunities to gain an enhanced understanding and appreciation of Thai culture and society as well as gaining greater knowledge of other cultures. In addition, it is envisaged that by 2005 every learner will be able to access ICT for learning at a reasonable cost.

Learners will use computers and digital information in many different ways, sometimes reinforcing traditional approaches to teaching and learning, and in other cases helping to redefine the classroom, the school and the role of the teacher and student. The changes should be guided by, and used to support, the broader reforms of the education system currently underway.

A range of possible scenarios depicting learning and teaching in a technology-rich environment are outlined in Appendix 1. The scenarios include links to video vignettes, graphics, samples of student work and web resources that are viewable on the CD-ROM version of this report. It is intended that the CD-ROM will be used to stimulate discussion and inform decision making about possible approaches to using ICT in Thai classrooms.

5.1 Successful implementation

Experience around the world has shown that in order to realise the full benefits offered by learning technologies, the following factors must be adequately addressed. If any of these is missing, the benefits of technology will be limited.

5.1.1 Routine access to ICT infrastructure

Students and teachers need routine access to technology in order to develop the skills and attitudes necessary to participate in the knowledge society.

5.1.2 Human resource development

Teachers and leaders require training and development to ensure they can use technology effectively in their work, and have the capability to capitalise on the potential of technology to

enhance the processes, content and outcomes of teaching and learning. It will also be necessary to develop the level of ICT skills in the community to support the initiatives.

5.1.3 Access to high quality digital learning materials

Students and teachers must have access to high quality digital information and tools that exemplify the way in which technology can add value to the learning process.

5.1.4 Change management

Leadership is central to the effective implementation of learning technologies. Resource allocation, staff training and development, classroom layout, and approach to teaching and learning require new approaches. It may also lead to change in the relationships between students and teachers. Planning is required at system and local levels to ensure adequate access to infrastructure, human resource development and resources. Implementation and communication strategies are required to ensure that plans are understood and effective.

5.2 Implementing the vision – *TLT 2010 Masterplan*

It is proposed that a *Thai Learning Technologies 2010 Masterplan* (*TLT 2010 Masterplan*) is developed by the newly formed National Advisory Committee on ICT in Education Reform. The plan should have student-centred learning and other themes from the Education Act as its focus, and should be developed in conjunction with other key stakeholders who will also have been involved in formulating a vision at the central and local levels. The plan will cover infrastructure, content, software, training, management and operating costs. It will build on the existing *National ICT for Education Masterplan* cited in Section A of this report.

5 (a) Recommendation

That a National Advisory Committee on Learning Technologies in Education Reform is established, responsible for developing the *TLT 2010 Masterplan* based on the advice provided in this report and Thai education policies.

5 (b) Recommendation

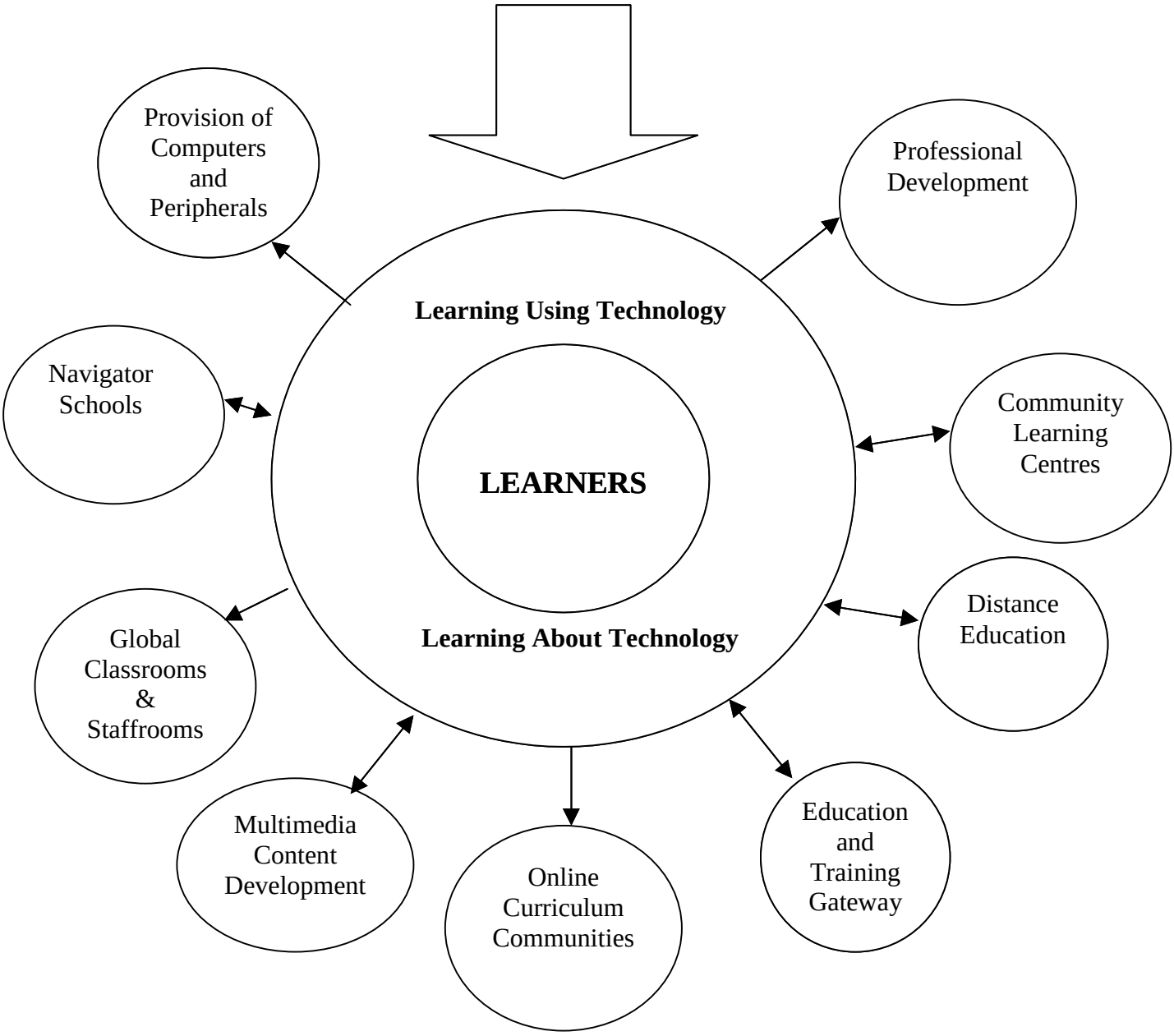
That the RTG conducts a national workshop for key stakeholders to consider a range of options for implementing learning technologies in Thai schools during the period from 2002 to 2010. The workshop outcomes should contribute to the *TLT 2010 Masterplan*.

In implementing the vision, a number of factors relating to Thailand's particular circumstances will need to be taken into account. Factors such as the limited and uneven distribution of ICT infrastructure will affect the way programs are developed and rolled out. A discussion of these issues and suggestions for dealing with them follows.

Thai Learning Technologies 2010 Masterplan

Stage 1 – 2001–3 Policy Development, Planning, Strategic Initiatives
Stage 2 – 2003–6 Major Rollout
Stage 3 – 2006–10 Embedding Practice

Infrastructure	Software and Content	Human Resource Development	Change Management



5.3 Narrowing the Digital Divide

There is currently an uneven distribution of computers in schools and incomplete penetration of telecommunication infrastructure in Thailand, causing a significant gap between those who have access to computers and the Internet, the 'information rich,' and those who do not, the 'information poor'.

A recent report on ICQ (a free Internet service and global online community which provides email, chat, news and shopping), claims that there are now one million ICQ members in Thailand. Thailand's ICQ users have joined the global information economy, with ready access to online news, entertainment and shopping as well as new opportunities for wealth creation. In other parts of the country, many Thais lack access to the reliable telephone system needed to make this possible.

Coming at a time when the telecommunications infrastructure is being expanded, the education reforms and associated expansion of ICT in the education system provide unique opportunities to bridge the gap between the information rich and information poor, both through the provision of access, and through the development of skills and understandings in communities across Thailand.

The following approaches to ICT use in education settings should be included in the Thai Education Technology 2010 Masterplan.

5.4 Doing More with Less

The full benefits of ICT in education will only be realised once all students and teachers have routine access to technology infrastructure. However, it is important to acknowledge that some of the qualitative improvements in learning and teaching, and growth in the understanding of how technology will bring change to our communities and culture, can be obtained from classroom environments with few computers and basic network access.

Pioneer programs involving the use of email and online databases such as Computer Pals Across the World, FrEdMail (the Forerunner of Global SchoolNet), National Geographic KidsNet, AT&T Learning Network, Global Laboratory, Campus 2000 (UK), Oz Projects and Nexus (Australia) were established and had an impact on classrooms around the world in the 1980s and early 1990s when computers were scarce and school networks rare.

In most cases, communication and access to online databases was via a single computer connected to a modem. In many cases, email was received and sent from a computer at a teacher's home or at a local university and then relayed to the classroom on a floppy disk. Where there was no classroom computer, messages arrived as paper printouts and replies were handwritten, to be later typed up by student monitors or teachers.

Although the access to technology was minimal, the impact of these programs on the learning process was transformational in many classrooms. For the first time, students learnt about distant countries and complex issues through the eyes of fellow students and experts with first-hand knowledge. Teachers were able to discuss educational issues, plan projects and offer professional support in an online community of like-minded colleagues.

Students had become researchers, writers, illustrators and editors working for a national or international audience. They had joined, and were helping to create, the global classroom. A new era of student-centred learning had begun.

Furthermore, the involvement of one class in such activities invariably impacted on others that were not directly involved. If students know that their colleagues have used technology to undertake particular tasks, they believe that given the opportunity, they could do likewise. That belief also flows on to parents and the community, building support for technology initiatives.

The development of understandings and expectations in school and local communities is a vital first step in building the knowledge and expectations necessary to use technology effectively and engage students in the global information economy. A range of strategies is available to maximise the usage and impact of available technology.

5.4.1 Networked Learning

Involvement in collaborative online activities typically involves the circulation of background material and the assignment of tasks via the Internet, followed by a period of research, writing and illustration off-line, and then presentation of results via the Internet. Often the proportion of time spent using technology is relatively small. The skills required to take part in such activities are straightforward, typically being restricted to the use of email and the web. Students usually work in groups as they carry out networked learning activities. Group work enables many students to participate, even with relatively limited access to technology.

5.4.2 Websites on CD-ROM

Websites can be reproduced on CD-ROM and accessed through local area networks for reference purposes and for developing skills in use of the worldwide web. Where possible, learning materials should be developed for both web and CD-ROM delivery. This approach can optimise access to key materials, effectively delivering a personal copy to every student and teacher and facilitating delivery to even the most remote communities.

5.4.3 Mobile Computers

The use of computers on trolleys or notebook computers that can be moved between classrooms has proven an effective way of adding value to the learning experience in schools where computers are not normally available in the classroom. For many learning activities, having access to a small number of computers in the classroom to assist with particular activities can be of far greater value than a computer lab in which normal learning activities cannot be conducted. Notebook computers can also be used in the field or taken home by teachers and students, increasing access to technology for individuals.

5.4.4 Low Cost Computing Devices

Many schools and school systems have made use of low-cost computing devices such as graphical calculators, text processors (eg Alphasmart), 'palmtop' devices (eg Palm), and devices utilising reduced versions of the MS Windows operating systems (eg Ipaq, SchoolMate) to increase access to technology for specific applications.

These devices have a number of benefits in addition to low cost. They are small and can be easily used at normal classroom desks, or moved between classrooms and between school and

home. They are often optimised for specific tasks (eg mathematics, science experiments, keyboard instruction) and require minimal training to achieve useful outcomes. Power consumption is generally lower and battery life longer than with notebook computers.

5.4.5 Surplus Computers

Surplus computers from industry and government agencies can be used to significantly expand the ICT facilities in schools and other learning centres. In some cases, a central refurbishment facility has been used to remove old software and data, and restore equipment to useful configurations.

5.4.6 Shared Use of Facilities

It is common in many places for the ICT resources in schools to be made available to parents and the broader community. An example is the EdNA community access initiative – see http://www.edna.edu.au . Similarly, community facilities can be made available to schools. Wherever possible, new ICT facilities should be shared between education and the community, in order to advance all strands of the e-Thailand agenda simultaneously and maximise the return on investment.

5.4.7 Distance Education for Teacher Development

Some studies argue that maximum return on investment may come from the use of distance education for teacher training and support. The IMFUNDO project is one example of this (see: www.imfundo.org)

5.5 Maximising Opportunities

In implementing the *TLT 2010 Masterplan*, every opportunity should be taken to harness the efforts of individuals and organisations already embarked on change and seek build mutually beneficial partnerships with others involved in reform initiatives.

5.5.1 Building on Strength and Sharing Best Practice

As with most reform movements, models for successful uptake of technology will already be in operation at the hands of inspirational leaders and innovative practitioners. Every effort should be made to capture and disseminate successful practice and innovation that supports the reforms. It is also important that Thailand's teachers and educational leaders at all levels are aware of unsuccessful practices, so that pitfalls can be avoided.

This can be achieved through competitions and programs specifically designed to share best practice (eg Navigator schools, IdeaBank) and through the selection and evaluation processes associated with funding schemes.

Experience in Australia and elsewhere has shown that schools, organisations and individuals exhibiting exemplary practice can form the basis of professional development programs. It should be noted, however, that appropriate target setting, mentorship, evaluation, support and promotion is required to derive full benefit from such programs.

5 (c) Recommendation

That pilot programs are conducted to investigate feasibility and develop models for addressing networking and infrastructure needs.

5.5.2 Cross-Sectoral and Interagency Collaboration

Different education sectors and cultural portfolios are currently managed by different Departments and/or Ministries, so there is potential for overlap and discontinuity in implementation of the education reform agenda. Mechanisms should be explored to maximise collaboration over technology initiatives associated with the reforms.

5.5.3 Engaging the Private Sector

While government agencies may be in a good position to specify and set standards, they are usually not ideally suited to large-scale production of materials and the supply of services. Every opportunity should be taken to engage the private sector in implementing Thai Tech initiatives where this will enable the large-scale delivery and materials and services. Involving local industry has the added benefit of employment creation and economic development.

5.6 Quality Assurance

All initiatives should establish appropriate goals, targets and quality criteria, and incorporate procedures to monitor progress against targets.

5.6.1 Evaluation and Accountability

Formative and summative evaluation of programs not only ensure that providers are accountable for funds invested but also help to identify the most cost-effective solutions. Formative evaluation involves gathering and analysing evidence about the innovation in order to develop it further and improve it. Summative evaluation involves gathering and analysing evidence in order to make a judgement of its worth and possibly whether to continue the program. Both forms of evaluation depend upon expert knowledge and skills.

5.6.2 Research

The education reform and associated programs provide a unique opportunity to study the impact of a range of innovations on learning, teaching and educational outcomes. Longitudinal studies that monitor change over time are important, as are cross-sectional studies that make use of the natural variation across schools at any point in time. Of crucial importance to these studies are the use of sound measures of the outcomes expected from the use of information technologies, and appropriate methods of analysis that explore the links between the technologies other educational factors and the outcomes. University research departments should be involved at the earliest opportunity in order to establish accurate baseline data for longitudinal studies.

There needs to be a mix of forms of policy and practice-oriented research so that results can readily be interpreted by schools and school systems in ways that lead to improvements. Where pilot programs and lighthouse projects are involved, action research may be a valuable tool for ensuring continuous feedback to practitioners involved in the programs. The results of research can be used to enhance classroom practice and teacher training, provide invaluable guidance to planners, and to support funding applications to Royal Thai Government.

In addition, it is important that research summaries be produced for dissemination as print material and through information technologies to build a wide knowledge base that is informed by research evidence. A research clearing house that collates and integrates research findings from Thailand and elsewhere could contribute to the development of that knowledge base.

5 (d) Recommendation

That a program of dissemination of research evidence is established, including access to international research and Thai language summaries of research pertaining to effective use of technology in each curriculum area.

5 (e) Recommendation

That a research and evaluation program concerned with the educational uses of information and communication technologies is established to inform planning, implementation and teacher education.

5 (f) Recommendation

That a commitment is made to undertake ongoing benchmarking studies using both formal and informal approaches.

5.6.3 International Benchmarking

Every effort should be made to benchmark key elements of the learning technologies program. This needs to involve the use of approaches to measurement that are comparable with those used in other countries. Thailand is involved in international studies, such as SITES, that can assist in this international benchmarking in information technologies. Other international studies such as those conducted by the IEA provide information about the achievement of Thai students in areas such as science and mathematics. Less formal benchmarking can be approached by having teachers, principals and researchers undertake studies in other countries and by commissioning evaluations from independent experts. The development of a 'critical friends' program between leading schools within Thailand, and with overseas schools serving as benchmarks, can also provide an effective tool for the former approach.

Once a number of Thai schools and programs have been benchmarked against leading examples in other countries, teachers, principals and decision makers will be able to compare local practice with 'world best'. It appears that some schools in Thailand already exhibit world best practice with regard to aspects of student-centred and constructivist learning using technology.

6 Access to ICT Infrastructure

In order to achieve the goals of the *Thai Learning Technologies (TLT 2010) Masterplan*, it will be necessary for learners, teachers and administrators to have adequate access to computers, software and telecommunication services. Computers need to be available in sufficient numbers to provide the 'hands on' experience required to develop the skills and attitudes necessary to become effective users of the technology. Equipment needs to be arranged in configurations that make it available for routine use for all those involved in learning, teaching and administration. Many schools and education systems have invested heavily in technology infrastructure only to find that computers are under-utilised or used only for a narrow range of purposes.

To maximise the return on the Royal Thai Government's investment in ICT infrastructure, consideration must also be given to providing community access to facilities in schools, colleges and universities, and making educational use of community facilities.

Because of the rapid advances in technology and varying needs of educational institutions, communities and individual learners, the approaches used in the provision of ICT infrastructure will need to be imaginative, flexible and appropriate to the Thai context. In some cases, it will be possible and cost-effective to leapfrog intermediate technologies. It may also be necessary to challenge some existing arrangements and offer 'break the mould' solutions that ultimately provide new benefits for current players in the ICT industry.

For this reason the National Coordinating Committee on Learning Technologies in Education Reform will need to investigate a broad array of ICT infrastructure options within the Thai context. For example:

- Would wireless networking be cost-beneficial compared to hard wiring some types of schools, or some parts of schools?
- Does one computer offer benefits over others (eg Intel/Apple)?
- To what extent is there a need for a Standard Operating Environment in schools?
- Would technologies such as hybrid satellite/PSTN or Satellite/ISDN be a cost-effective way to meet the Internet needs of schools?
- Is there a real need for a WAN, or would some Internet connectivity and VPNs provide a more efficient and effective means to meet Internet working objectives?
- Can notebook computers address issues in schools that do not have power in classrooms?
- Is a dedicated satellite TV network required, or could currently unused broadcast TV capacity be used to distribute video tape programs?
- Would 802.11 radio links be a more cost-effective means than vendor services such as ISDN or ADSL to link some schools and district offices?
- Can the provision of broadband Internet to schools assist the development of local Internet service provider businesses in rural areas?
- Will caching technologies be used to significantly enhance students' Internet experience in schools (and optimise bandwidth usage)?

Planners must also be prepared for a compounding of demand once stakeholders gain access to ICT resources through the *TLT 2010 Masterplan* initiatives. It can be reliably predicted that once learners and teachers have routine access to the Internet, for example, that using conventional approaches bandwidth will soon become a limiting factor on the further advancement of the reform agenda.

Technical infrastructure initiatives in education will have major implications for budget planning for the Royal Thai Government and also require coordination of effort with authorities responsible for ICT planning and regulation. The success of *TLT 2010 Masterplan* will be dependent to a significant extent on the degree to which coordination and collaboration across portfolios is successful.

6.1 Provision of Computers and Peripherals

The provision of computers and peripheral devices such as printers, scanners, cameras and special purpose interfaces, is one of the crucial first steps of any learning technologies program, but one which has significant ongoing implications. It is important to select equipment not only on the basis of specifications and cost, but also on its suitability to fulfil education purpose. This may mean that different equipment is needed in different learning situations, which in turn raises issues of compatibility. Attention must be paid to the total cost of ownership, taking into account installation, training, maintenance and service life, not only the purchase price.

Hardware provision programs in public school systems usually have a major impact on the receiving institutions and will bring a major cost burden to the Royal Thai Government. For this reason, it will be important to carefully plan and implement the provision programs to ensure coupling with other elements of the TLT 2010 programs and with government ICT planning. Procurement plans should be designed to guarantee quality, value, transparency and, where possible, also promote development of local industry and Thai economy.

The success of the major infrastructure rollout and all related activities suggested for Stage 2 of the TLT 2010 will rely greatly on the resources available for the rollout. It would be advisable for new, ambitious targets for student-computer ratios and teacher-computer ratios to be set. The setting of these targets needs to be informed by the availability of funding, amongst other considerations. The extent to which the vision for implementing learning technologies in Thailand can be fulfilled will depend on access to technology.

6.1.1 Access to Computers for Students

The most recent figures, compiled in 1998, indicate the ratio of computers to students in primary schools is 1:84, and 1:53 in secondary schools. It is assumed that the number of computers has increased but also that many of the computers included in the 1998 statistics will now be obsolete. Although much value can be derived from using older equipment (eg writing, calculation, curriculum applications, basic computer literacy, computer studies at the machine level, keyboard skills), many new business and educational applications including office software and video processing software require current operating systems, high equipment specifications and network connectivity.

In order to plan for the provision of hardware to support *TLT 2010 Masterplan*, it will be necessary to obtain up-to-date information on the number, distribution, age and specifications of computers and peripheral devices in Royal Thai Government educational institutions.

6 (a) Recommendation

That a census of computer and peripherals is conducted to form a basis for planning, procurement and supply.

6 (b) Recommendation

That the current targets and timelines for the supply of computers and peripherals to students and teachers be reviewed early in Stage 1 of the TLT 2010 program.

6.1.2 Access to Computers for Teacher

6 (c) Recommendation

That a technical support program is established, linked to the ICT Skill program, to support computers, and local area networks and interconnection with the wide area network.

6.1.3 Installation and Technical Support

There may be difficulties in providing qualified technical support in some areas, so vendors should be required, as a condition of the contract, to guarantee supply, installation and support of all computers and peripherals for the warranty period of the equipment. An option to extend the service elements of the contract beyond the warranty should be considered.

Schools, universities and learning centres receiving equipment should be required to engage technical support on an ongoing basis. Consideration should be given to a program to recruit and, if necessary, train technical support staff.

6 (d) Recommendation

That in developing plans for school networking, the proposed National Coordinating Committee on Learning Technologies in Education Reform investigates the potential for whole of Government and whole of school and/or education sector approaches to telecommunications services, in order to optimise cost-benefits.

6.1.4 Procurement of Computers and Peripherals

The purchase of computers, peripheral equipment and networking infrastructure to meet the targets in the *TLT 2010 Masterplan* will require a major investment by the Royal Thai Government, with significant implications not only for the budget process but also for manufacturers, suppliers and service providers in the ICT industry. It is crucial, therefore, that the purchase and installation of ICT infrastructure be conducted in a manner that delivers quality and value, guarantees fairness, and contributes to economic and industry development in Thailand. It is also important to establish a model of provision that meets the particular needs of local education and training providers, while gaining the benefits of centralised purchasing of hardware and software.

6.1.5 Procurement process

6 (e) Recommendation

That the procurement of goods and services associated with the *TLT 2010 Masterplan* is guided by principles derived from principles published by the Victorian Government Purchasing Board: www.vgpb.vic.gov.au .

These principles are outlined below:

Value for money

- adopting a strategic approach to purchasing
- planning purchases within well-defined objectives and methods, and minimising rushed decisions
- researching the market
- maintaining and developing a competitive market
- establishing appropriate evaluation criteria such as compliance to specification, commercial matters, community service obligations, whole-of-life cost and supplier support
- negotiating with suppliers to clarify ambiguities and contractual terms and conditions
- working in partnership with suppliers
- using functional and performance specifications which focus on the application to be performed and the expected results and all user requirements clearly specified.

Open and fair competition

- ensuring open and competitive tendering and public scrutiny of the process, and ensuring all suppliers have the opportunity to do business with the Royal Thai Government
- auditing and reporting of purchasing activities
- including evaluation criteria and methodology in requests for tender or quotations which will allow suppliers to understand requirements and offer their best solutions
- holding pre-tender meetings to explain and consult on all aspects of the tender, including the specification, contract, evaluation methodology and process
- ensuring a transparent decision-making process
- publishing and promoting an internal purchasing procedures manual
- ensuring knowledgeable staff are available to answer suppliers' queries
- maintaining a records system for purchases which will satisfy scrutiny
- providing all suppliers with the same information
- ensuring specifications are open and generic and not biased in favour of a particular supplier.

Professional integrity and probity

- being accountable for purchasing decisions and for the use of public funds
- exercising appropriate levels of delegation in the decision-making process
- ensuring equal treatment of all suppliers
- observing government and board purchasing policies
- maintaining confidentiality
- not accepting gifts or favours from potential suppliers which might compromise the integrity of the purchasing process
- avoiding conflicts of interest
- employing professionally trained staff to manage and coordinate department purchasing
- ensuring that the experience and expertise of officers conducting purchasing is commensurate with the nature of the purchasing being undertaken
- providing ongoing purchasing skills training
- establishing procedures to ensure ethical practices.

Management of risks

- early and systematic identification, analysis and assessment of risks and development of plans for handling risk carried out

- responsibility allocated to the party best placed to manage risks
- costs incurred are commensurate with the importance of the purchase
- in managing a procurement, buyers and suppliers both deal with risks as exposures can impact on project costs, delivery schedules and acceptability to users
- government buyers develop risk management plans.

Accountability

- department Purchasing Management Plans include accountability framework for major purchasing decisions
- all major purchases approved by Accredited Purchasing Unit (APU)
- Annual Reports by the APUs published
- audit records on purchasing maintained
- automated purchasing systems to ensure controls maintained
- outsourcing contracts identify accountability relationships (eg project management).

Simplicity

- using of open and generic specifications
- using standard terms and conditions
- reducing the costs of tendering for suppliers by the use of simple tender documents
- encouraging the use of panel and period contracts including the use of common use contracts where appropriate
- rationalising the advertisement of public sector supply requirements
- streamlining of business practices.

Local industry sourcing

- observing government policy and industry development policy
- developing partnerships with suppliers
- providing information on local sourcing opportunities
- actively seeking out opportunities for competitive local industry, where it is competitive, when undertaking major purchases
- ensuring that purchasing practices, procedures and specifications do not disadvantage local suppliers, and using open and generic specifications
- providing industry with advance notice of major purchases through forward procurement planning and information sharing
- promoting a 'buy local' philosophy, where it is competitive and represents value for money
- providing opportunities, where possible, for innovative and research-based companies with export potential
- supporting quality-assured companies who supply competitively priced goods and services
- supporting country-based businesses to stimulate regional employment
- fostering good relations with suppliers and industry bodies
- providing feedback to local suppliers to improve their competitiveness.

The result of a public tender may be:

1) a Standing Offer, an agreement to supply goods and/or services for a period of time based on specified terms and conditions and at agreed prices, often with no obligation to purchase a particular quantity

2) a Period Contract, a legally binding contract that provides for the supply of a specific or minimal quantity of goods and/or services for a specific period.

The tender may also be designed to establish a Panel Contract Arrangement, a common use agreement comprising a number of suppliers for a similar product or service.

It is important when purchasing computer hardware to consider the total cost of ownership. In addition to initial purchase price, the cost of delivery, and installation and networking must be added as well as the recurrent costs associated with maintenance.

6.1.6 Meeting Local Needs through Centralised Purchasing

The purchasing scheme for hardware will not be fully effective if it delivers a low priced equipment of a standard configuration to schools and learning centres that does not meet specialised needs. In order to achieve flexibility in equipment specifications and local support, educational institutions often prefer to deal with local vendors. While this strategy is successful in many cases, it is unlikely to be the best overall outcome from the point of view of cost and quality.

A model that that has proved successful in several states in Australia involves centralised tendering for computers combined with a variety of upgrade options. Schools and other providers are then able to purchase themselves equipment through contracts established through the tender process.

The tender specification typically includes delivery, access to a service network, a three-year warranty and an invitation to openly package 'value adds' such as local investment, contributions to research and staff training in tender bids. In large scale tenders, vendors should be encouraged to establish a network of local suppliers and service agents who are able to support centrally purchased hardware.

6 (f) Recommendation

That all medium-sized and large purchases are made through a five-stage process involving a public tender, consisting of:
- **procurement planning**
- **bid document preparation**
- **invitation process**
- **evaluation, selection and award**
- **contract administration.**

6 (g) Recommendation

That the RTG develop procurement guidelines are based on the requirement for quality, value for money, value adding and, where possible, contribute to the development of local industry.

6 (f) Recommendation

That the RTG implement procurement arrangements align with policies to support school-based decision making.

6 (g) Recommendation

That the RTG develops and implements a hardware provision program that capitalises on the aggregate capacity of all the RTG, and facilitates and stimulates local television making and initiative.

6.1.7 Surplus Computer Program

The use of surplus computer equipment from public and private sector organisations to supplement computer provision programs for education and training has proven highly successful in a number of countries. Successful programs have undertaken with the government support in Australia at both the National and State levels. Community based and profit-making ventures have also successfully delivered second-hand computers into schools, community learning centres and private homes.

The computers handled by these programs are typically in good operational condition, and come supplied with a licensed operating system, but are no longer suitable for running current business applications because of limited processor speed or storage capacity. In most cases this equipment is suitable for running much of the software used in schools, including web browsers and telecommunication programs. Issues do arise, however, in relation to the quality of hardware received from some sources as well as the ownership of installed software.

A computer refurbishment centre operated by the Department of Education, Employment and Training in Victoria, Australia has been used to ensure that surplus computers are delivered to schools with a suitable configuration of memory, disk storage and operating system. The computers from this centre can be quickly connected to school networks and put to use.

Programs of this kind can also provide opportunities for the Royal Thai Government to promote educational IT program to Industry and provide a mechanisms for accepting tangible support from the private sector.

In Thailand it may be possible not only to direct surplus computers in education and training settings, but also to provide training opportunities in conjunction with refurbishment programs.

6 (h) Recommendation

That a study is conducted into the feasibility of establishing a 'surplus computers for education' program in Thailand, to assess issues associated with sourcing, refurbishing and distribution of equipment.

6.1.8 Access to Computers for Teachers

Research in Victoria in 1997–98 indicated that lack of access to computers was the largest single factor preventing the uptake of ICT in the classroom. Teachers needed access not only to prepare materials for classes but also to build the confidence required to allow and supervise student use of computers. The provision of notebook computers to teachers has contributed to a significant improvement in the level of computer use in lesson preparation, and in the classroom.

In order to gain maximum use of all computing facilities, it would be desirable for all computers to be available to students and teachers. If teachers' computers are to be used to provide access to management information systems it may prove advisable, for security reasons, to maintain the student and teacher computers on separate local area networks. This is still the reality in most

Australian school systems. Provision of a computer at school or at home could be used as an incentive to contribute materials, or to take part in professional development.

6 (i) Recommendation

That programs are established to provide teachers with access to computers (software and networks) in the workplace and at home.

6.1.9 Optimum Layout of Computing Facilities

In the rollout plans, consideration also needs to be given to achieving hardware configurations that will achieve optimum access for students. This will probably result in a combination of computer labs, classroom-based desktop computers and mobile computers (desktop computers on trolleys and notebook computers) that can be moved between learning areas and potentially also be used by students at home. In keeping with school-based management, such decisions should be made at the school level, and informed by Navigators.

Priority should be given to the provision of routine access to computers and networked learning resources rather than provision of computer labs that can only be accessed on a whole-class, scheduled basis. This can be achieved through the provision of networked computers in classrooms, and through 'pods' of computers situated amongst classrooms that can be accessed during class time. Supervision can be provided by situating the pods between classrooms with windows provided to ensure that students are operating within sight of teachers or supervisors.

These computers should be networked to a school intranet that keeps local copies of appropriate digital resources. Access should also be provided to the Internet so that, in keeping with the *TLT 2010 Masterplan* vision, learners have access to high quality learning resources 'any time, any place'.

Trolley-mounted desktop computers and notebook computers are well suited to applications that require special peripheral devices such as scanners and robotics controllers that are not easily accommodated in lab situations. They are also appropriate when additional adapter cards and software drivers are required as these may cause conflicts with network hardware and software.

If dedicated classroom computers are not available, mobile computers provide the most appropriate solution for applications such as data-logging, device control (eg Lego-Logo, robotics), video capture studies and data gathering in the field, which require computer power at the site of learning.

6 (j) Recommendation

That the RTG develops model designs and specifications for school and university computing facilities, covering classroom layout, furnishings, cabling and security.

6.2 School and University Networking

6.2.1 Alternative Models for Bandwidth

Governments have adopted two broad, and very different, models of networking schools to the world. One is the establishment of whole of government, or whole of education sector, wide area network. The other is to encourage and stimulate for the marketplace to implement broadband Internet connectivity to schools with government initiatives to address equity issues.

The Victorian 'VicOne' WAN is an example of the former approach, whereas the National Infrastructure Initiative in the United States exemplifies the latter.

Costs, both capital and recurrent (fixed and variable), and network performance are key considerations. Many organisations stage their network implementation by meeting immediate needs through affordable solutions, and addressing long-term requirements as budget and resources become available.

6.2.2 Strategic Plan for School and University Networking

Connected personal computers can be powerful educational enablers – linking students to authentic learning tasks which encourage the development of international perspectives and understanding, providing expanded audiences for student work, new opportunities for individual and collaborative learning, and enabling students to reach beyond normal classroom and school resources.

Efficient networks can also make possible new administration capabilities. Networks can provide expanded and efficient communication, linking and enabling systems such as human resource management systems that can support local decision making through access to data that is now only available centrally. Email can provide significant gains. Productivity savings can be achieved if staff can directly enter requests for leave and training applications online, eliminating the need for paper forms and data entry, and enabling streamlined business processes. The web can make feasible the evaluation of educational and professional development programs at unprecedented levels and speed, providing tangible enhancements to project outcomes and enabling immediate central quality assurance of locally delivered programs that may have been deployed in remote locations and on a massive scale.

A range of models exist to provide links between schools, within schools, within classrooms and to link schools to the world. Although there is no simple blueprint for school and university networking, there are best practices that should be investigated for potential adoption or adaptation to local circumstances. Similarly, there are notable instances where costly, leading-edge networks have been installed, but the educational or administrative benefits have been insignificant, and where similar or better outcomes could have been achieved using standard, proven technology. It is important to be aware of those potential pitfalls, in order to avoid them.

There is no need to experiment in the application of technologies – proven models are available. Standard, proven technologies should be implemented. 'Fast follower' approaches are recommended (Kempis, Rolf-Dieter and Ringbeck, 1998).

Schools, school systems and universities should seek to implement networking arrangements that are most cost-beneficial to the agency. The models of networking available are changing, as emerging technologies and new applications of existing technologies create new possibilities, some of which challenge ICT wisdom. In particular, schools and school systems are just beginning to harness the power of the Internet, intranets and extranets, virtual private networks, wireless networking and portable computers.

Around the world, schools and universities are connected using a mix of public and private networks. Telecommunications companies provide some services, while others are implemented, and owned, by the school or university system or by individual institutions. Still others are installed and supported through corporate philanthropy and community contributions. Governments often play key roles in stimulating those inputs and in establishing appropriate legislative and regulatory frameworks connectivity that enable such activity.

6 (k) Recommendation

That goals for the networking project are set based on benchmarks of international best practice, including consideration of the cost-effectiveness of systems.

6.2.3 Network Delivered Services

Once schools have reliable access to a data communication network a range of new options for streamlining business process across the Thai education system will become available. In the past, most corporate large organisations have operated a private network, aiming to guarantee service levels and security. Modern technology allows organisations to operate a 'virtual private network' (VPN) over a public switched network, or to deliver secure transactions over the public Internet using either a permanent or dial-up connection.

A wide range of current business processes can be facilitated by operation over network linking educational institutions and administrative offices. For example:

- corporate communication – email and web-based communication can supplement or replace paper-based communication
- Human Resource Management System (HRMS) – facilitating staffing and payroll operations, with increased local involvement and employee self service
- Management Information Systems (MIS) – collection and dissemination of critical corporate information
- collection of miscellaneous statistical information – statistical returns delivered directly from provider desktop into corporate databases
- links to partner organisations and agencies – facilitate information flow and transaction processing
- Replacing paper-based transfer of information with data communication, dramatically reduces the time taken to transfer information from education providers (schools, technical colleges, private providers, etc) to central offices, at the same time minimising data entry errors and reducing mail costs.
- By providing 'front ends' to corporate data systems that are accessible via the worldwide web, it will be possible for providers to submit and validate statistical information from any location, not only from dedicated network terminals. Using the same approach, employees can gain access to corporate data systems from any location, identifying themselves by a unique network ID and password.

To achieve this functionality, it is necessary for centrally stored data to be accessible via the web. This implies either that the data storage systems are web-enabled, or that data can be transferred via transfer protocols from storage to a web server for delivery.

6 (l) Recommendation

That corporate business applications are designed with the capacity to deliver exchange data with education stakeholders via the worldwide web.

A range of new opportunities for business process re-engineering and for the establishment of new services also arise as the result of establishing a network connecting all schools. For example:

- e-procurement – streamlined ordering of supplies and electronic payment
- broaden curriculum offering in small schools using online transfer of student academic records between provider institutions

- point-to-point videoconferencing for delivery of student programs and teacher professional development
- integration of education services and training into whole of government service locator.

Such systems also provide avenues for delivering information about the education system to the general public as part of the e-Government strategy, and facilitate development of the e-business and e-commerce strategies.

6 (m) Recommendation

That corporate business applications developed for the education sector are consistent with the RTG's e-Government, e-business and e-commerce strategies.

6.2.4 Supporting System-Wide Enhancement of Business Processes

A wide range of business processes can be facilitated by operation over a network linking educational institutions and administrative offices. For example:

- Corporate Communication – email and web-based can supplement or replace paper-based communication
- Human Resource Management System (HRMS) – facilitating staffing and payroll operations, with increased local involvement and employee self service
- Management Information Systems (MIS) – collection and dissemination of critical corporate information
- collection of miscellaneous statistical information
- videoconferencing – bandwidth permitting
- links to partner organisations

By replacing the paper-based transfer of information with data communication, it is possible to decrease the time taken to transfer information from education providers (schools, technical colleges, private providers, etc) to central offices, minimise data entry errors and reduce mail costs.

By providing 'front ends' to corporate data systems that are accessible via the worldwide web, it will be possible for providers to submit and validate statistical information from any location, not only from dedicated network terminals. Using the same approach, employees can gain access to corporate data systems from any location, identifying themselves by a unique network ID and password.

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Such systems also provide avenues for delivering appropriate information about the education system to the general public as part of the e-Government strategy.

6.3 Models for Purchasing Internet Services

Some benefits may accrue from allowing schools to select their own Internet service providers in a competitive marketplace. However, the cost-benefits to the system are likely to prove more favourable if one or several preferred suppliers are selected by the system through competitive tender processes. Benefits achieved through the aggregation of demand may include reduced costs, and the provision of system-wide common services.

For example, a single preferred Internet supplier has been selected by five Australian States and Territories because of the attractive suite of value added services provided as well as value for money. Features include:

- Centrally hosted virtual web server (ie no web server or maintenance required at the school)
- Customisable homepage for every teacher and student
- Individual, school managed email and network accounts to allow for usage tracking
- Content filtering at provider and school level to exclude unsuitable content
- Substantially reduced cost of Internet access through smart caching.

The Internet services are provided by a partnership between a telecommunications company (Telstra) and a company that provides the value added software services. The States and Territories individually conduct competitive tenders for Internet services on a periodic basis.

Networking Within Universities, Schools and Classrooms

The value of computers in learning environments is multiplied by having the computers connected to a local area network and to the Internet. The major benefits of LAN and Internet connections include:

- Communication between users – to share files, data, send email
- Sharing of peripheral devices such as printers and CD-ROM drives
- Connection of all computers to the Internet via a single connection
- Access to resources and software from any location in the school
- Storage of student and teacher work on the network so that it can be accessed from anywhere in the school.

6.4 Networking At Classroom Level

In classrooms, LAN points and power points should, ideally, be where the computers are located.

As Thailand's classrooms become increasingly student-centred, teachers will want to move furniture at various times, to best suit the learning activities that they plan. As computers increasingly become central tools for learning, some teachers will also want to move the computers to suit the learning activities.

Experience in the ACOT (Apple Classroom of Tomorrow) program and in the Victorian Navigator schools indicates that the periphery of the classroom is often not the best location for computers. Dwyer (1995) describe how networking and other factors, such as furniture, can impede desired learning and teaching approaches when technology is added to traditional classrooms.

> *many classrooms were organised in a traditional manner. Although student collaboration was a goal, there was little effort to define areas in which students could work together. In the two smaller high school classrooms, the student desks − each with a computer − faced the front of the room. In these rooms, the teachers generally gave full-group instruction, made desk assignments, and circulated through the room to answer questions. In the two larger rooms, the technology stations were organised around the perimeter of the classroom (in part, for access to electricity), and some of the desks were in a major circulation path. A full-group instruction area included rows of two-student tables facing the front of the room. Student work was frequently interrupted by other students circulating through the room … Interactive technologies do not necessarily increase physical or*

organisational flexibility, but may actually do the reverse. The lack of physical flexibility within the classroom may be a disincentive to change pedagogy.

6.5 Models For Local Area Networks

Guidance for Victorian schools on designing and installing local area networks (LANs) is available in *Learning Technologies Planning Guide*, a copy of which has been provided to ONEC. Processes and models for school network designs are given in that document. Victoria's Navigator schools play an important role in advising other schools of their plans for LANs and contributed to the development of that Guide.

6 (m) Recommendation

That a guide to school networking for Thailand's schools is developed and provided to schools.

6 (n) Recommendation

That professional development is provided to assist schools to plan and implement LANs.

6 (o) Recommendation

That LAN guidance and professional development is based on the experience of Thailand's Navigator schools.

6.6 Wireless LAN: A Quantum Jump In Classroom Networking Technology

Wireless local area networks provide a viable and proven way to link computers to school networks. There is a range of factors that should be considered when selecting wireless LAN products. A paper addressing those factors is at: ***http://www.hotsource.com.au/default.asp?page=search_disp_article&smenu=topic&titleid=12***

Several schools in Chester County, South Carolina provide networked computers to all students in all classrooms, but only when they are needed. These schools have wireless LANs. Trolleys containing class sets of notebook computers are wheeled to classrooms as needed. Using this approach, every classroom becomes a computer lab, when needed. In those schools, most desktop computers, such as those used for administration and in computer labs, are hard wired.

Wireless LANs save on the number of switch ports required and on cable installation costs. Importantly, the Chester County approach saves on power requirements in classrooms (the notebooks arrive charged at the beginning of the lesson) and frees up classrooms that would otherwise be dedicated to computer labs.

A similar approach has been adopted at John Paul College in Frankston, Victoria. ***http://www.jpc.vic.edu.au/radiolan.html***

Wireless LAN is also a cost-effective way to provide broadband links between schools and between school buildings, as described in examples above. This cost-efficient, wireless, way of providing broadband links is enabled by government spectrum management regulatory

authorities in many parts of the world reserving the Industrial Scientific and Medical (ISM) bands for free, unlicensed use for such digital communications. In Thailand at present, the required (MMDS) band is licensed for use by cable TV licence holders, which would prevent classroom and building-to-building applications of wireless LANs.

6 (p) Recommendation

That consideration is given to the following questions when considering the existing and emerging options for school and university networking:

What is to be achieved through networking?

Are quantum leaps possible? For example, is it necessary for individual schools to ever host student and teacher administration systems on site?

Can centrally hosted student information be hosted via the Internet anywhere?

Is there a need for a single network linking Thailand's centres of learning?

Could the Internet and, where necessary, VPNs be used for that purpose?

In relation to staging, would there ever be any benefit in providing a national dedicated learning network? If so, when?

Is there benefit in owning or leasing links?

6 (q) Recommendation

That the proposed spectrum management agency regulates the Industrial, Scientific and Medical bands for unlicensed use in Thailand.

6 (r) Recommendation

That clear, ambitious goals for the networking project are set, based on benchmarks of international best practice, including consideration of the cost-effectiveness of systems and that stakeholders are involved in selecting the technology systems, including pilot projects.

7 Improving Access To Education And Training Through ICT

One of the main benefits of improving the ICT infrastructure in Thailand will be the new avenues it creates for people of all ages and in all locations to gain access to education and training. In this way, technology will support major goals of the education reforms including lifelong learning and equity of opportunity. Through a range of strategic initiatives, the Thai people will be able to acquire basic skills and qualifications, upgrade their qualifications, from home or in the workplace and undertake informal learning based on the local knowledge and the country's rich cultural assets.

7.1 Lifelong Learning

Delors (1996) identifies four pillars of lifelong learning: (1) Learning to Know, comprising a broad general knowledge and opportunity to work in depth on a small number of subjects, in addition to learning to learn; (2) Learning to Do to acquire skills needed for an occupation, competencies to deal with social, work and learning situations, and to work as a member of teams; (3) Learning to Live Together to develop an understanding of other people and an appreciation of interdependence, including learning to manage conflicts; and (4) Learning to Be, to develop one's personality and be able to act with increasing autonomy, judgement and personal responsibility.

For many people, ICTs play a powerful role as lifelong learning enablers, and as cognitive tools in learning to know, to do, to live together, and learning to be. If the new ways of lifelong learning are to be made available to all, then there must be widespread routine access to existing and emerging ICT learning tools. If individuals and groups are to optimise the learning benefits they receive, they must continuously develop their skills, knowledge and understanding of how to use ICT in new ways, including the tools for lifelong learning. A culture of lifelong learning is another necessary ingredient. Access, capabilities and learning culture contribute to the development of individuals and the communities they live within, and to the competitive advantage of businesses, communities and countries.

Cultures of learning community and learning society can play important roles in supporting learning throughout life. Longworth (1999 cited in ANTA 2001) identifies a learning community as one which:

- excludes no one from learning, and values learning as an enjoyable and rewarding thing to do
- makes all its resources, especially its human resources, talents, skills and knowledge, available to all
- looks outwards to the rest of the world and encourages its citizens to do likewise
- uses modern communications technology, where possible, to link people internally and externally
- encourages its citizens to develop personal learning plans and to use guides and mentors to develop their knowledge and skills
- mobilises special interest groups – birdwatchers, botanists, scouts, guides, church groups and the many informal organisations in which people congregate – in the monitoring and preservation of a sustainable environment

- celebrates learning frequently and encourages whole families to participate.

Learning communities may be encouraged through creating stimulus and support for their formation, development and maintenance. In Australia, the Australian National Training Authority (ANTA) is endeavouring to provide such stimulus and support through a Learning Communities program. Key strategies in building learning communities include improving the links between existing educational providers (formal, non-formal or informal), establishing new learning pathways, and promoting and supporting an understanding of and participation in lifelong learning to the community and business (ANTA 2001). In addition, there is a need to build and improve infrastructure, to disseminate information and learning materials and to provide all learners with the ability to use them. This will include developing widespread skills in the efficient and effective use of ICTs for a range of purposes.

7.1.1 Facilities For Lifelong Learning

Many individuals have facilities at home that can be powerful tools for lifelong learning, unfortunately, access to those tools – such as television sets, VCRs/VCDs, radios, and computers with Internet connections – is not evenly spread through society. Furthermore, access to the technical facilities for learning does not guarantee that lifelong learners are both aware of learning opportunities that are available – with and without the technology – and have the capabilities to use them effectively and efficiently.

7.1.2 Social Dimensions of Lifelong Learning

Throughout life, motivation and beliefs play important roles in learning. The social dimensions of learning are significant. The contributions of groups and networks to individual and community learning are well documented, including their role as powerful shapers of beliefs, as motivators, and as audiences for reflection on one's understandings and learning.

Physical meetings and dialogue are central to support learning in communities and for individuals. There are cultural and individual characteristics that shape preferred learning styles.

7.1.3 Role of the Mass Media in Promoting and Supporting Lifelong Learning

The media, including free-to-air television, radio, newspapers and the Internet, can provide a range of lifelong learning functions, including promoting lifelong learning opportunities, and delivering learning materials and courses. Examples of the contribution of the media to lifelong learning in a range of sectors and life-stages follow.

7.1.4 Informal Learning

The use of mass media resources can encourage informal participation, and learning, by people who would not otherwise access learning opportunities. For example, free-to-air television is one tool used by the Australian Government to promote and support the development of adult literacy.

7.1.5 Pre-School Learning – for Children and their Parents

For young children in many countries, access to Sesame Street contributes to improvement of pre-school literacy, numeracy and social development. The Sesame Street programs are linked to

research, which informs program development and measures educational gains. The Sesame Street producers encourage parent participation (which has been shown to enhance learning gains for children), and its programming and activities are culturally and age appropriate for its US target audience. For those with access to the Internet, the Sesame Street website (http://www.sesameworkshop.org/sesame/) provides activities for parents to undertake with their children, information for parents such as making the home safe for children, and discussion forums for parents.

7.1.6 Open Access to Higher Education

Britain's Open University and the Open Learning Agency of Australia have substantially expanded access to higher education in those countries. Both make significant use of mass media, including TV, radio and the Internet, for some programs. This approach offers multiple benefits, including low cost (or no cost) materials distribution, and widespread access to informal learning opportunities for British and Australian societies.

7.1.7 Corporate sector

In the corporate sector, companies such as 3Com are now offering online training programs globally. The company's 3Com University provides online training and assessment associated with the company's products and the concepts behind those products – such as computer networking. When participants from 'partner' companies complete a series of courses they qualify for recognition from 3Com, documented by a certificate and wall plaque. Such 'qualifications' may assist with career development and maintenance. The company has leveraged the Internet and ICT to provide a minimal marginal cost global training delivery system, which provides course access, learner interaction (via web-based discussion groups) and automated assessment.

7.1.8 Lifelong Learning in Agriculture

Recent research by Kilpatrick (1999) indicates that media sources used by Australian farmers include print media, radio, television and the Internet. Farmers with Internet access used it mainly for marketing information such as stock market reports, futures trading, and commodity prices, and to search for information relating to production issues or potential new business. Farmers indicated that the major benefit of the Internet was to gain instant access to up-to-date local and overseas information, as the following quote indicates:

> *I probably get most of my information and have learnt quite a lot from e-mail discussion lists ... There's all sorts of consultants and professors and farmers and all sorts of people that are interested in growing grass ... mainly (from) the States and England and Ireland and South America and Australia … it's instant, … and it's up to date ... I've got more out of that in 12 months than I've learned in my whole farming career.*
>
> (Tasmanian broadacre farmer) – cited in Kilpatrick, 1999.

There is clear potential for competitive advantage for individuals, communities and countries if the mass media can be effectively harnessed for lifelong learning, and if capabilities and a culture of use of those resources can be mainstreamed.

7.1.9 Public Infrastructure For Lifelong Learning

Public infrastructure for lifelong learning includes telecommunications networks, radio spectrum, meeting halls and public libraries. New infrastructure can include a variety of models of physical facilities for lifelong learning within the 'learning centre' concept, which is addressed elsewhere in this report.

7.1.10 People And Models Of Use

In addition to physical facilities, leadership and support – at a central and local level – a widespread understanding and application of models of effective use are needed. ANTA's Learning Communities project, described earlier in this paper, will study and document such models.

A range of people in existing and new roles can provide leadership and support, and can develop, capture and disseminate models of lifelong learning for individuals and communities. An example, of librarians and public libraries, is considered in the paragraph below. However, there are many other people who will make important contributions, and a broad range of possible models. In particular, the Royal Thai Government's National Village Fund Initiative could provide a powerful policy platform on which to build, study and disseminate effective and efficient local models for learning communities. There is potential for extension of that program to directly address lifelong learning initiatives in those communities, in order to stimulate the development of access, capabilities and cultures of lifelong learning that make appropriate use of learning technologies.

Disintermediation and re-intermediation are important dimensions of the application of information technologies. As an example of disintermediation, if one has access to the Internet it is no longer necessary to ask the librarian to assist with finding particular types of information. However, in addition to the traditional roles played by librarians, the technology makes possible new and more powerful information management roles. Librarians are re-intermediating as constructors of directories, providers of advice and instruction to aid information searches, providers of metadata to ensure that essential information is easily retrievable. Widespread use of such skills and services can significantly enhance the efficiency and effectiveness of individuals and communities as lifelong learners.

The International Federation of Library Associations and Institutions has recently commenced a research into the role of public libraries in lifelong learning (IFLA 2001). That study will investigate a broad array of issues that could inform the design, function and processes of public libraries to support all areas of lifelong learning, including the role of ICTs.

Similar studies should be considered, at local, regional, national and international levels, to investigate models of support for lifelong learning.

7 (a) Recommendation

That the RTG expands the National Village Fund to include initiatives that will stimulate and support the development of learning communities.

7 (b) Recommendation

That the RTG expands the National Village Fund to include targeted subsidies that will stimulate the appropriate integration of ICTs and lifelong learning into telecentres and other community projects.

7 (c) Recommendation

That the RTG commissions and participates in research in areas to investigate, document and disseminate effective and efficient models to stimulate and support lifelong learning.

7.1.11 Online Infrastructure

In many countries, there are major initiatives underway to construct national and State online 'infrastructure' to support lifelong learning. These include New Zealand's Online Learning Centre (http://www.tki.org.nz/), the Scottish Further Education Unit's Virtual Learning Centre (http://www.sfeu.org.uk/vlearn_c/mainindex.html), Victoria's SOFWeb site (www.sofweb.vic.edu.au) and Virtual Campus (http://www.tafevc.com.au/) Britain's National Grid For Learning site (http://www.ngfl.gov.uk/). There is discussion and recommendations elsewhere in this report that address building a learning gateway for Thai education.

7 (d) Recommendation

That the proposed Thai Virtual Gateway includes areas and structures that support lifelong learning throughout Thailand.

7.1.12 Coordination

Local initiative and leadership, combined with national coordination will be important drivers of lifelong learning development in Thailand. National coordination should aim to optimise the benefits that accrue to Thailand's learners from the creativity of its learners, teachers and other resources. Elsewhere in this report it is recommended that a Lifelong Learning Unit be established as an element of the national education ministry.

Key strategies of that Unit would include the establishment of networks of lifelong learning communities and individual learners, capturing knowledge of effective models and making them accessible throughout the system, and coordination of a national online resource for lifelong learning.

7.1.13 Learning Centres

In Thailand there could be an opportunity to build upon existing community-based facilities to provide learning centres, principally for those students who do not own or have access to the necessary hardware. There is a wide range of potential learning centres, some of which currently provide learner support services, including public libraries, monasteries, schools, colleges and universities.

Ideally, a learning centre would be located within reasonable proximity to learners' homes, be open throughout all study periods, available seven days a week at hours appropriate to a diverse client base, and have appropriate physical facilities, hardware and software. It would need to have a stable electricity supply and telephone connections. Staff should be skilled in providing and supporting the use of computers to access online services. There would need to be administrative systems to manage student bookings for computer access, charging for additional

services, and a capacity to provide access at minimum cost to the learner and to the provider. It would be desirable that learning centres also give learners access to other services such as faxes, photocopiers, video recorders, and relevant books and journals. Experience in Australia indicates that some groups of learners will more readily utilise certain types of learning facilities and resist using others.

Effective models for the establishment and support of telecentres are well established. Models for establishment of community information and communication technology centres are being developed within Thailand, through initiatives such as the 'Strengthen Community Using ICT Network Spider Web' project in Yor Island, coordinated by the Songkhla Rajabhat Institute.

Centres could be established by extending the National Village Fund using a competitive grants program.

7 (e) Recommendation

That the RTG evaluates possible models of extending educational facilities to learners including the piloting of community telecentres as a means of providing facilities and support for lifelong learning.

7 (f) Recommendation

That the RTG evaluates possible models of extending educational facilities to learners, using criteria including learner access, physical facilities, staff skill profiles for supporting learners, administrative systems and as private and public costs.

7 (g) Recommendation

That the RTG develops and maintains a website showing learning centre locations throughout Thailand.

7.2 Models for distance education in Thailand

The investigation of models for distance education in Thailand should be driven by educational considerations. Figure 2 provides a framework for the selection of an appropriate technology mix for flexible learning and distance education programs (AEC, 1992). It includes the following criteria for decision making:

Student characteristics: The selected technology mix should take into account the preferred learning styles and other characteristics of students.

Availability: It is important that the technology selected is well established in the local environment so that an adequate number of skilled staff is available to support the reliable use of the medium.

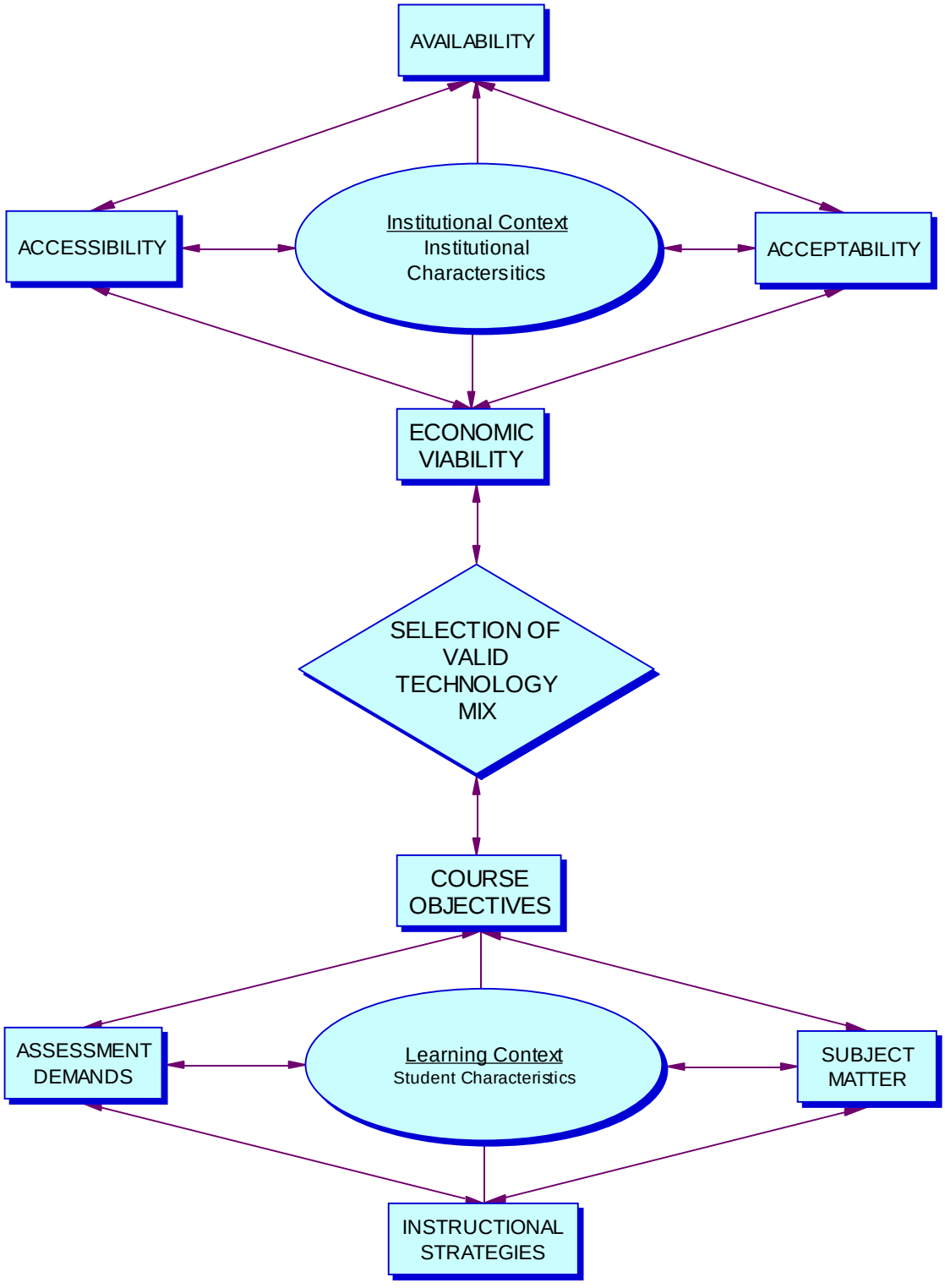
Accessibility: The chosen technology should be available to all students.

Acceptability: The attitudes of both teachers and students must be favourably disposed towards the use of the technology. Teachers and students need to be skilled or trained in the use of the technology if it is to be effective.

Economic viability: Consideration of cost-effectiveness and associated economies of scale is often the number one criterion in selecting technologies for distance education.

Validity: The technology must be appropriate for the objectives and content which constitute the focus of the course.

Figure 2 Framework for the selection of a valid technology mix at the level of a course of study



7.2.1 Student Characteristics And The Learning Context

When considering possible models for distance education it is essential to have an understanding of the learners who will participate in the educational programs. This includes consideration of literacy levels, technology access, and the local support structures that may be available to the learners. For example, for school students studying at home, the child's mother is often their tutor. The support of a local adult is often a core ingredient in successful distance learning for such students.

Recent and emerging technologies and associated flexible learning techniques would make it increasingly possible to cater for the varied preferred learning styles of the students involved in Thai distance education. The potential exists, over time, for the Royal Thai Government to create interactive, integrated, learner-centred distance education programs featuring active environments of social learning. Distance education programs could offer key aspects of learning experiences currently available only in the best classrooms in Thailand.

Technologies make it possible to design distance education experiences that address Gardner's multiple intelligences (Berge & Collins, 1995). Good instructional design uses a wide variety of formats for instruction, such as small group discussion, graphics, lectures, hands-on labs, writing and reflection, computer-mediated communication, and conferencing.

It should be recognised that not all students commencing distance education programs are highly print literate – regardless of whether print is provided on paper or on a computer screen. It is important that those responsible for program design and program delivery are able to draw upon a range of teaching and learning approaches and media, according to the needs and preferred learning styles of target groups of students.

7 (h) Recommendation

That an ICT skills development program is established, including online delivery, which is accessible to students involved in formal and non-formal education, as well as adults undergoing retraining.

7.2.2 Fourth Generation Distance Education

Taylor (1997) distinguishes four generations of distance education, characterised by the technologies used for instruction. The first generation Correspondence Model involves the use of print resources and interaction between teacher and learner by mail. The second generation Multi-media Model of distance education involves the use of self-instructional resources such as printed study guides, readings, videotapes, audiotapes, computer-based courseware and CD-ROM. The third generation Telelearning Model of distance education is based on the use of technologies such as audioconferencing, audiographics, videoconferencing and broadcast television/radio. The fourth generation of distance education, the Flexible Learning Model, combines interactive multimedia, with access to learning resources and interactivity through computer-mediated communication (CMC) through the Internet. Each successive generation of distance education provides enhanced opportunities: for individual interaction between learner and instructional materials and other resources; for social

interaction between learners and teacher, learners and other learners, and learners and the world; and catering for a range of preferred learning styles.

The implementation of fourth generation technologies and distance education techniques will involve substantial educational, organisational, technological and personnel issues, such as acquiring new technologies for staff and students developing new skills to support learners, the redevelopment of course materials and re-conceptualising pedagogy.

It is likely that the successful implementation of the fourth generation distance education models in the higher education sector will have enabled teachers and officers in that sector to develop expertise in fourth generation teaching and learning practices that could potentially be transferable to other sectors. It is important that this expertise and the experience of other sectors are drawn upon in developing models for fourth generation distance education programs for schools.

The adoption of fourth generation distance education models will also require participating students and teachers to have routine access to computers connected to the Internet, both during and out of school hours. In the short term, providing such access would present a substantial challenge for many schools and would be possible in only a small proportion of households.

While approximately 18.2 in 1,000 of Thailand's population have a PC, it is likely that students from low socio-economic status and other financially disadvantaged groups will have less access to computers in the home than other groups. A 1995 United States study *Falling Through The Net: A Survey of the 'Have Nots' in Rural and Urban America* (Brown et al, 1995) found a direct relationship between household income and home access to computers/modems, and a direct relationship between educational attainment and home access to computers/modems. It is likely that similar trends exist in Thailand.

Over time, as the Royal Thai Government moves toward implementing fourth generation distance education models, consideration should be given to ways to make computers and the Internet more readily available to all distance education students, both during and out of school hours. Telecentres discussed earlier provide one model for after school access.

7 (i) Recommendation

That the RTG investigates, pilots and implements ways to make computers and the Internet available to distance education learners, both during and out of school hours.

7.2.3 Economic Viability: Development Of A Costing Model

The costing model adopted for distance education programs should take into account all relevant activities, including:

- administration and coordination
- materials development and maintenance
- staff development

- materials design, continuous improvement and upgrading including subject specialists, teaching and learning specialists and multimedia producers
- materials production
- scriptwriting, editing, camera operation, narration, desktop and web publishing
- delivery and support
- reproduction – printing, binding, storage, web database integration
- packaging and dispatch – by mailing, the web or broadcast
- technical support – in communications and for users
- infrastructure provided for learners to access materials
- teaching
- assessment

When costings on these parameters are defined, it should be possible to identify those activities most efficiently undertaken 'in house' and those that should be outsourced. This approach may also lead to considering the formation of consortia or joint ventures with other organisations with specialist, cost-effective skills.

The report *The Evaluation of the Cost-effectiveness of Multimedia Mixed Mode Teaching and Learning* (Taylor & White, 1991) applies an activity costing model used by the University of Southern Queensland to identify and control the costs of each activity involved in distance education. The report provides a useful framework for analysing the cost-effectiveness of possible distance education models.

7.3 Selecting Models Of Distance Education

As new technologies enable shifts in distance education practices, old technologies are augmented and not totally replaced (Berge & Collins, 1995). New models of distance education are expected to make use of a range of existing and emerging technologies. The educational opportunities offered by videoconferencing and the worldwide web deserve particular consideration.

7.3.1 Videoconferencing In Schools

In the early 1990s, Australian industry and the tertiary education sector quickly recognised and capitalised on the educational and administrative opportunities offered by videoconferencing. At that time videoconferencing was uneconomic for use in school level distance education: videoconferencing units were very expensive and required access to relatively high cost ISDN communications links.

In the mid 1990s the advent of desktop videoconferencing and broader access to ISDN communications at reduced cost brought videoconferencing within the reach of the schools sector.

Eighty-six Victorian schools involved in that State’s Videoconferencing and Telematics Program now have high quality desktop videoconferencing systems. The Videoconferencing and Telematics Program is a highly successful third generation 'telelearning model'. An overview of the program is available on SOFWeb (http://www.sofweb.vic.edu.au/lt/telemat/index.htm). D’Cruz (1990), in a review of the then 'Telematics' program found that:

> *in most of the clusters in which (Telematics) operated, retention rates in Years 11 and 12 have improved … (and) … the range of subjects available to students has increased.*

A further study (Gallagher, 1993) confirmed that:

> *When everything is in place, Telematics works. Schools increase the curriculum choice they offer students. Teachers have satisfying and successful experiences. Students learn – motivated students at remote sites learn at least as well as on-site students, they report satisfying class participation experiences and they are grateful that Telematics has given them the opportunity to participate in courses they could not otherwise have taken.*

These studies were carried out at a time when 'audiographics' – a combination of graphics sharing on computers, facsimiles and audioconferencing – were the prime tools for Telematics. Since then videoconferencing has replaced those technologies. Most Telematics teachers and students find that videoconferencing has significant educational advantages over the earlier technologies (Arms, 1997):

> *The kids find (videoconferencing) far far superior to the old (audiographics) system. It makes them feel part of the class.*
>
> *Videoconferencing has led to a marked improvement in the delivery of curriculum. Students are more enthusiastic and curriculum delivery more efficient.*

Schools involved in the Videoconferencing and Telematics Program report that, when offered a choice, students select Videoconferencing and Telematics in preference to conventional second-generation distance education programs. Key elements of Victoria's Videoconferencing and Telematics teaching and learning model include the following:

A face-to-face meeting held between the teacher and all participating students early each semester. It is important that this occurs early in the program so that the students and teacher, who might otherwise never meet, are able to establish relationships within the 'virtual' class.

- Regular videoconferencing links between participating classes. A variety of teaching and learning activities are conducted during videoconferencing sessions.
- Students and the teacher maintain relationships through the videoconferencing link. There is an element of informal relationship maintenance in many lessons. In some instances, students link up with their virtual classmates between lessons.
- Some classes undertake field trips and excursions: all virtual class members are encouraged to attend.
- Professional development on teaching techniques and training on videoconferencing equipment is conducted with teachers prior to teaching in the program. This is generally provided at cluster level.
- Clusters form a structure for collegial support for Videoconferencing and Telematics teachers.

- Ongoing teacher professional development. This occurs through the clusters, an annual conference and through targeted programs such as Learning with the Internet.

Opportunities for expanded interaction

Low cost computer-based tools for collaborative learning are available. For example, *Microsoft NetMeeting* software is available free from the Internet. *NetMeeting* enables collaborative capability on a standard networked multimedia computer. Networked computers in classrooms and homes are enabling some students to:

- videoconference
- receive video
- receive and transmit audio
- send and receive email
- share applications and documents
- collaborate in shared applications
- draw with others on a shared whiteboard
- send messages to others in chat.

7.3.2 Flexible Learning And Distance Education Using The Worldwide Web

Much attention is being given to the educational potential of the worldwide web. The web offers far more than a means to provide online access to materials that might otherwise be provided on paper. There are numerous educational possibilities offered by the web which can enhance student-centred learning. The following are adapted from University of Washington's 'Effective Use Of The Web For Education: Design Principles and Pedagogy' (http://weber.u.washington.edu/~rells/workshops/design/).

- Simplified creation, distribution, and maintenance of educational materials is possible. (eg *Learning with the Internet* materials are available on SOFWeb and updated materials become available immediately http://www.sofweb.vic.edu.au/loti/index.htm)
- Tools for distributed, collaborative projects are possible (eg Saltwatch project – Learners in distributed locations contribute environmental data to collaborative learning activities. The salinity map is automatically updated. http://www.saltwatch.org.au)
- Multiple channels for educational participation
- Content reinforcement
- Easy access to current information (eg The Centre for Disease Control is a huge, constantly changing archive of information about diseases http://www.cdc.gov/)
- Multimedia presentation of content (eg The Stanford Center for Professional Development is using web technology to enable asynchronous access to courses delivered on campus).

7.3.3 Key Issues In Selecting Possible Models

In selecting distance education models, key questions include:

- What elements of existing distance education models are most effective for the students in our programs?
- What does research say are the most effective models used elsewhere?
- What dimensions of existing Thai distance education provision do we most want to retain?
- Are there dimensions of distance education that the Royal Thai Government wishes to avoid?

7.4 Developing A Business Model For Distance Education

It is likely that computers, the Internet and low cost videoconferencing may provide the technical foundation for a new paradigm of distance learning in Thailand. Not only do such technologies make possible new experiences for distance learners, but they also enable new arrangements for coordination, administration and materials production.

In developing a business model for distance education provision, it is helpful to consider modern business practices. Many successful businesses are focused on identifying the key work activities that directly address customer values and organising the business to perform that work better than anyone else. Other dimensions are considered for outsourcing.

The business model for distance education should consider all aspects of provision, including materials design, production, continuous improvement and upgrading, course delivery and support, coordination and administration.

An overview of key issues associated with each area follows.

7.4.1 Materials Design, Production, Continuous Improvement And Upgrading

There are substantial differences in the learner groups and economics of school and higher education sector distance education.

In the higher education sector large student numbers and amortisation of the production costs justify use of multimedia and online self-instructional materials over the (often) 3–5 year useful life of the materials. For example, in 1997 the University of Southern Queensland had 13,000 distance education students studying off-campus in over 40 countries (Taylor, 1997). A Distance Education Centre with 109.6 EFT staff supported this large cohort of students.

In the school sector there has traditionally been a reliance on materials developed 'in house', often by the person who will deliver the program. School sector distance education programs therefore generally utilise lower cost first and second-generation materials.

> *What appears to be required is a shift from the status quo, wherein a single teacher … is more-or-less solely responsible for the design, development, delivery and evaluation of courses, to a multi-disciplinary team approach, wherein a range of specialist expertise can be applied to the task of improving*

the quality of teaching and learning through the application of a range of technologies. (OLTC, 1992).

The higher education sector has shifted its practices. Flexible learning centres employ teams of specialist staff to design and produce materials, including:

- instructional designers
- graphic designers
- audio and video production staff
- web specialists
- interactive multimedia designers
- technical support staff.

Content experts are utilised during the materials production cycle.

The higher education sector also uses purchased materials in its programs. For example, in Australia, the Open Learning Agency has developed a significant suite of flexible learning courses within a limited budget. A number of these courses utilise television programs broadcast on the government-funded TV network, Australian Broadcasting Corporation (the national broadcaster). Given the high production values required by the ABC, the Open Learning Agency has funded only a small number of locally produced television series. Most Open Learning Agency courses with a television component have been developed by adapting Australian university distance education programs to integrate with suitable overseas produced distance learning television series.

As the Ministry moves to implement fourth generation models, over time, it will be necessary to consider options for materials acquisition and development including purchasing and, as required, adapting commercial materials, and distributed, collaborative models of materials development – possibly involving education authorities in other countries which face similar challenges.

7 (j) Recommendation

That the RTG investigates potential efficiencies and educational benefits available through:

◆development of an online collaborative program for the development of distance education courseware
◆development of a 'pick and mix' course materials facility, from which teachers would be able to access commercial and locally developed distance education materials for adoption or adaptation, accessible online via a Digital Library
◆integration of elements of the materials design and production activities of existing programs
◆planned use of instructional materials over several years.

7 (k) Recommendation

That currently unused broadcast time on television channels is made available to deliver educational TV programs, including for distance education, classroom use and teacher professional development in learning technologies.

7 (l) Recommendation

That teachers and students in conventional settings are able to access distance education materials via the Digital Library.

7.4.2 Course delivery and support

In Third Millennium distance education, learner value from distance education providers will be centred on the quality of interaction between learners and teachers, learners and materials, and learners and other learners. Students will increasingly turn to technology for content learning. Distance education teachers will focus on building and maintaining relationships and on designing, implementing and continuously improving learning processes.

Distance education teachers will have greater scope to customise programs for individual learners, selecting and, if needed, adapting high quality self-instructional materials. The capacity of teachers to do this will hinge upon each teacher understanding the learning needs and characteristics of their students.

Programs such as DELTA and Videoconferencing Telematics have established that real-time interaction is a high priority when developing distance education programs. The Open University has found that:

> *courses which are delivered primarily through one medium – say asynchronous computer conferencing – tend to have a falling off of participation. Asynchronous text messaging is a very flexible learning medium for fitting into busy schedules, and encourages reflection and writing skills in the language of the discipline. But it is less powerful than real-time interaction as a means of motivating participants and maintaining commitment to completing the course. (Mason, OTD No. 11)*

Experience in Victoria indicates that few students in rural locations will travel to the city for face-to-face sessions.

The Videoconferencing Telematics Program highlights the potential benefit of cluster-supported distance education programs. That program also demonstrates the feasibility of classroom teachers supporting distance learners through a third generation Telelearning model.

Consideration should be given to the development of a network of local school-based clusters to provide learner support.

7 (m) Recommendation

That the RTG investigates:

◆models for distributed, cluster-based program delivery and support with students 'virtually' integrated into the programs of local or, in some instances, distant schools

◆the feasibility of schools becoming local distance education delivery centres if they have the capacity to accept further enrolments
◆options for the provision of technical and library services for distance education students
◆structures to provide teachers, para-professionals and parents responsible for supporting student learning with ongoing support and access to expertise.

7.5 Coordination And Administration

This CABTER project is a key step in identifying and creating a preferred future for distance education in Thailand. If that future is to come to fruition, a strategic plan is required, based on an assessment of current distance education provision, and a vision of Thai distance education in the early 21st century.

- A crucial element of the strategic plan will be the design and implementation of structures to:
- support the investigation, design, implementation and continuous improvement of the selected distance education models
- identify, evaluate and capitalise upon emerging technologies and teaching and learning models to maximise educational benefits to Thailand's distance learners.

7 (n) Recommendation

That the RTG develops a strategic plan for distance education in Thailand that would produce a coordinated national management and support structure for distance education, with a charter to best utilise technology and distance education techniques to provide the most effective, most efficiently delivered distance learning within available budget.

7 (o) Recommendation

That key functions of that management and support structure include:

- **coordinating the effective design, development and implementation of programs for active distance learning**
- **leadership in distance education and flexible delivery**
- **distance education planning and resource management**
- **managing and maintaining technical infrastructure for distance education and flexible delivery**
- **improving access for all distance education students**
- **providing effective and efficient administrative systems and services**
- **supporting the needs of learners**
- **evaluation for continuous improvement**

7.6 Online Learning Facilities

Extensive use will be made of online learning under the *TLT 2010 Masterplan*. Large institutions will be able to provide facilities to deliver course materials and manage groups of online learners. There should, however, be a facility that allows small

institutions and individuals capable of producing high quality materials to deliver the courses, without incurring the operating overheads of the learning management system.

It will be invaluable to have a centrally provided course delivery system available to those delivering the *TLT 2010 Masterplan* associated programs. The system should comply with emerging standards for learning object metadata and content packaging (eg IMS) to optimise the capacity for sharing content and student information between systems, and to facilitate content migration in the event of a system upgrade or replacement.

7 (p)Recommendation

That the RTG establishes an e-learning (online delivery and learning management system) facility for use by providers of education and training.

8 Access To High Quality Digital Learning Tools And Materials

During the implementation of TLT 2010, students and teachers will utilise a wide range of digital learning tools and materials, including software applications, online courses, reference materials and programs delivered via television and radio.

Some of these are currently in existence and some are yet to be created. Some will be 'off the shelf' products while others will be created specifically for Thai education.

Regardless of origin and mode of delivery format, it is important that all content sponsored under the program:

- is consistent with the vision goals, promoting student-centred learning, broadening the scope of the educational experience
- supports achievement of student learning targets and teacher development goals at each level of education
- provides an appropriate balance between content in the Thai language and in content from other cultures
- is delivered in a format that maximises accessibility to the target audience
- is designed to minimise the need for specialised training and support

To ensure that the needs of individual students in different learning situations are met it is important that a wide range of software and information sources is available. Selection and procurement processes should be designed, both to ensure access to an appropriate variety of digital media and ensure that costs are minimised through the use of free content and through bulk purchase arrangements.

Where possible, the development and supply of digital learning materials should be facilitated in a fashion that stimulates the development of the local industry.

8.1.1 Quality And Suitability Of Digital Tools And Materials

Digital tools and materials used in the Thai education and training system should be selected to support the objectives of the education reforms, and made available to learners and teachers in such a way that the most appropriate resources are easily identified and accessed.

8.1.2 Supporting Student-Centred Learning

Guidelines have been developed by the Victorian Government to assist teachers in the selection of digital learning resources and to assist multimedia developers in the design of high value educational multimedia products (*More than a Game - Exploring Educational Multimedia for Educators and Designers* 1999, Department of Education, Victoria, Australia and Multimedia Victoria. Available at http://www.sofweb.vic.edu.au/lt/sweval/mtag.htm).

The guidelines recognise that students will make use of information resources, authoring tools, knowledge construction and knowledge reinforcement tools, and that

to support active, student-centred learning, multimedia applications must encourage students to engage, interact and think.

A list of associated learning qualities and keywords is provided, which together provide the basis for evaluating digital media and applications from the perspective of supporting student-centred approaches to learning and teaching.

Combined with criteria reflecting other values and priorities embodied in the Education Act these should assist in the selection of content to support the improved learning outcomes associated with the education reform.

8.1.3 Supporting Resource Based Learning

In order to support models of learning that encourage students to conduct open-ended investigations, it is necessary to make a wide range of resources available. Such approaches are not readily supported when learning resources are restricted to textbooks and limited library resources.

To achieve the goals of the Thai education reforms it will be necessary to provide greatly expanded access to information resources and information gathering techniques. Digital resources such as databases on CD-ROM and online information accessed via the Internet provide unprecedented access to information and will be central to achievement of the reform goals.

Technology-assisted measurement and data recording, combined with data communication and analysis techniques, will help students learn about the natural and social world and develop transferable skills that will be of value both in the workforce and in civilian life.

Quality assurance processes should be applied in the selection of information resources for Thai education, to ensure that suitable materials covering all areas of learning is readily available.

CD-ROM resources should be selected or developed to reflect Thai culture and values, as well as supporting learning about other cultures. These will include standard commercial products such as encyclopaedias, subject and program specific resource bases.

8.1.4 Supporting Curriculum Standards

Technology can play a significant role in the supporting the implementation of new curriculum structures and standards. Through electronic labelling of digital documents, implemented through the use of 'metadata' stored within Office documents (eg word processor files and spreadsheets) and web pages, resources can be retrieved that meet specific curriculum requirements.

Quality assurance processes can be designed to check learning materials for consistency with the reform priorities, and also apply metadata labels.

Examples of systems that exemplify this approach are provided by the Victorian Education Channel (www.education.vic.gov.au) and curriculum@work (www.eduweb.vic.gov.au/curriculumatwork)

This model can be extended to include the sharing of effective teaching strategies and materials that support the reforms. One successful system that performs this role is the IdeaBank, operated by the Victorian Department of Education Employment and Training.

8.1.5 Suitability For Student Use

Quality assurance criteria are of special importance in the selection of content accessed through the worldwide web, in order to optimise access to materials suited to a particular purpose, as well as to minimise exposure to material that is unsuitable for students.

Experience in Australia has shown that the quality criteria developed for the EdNA Online service provide a practical framework for content selection, which is applicable not only to online content but also to software and TV programs.

8 (a) Recommendation

That quality standards are established for the selection and design of digital learning materials to maximise effectiveness and suitability.

8.2 Online Information And Curriculum Applications

Online information and services have many advantages in education and training compared to physical learning media and will play a key role in supporting the education reforms. Benefits include:

- resources and services are readily published and updated
- new information is instantly accessible from any location
- access can be restricted to individuals or groups if required
- information can be accessed on a wide range of computers
- integrated support for groups of dispersed teachers and learners including discussion groups and knowledge sharing
- gathering and sharing of information from dispersed learners and teachers eg collection of research data, sharing of examples of effective teaching practice, surveying public opinion
- online transactions including conferences registration, job applications and course enrolments, tender applications.

The resources and services available online encompass information about education, reference materials and applications to support the learning process, and interactive services that enable stakeholders in any location to enquire about and become involved with the education and training system.

Even when learners do not have frequent personal access to the Internet, they may receive benefits from the Royal Thai Government’s online strategy as a result of

improved teachers' skills resulting from online professional development activities, or from the distribution of updated teaching materials through a shared Internet terminal in the school, village or district.

In many cases, electronic resources developed for distribution via the web can also be made available on CD-ROM and diskette. This increases the access to materials in areas where Internet connectivity is limited.

8.3 Establishment of the Thailand Education and Training Gateway and Virtual Resource Centre

The potential of the Internet to support the education reforms will be multiplied if there is a single, well-publicised location on the web where all members of the community can obtain relevant information about education and training. A suitable name might be 'The Thailand Education and Training Gateway'.

8.3.1 Thailand Education and Training Gateway

The Gateway would provide access to:

- information about education and training, including descriptions policies for parents in Thai and other appropriate languages
- information about courses and careers
- high quality reference materials for students and teachers
- access to online courses
- professional development opportunities for education staff
- links to other key websites.

This would consist of a website with the following facilities:

- publishing services available to the key agencies, including remote, template based authoring and content approval
- capacity to present information Thai and appropriate other languages
- quality assurance and content management services to ensure currency and accuracy of published information
- interactive services, including discussion groups and mailing lists
- supports and promotes international content and interoperability standards (eg metadata, accessibility, content packaging)
- capacity to support multiple web domains (ie more than one web address) from a single online service delivery unit.
- high bandwidth connection to the Internet and high security firewall

The Gateway would provide a publishing platform for use by key agencies and affiliated organisations, through centrally delivered and devolved publishing services.

By conforming to established and emerging content standards, the Gateway would facilitate the exchange of online content with other education gateways and content development initiatives in Thailand and overseas.

It would also support the hosting of outsourced content within centrally determined guidelines, and provide content indexing of selected externally hosted sites to support searching across multiple websites.

This will facilitate the provision of a high quality and scalable Gateway service to meet the needs of all stakeholders in the education and training community into the foreseeable future. The Gateway is likely to become a key element in the e-Thailand strategy.

8 (b) Recommendation

That the Thai Education and Training Gateway website is established to provide a single entry point to online information and services associated with education and training, to provide a publishing platform for key stakeholders in the reform and to facilitate the interchange of online materials.

There are many examples of learning gateways from countries around the world. The SOFWeb site (www.sofweb.vic.edu) which was established in 1995 to assist schools Victoria, Australia with the implementation of major education reforms, including the roll-out of learning technologies, is the most heavily used education reference website in Australia.

In addition to providing a publishing platform, the Gateway would also act as a collection point for links to high quality third party resources available online, creating a 'Virtual Resource Centre'.

8.3.2 Thailand Virtual Resource Centre

The establishment of a 'virtual resource centre', providing access to quality assured websites that support teaching and learning, will play a major role in the implementation of the reforms. It will be of particular importance in locations where access to the Internet is limited, as it will ensure that users quickly locate high quality materials.

Two examples that may provide suitable models for Thailand are the Victorian Education Channel (www.education.vic.gov.au), operated by the Victorian Department of Education, Employment and Training, and EdNA Online (www.edna.edu.au), a service owned and operated jointly by the State, Territory and Commonwealth governments in Australia.

The Victorian Education Channel provides a leading example of the way in which a government agency can provide access to selected Internet resources to meet specific education and training needs, facilitating partnerships with other content providers such as museums, galleries, research institutes and newspapers. The Channel also makes use of metadata to assist students and teachers to quickly locate resources linked to particular topics and areas of the curriculum.

The Channel also acts as the main education and training portal for use by the general public, providing advice to parents and adult learners, thereby acting as a key delivery mechanism for the State’s government online program.

EdNA Online, provides an good example of the way in which organisations, in this case state education agencies and universities, can work together to provide a single, nationally focused database of quality assured education and training resources.

By linking services such as the Victorian Education Channel and other State and sector-based online resource directories to EdNA Online, it has been possible to build a web-based 'knowledge infrastructure' that harnesses local and sectoral initiatives to provide a major shared resource.

8 (c) Recommendation

That a virtual resource centre for Thai education and training is established.

8.4 Provision of learning materials in the Thai language

Learning materials authored in English, as well as other foreign languages, will of great value to students and teachers in Thailand, not only because of their intrinsic educational value, but also because of the opportunity presented to practice foreign language skills. It is essential, however, that extensive core educational materials be available in the Thai language and reflect Thai values.

The creation of digital materials in Thai is straightforward and it is assumed that new materials produced for the education reforms will be developed in Thai. Where possible, however, materials should be developed in a fashion that readily enables translation into other languages. This will facilitate collaboration with international partners and create opportunities for the delivery of locally developed materials into other markets.

The capacity to easily produce content in different languages, and include multiple languages in the same document requires some specialised technology, such as storage of data in Unicode format rather than ASCII, and specialised expertise with document design and development. It will be advantageous, therefore, to establish a special interest group to pool expertise in multi-language e-publishing involving staff involved in the Thai Education and Training Gateway as well as staff from universities and the private sector involved in developing educational content for Thailand.

It will also be desirable to establish models and facilities for repurposing content in authored in foreign languages for use in Thailand. This approach will be particularly appropriate for content that employs graphical and interactive elements that are essentially text free. Thai materials developed using such a model could also be translated into other languages, providing a basis for content sharing and revenue generation.

8 (d) Recommendation

That capacity is developed in the production of multi-language online materials and in the repurposing to foreign language materials for use in Thailand.

8.4.1 Effective And Safe Use Of The Lnternet

While the provision of online catalogues of quality assured resources will greatly assist students and teachers in gaining value students and teachers should also develop skills in the use of the Internet search engines and other online information discovery services. This way they can access valuable resources not included in the Virtual Resource Centre. Resources considered to be of high educational value should be submitted to the digital resource centre for evaluation and possible inclusion.

By providing online catalogues of high quality education resources, employing filtering on the schools Internet service, and by promoting the use of Internet 'Acceptable Use' policies in schools, the problem of exposure to unsuitable Internet content in schools can be reduced to a negligible level.

8.5 Collaboration With Cultural And Scientific Organisations

Learners and teachers in all sectors of education and training will benefit greatly from having improved access to knowledge and expertise that resides in Thailand’s scientific and cultural organisations (including religious organisations). These organisations house precious knowledge assets that will be of great value as resources for teaching and learning, supporting in particular the model of student-centred, resource-based learning.

These organisations are also centres of knowledge discovery that can play a key role in assisting students and teachers to learn about the process of scientific and historical research. Where possible, it will be valuable to create opportunities for students and teachers in conducting research and curatorial activities, providing an authentic learning experience for students and valuable professional development for teachers.

The main method of improving access to cultural and scientific organisations is via the worldwide web. Through the establishment of a website, an organisation is able to makes its knowledge assets available in every part of Thailand. Students are readily able to locate information and images not available in textbooks and libraries to assist with projects and assignments.

It will also be possible for students and teachers to interact with scientists and professional staff where appropriate. The model of 'expert online', in which a scientist or other specialist researcher answers questions from students and teachers for a specified period of time via email or web forum has proven extremely valuable in helping students acquire knowledge that is not available in textbooks and also for promoting the sponsoring institution.

Many museums in Australia and other countries have established a substantial online presence, and in many cases developed online resources specifically for students and teachers. It is generally believed that in addition to attracting the 'virtual visitors', the establishment of websites leads to increased numbers of physical visitors to institutions such as museums, galleries and historical sites.

It is assumed that the majority of the web content will be in the Thai language. Where appropriate, content should also be available in other languages. This will assist in the

promotion of Thai culture in other countries, providing support for international scholarship and the tourism.

In order to facilitate the establishment of websites for cultural and scientific organisations, consideration should be given to making available web publishing services associated with the proposed Education and Training Gateway.

8 (e) Recommendation

That knowledge from Thailand's cultural and scientific organisations is made available via the worldwide web for the benefit of students, teachers and the general public for educational purposes, and also for the purpose of promoting Thai culture in other countries.

8.6 Knowledge Sharing Systems

During any period of change, it is important to have access to new ideas, the results of research and examples of practices that have proven successful in the field. Traditional mechanisms for sharing such knowledge, while valuable, tend be inefficient because of the time taken to locate, publish and effectively disseminate information. The Internet provides two main mechanisms for the rapid dissemination of new knowledge.

8.6.1 Online Discussion Groups And Web Forums

Online discussion groups based on email (listservers) and on web-accessible forums (eg web board) have proved highly successful in supporting disperse communities of teachers, administrators and policymakers who are engaged in systemic change. E-mail-based discussions have the benefit that new messages are delivered directly to participants who can read and respond at their convenience. Web-based discussions are useful when participants do not have personal email accounts and when it is beneficial to have all contributions viewable as a chronological archive.

It should be noted, however, that such discussions cannot be assured of success simply by decree. Online discussions, like face-to-face discussions depend on a participants having a common purpose, and personal motivation to communicate.

Online discussions benefit from and typically require the involvement of a skilled moderator who is able to stimulate discussion, invite contributions from external experts and, under some circumstances, provide quality assurance over the contributions made to the discussion.

Online discussions can be:

- Open – allowing contributions from anybody with email or web access
- Closed – restricted to a selected group of discussants
- Moderated – a moderator in an open or closed discussion checks contributions for suitability before posting to the group.

Online discussions often prove useful to support the work of groups engaged on long term projects such as the development and trialling of curriculum materials who are able to meet infrequently.

8 (f) Recommendation

That online discussion groups are used to facilitate public discussion of issues associated with implementation of the reforms, and the work of teams engaged in long projects.

8.6.2 Structured Knowledge Sharing System

Knowledge can also be shared through a system that provides organising structures allows for automated quality assurance. For example, the IdeaBank (www.sofweb.vic.edu.au/ideabank) which was developed in Victoria, Australia, facilitates that sharing of teaching ideas and lesson plans that support that State's Curriculum and Standards Framework.

Teachers or curriculum support staff in any location can submit an idea or lesson plan to the IdeaBank, using a guided process to link their submission to the Curriculum and Standards Framework and any other priority programs such as indigenous education or science enhancement. Content specialists can then check the submission through a special editing and approval interface.

Once approved, the submission, becomes available to all teachers via the Internet, using the IdeaBank or virtual resource centre interface, searching either by keyword or by navigating through menus reflecting the Curriculum and Standards Framework.

This model of knowledge sharing (www.eduweb.vic.gov.au/curriculuatwork), which is extended in Victoria to support the mainstream delivery of curriculum support has potential to support a wide range of knowledge sharing and knowledge building activities associated with curriculum and structural reform.

8 (g) Recommendation

That an online knowledge exchange is established to facilitate knowledge sharing and building to support implementation of the education reforms.

8.7 Distributing Content For System Wide Use

Because of their reliability and low cost of production, CD-ROMs have become a valuable means of distributing text documents and rich multimedia materials such as those including extensive graphics and video as well as software. Where possible new materials developed to assist the education reform should be produced in a digital format suitable for storage on CD-ROM.

Ideally, materials will be developed in a format suitable for distribution both via the worldwide web and on CD-ROM. In this way, materials can be made available instantly to all parts of Thailand via the Internet, and also be accessible from CD-ROM in areas where the Internet is not yet available or where bandwidth intensive materials such as video are used. This is simply achieved by designing materials to be

viewed through a web browser, rather than through a custom-designed multimedia interface.

8.8 Collaborative Online Learning Activities

The benefits of networked online learning activities to support student-centred learning, broadening of curriculum and teacher development are outlined in the review section of this report. The potential of such activities to facilitate change in the classroom culture even with limited access to technology is highlighted elsewhere in this section.

It is proposed, therefore, that the establishment of a program of networked learning activities be instigated as a strategic initiative. The program would support the development of Thai language projects, but also establish links to selected projects in other languages.

The project would be designed to build a network of teachers in schools across Thailand who will lead and moderate online learning activities. Based on experience elsewhere, these teachers are likely to play a key role in facilitating change in teaching and learning through the use of technology, providing support and professional development network to colleagues across the country.

Consideration should be given to involving existing online teacher networks in the initiatives. For example, the International Education and Resource Network (www.iearn.org) and the Global Classroom Project in Victoria (www.sofweb.vic.edu.au/gc) have already established links with schools in Thailand.

The name 'Global Classroom' is suggested because of the strong association with learning extending beyond the classroom. The name could be reflected in a related facility for teachers: the 'Global Staffroom'.

8 (h) Recommendation

That a program of networked learning activities for students and associated support for teachers is established.

8.9 Procurement Of Software Applications

Much of the software that will be used in Thai schools, including authoring tools, knowledge construction tools and knowledge reinforcement tools will be available from commercial suppliers. Procurement processes need to be established to guarantee that teachers and learners have access to software that supports the goals of TLT 2010 and represents good value.

There are two main approaches to purchasing software for school use: centralised purchasing and provider purchasing, each with benefits. The best solution for Thailand will probably involve a combination of the two.

8.9.1 Central Purchase Of Software

Central purchasing through system-wide licensing or bulk purchase of software is often used to achieve the lowest pricing on software. The aggregated demand from an entire education system naturally leads to savings for both the supplier and the purchaser. Central licensing has particular benefits because it can reduce the need for decision making and expenditure at the school and college level.

The main risk associated with central purchasing is that, unless software purchased meets the precise needs of learners and teachers, the value of the purchase is lost. Care must also be taken to ensure that the centrally purchased product continues to represent quality and value.

The strongest case for central purchasing usually relates to base products such as office software and authoring products for which uptake by teachers and learners can be predicted. Licensing arrangements should be designed to encourage use of technology. For example, licenses or special pricing negotiated for school use of some products might also be extended to teachers and learners for use at home. Although there may be some risk of license abuse, suppliers should be encouraged to view the total benefit that can be derived from licensing arrangements, which include a substantial increase in net sales and advances in product awareness and loyalty.

Central licensing and purchase can also be used to achieve customisation of the product or the distribution mechanism which would not be possible using direct purchase by education providers.

Considering the high cost and significant risk, it is important to employ a transparent procurement process reflecting the principles outlined for hardware purchase and including a selection process that adequately assesses the educational value of products to providers, students and teachers.

It should be noted that some products worthy of consideration may be available at little or no cost to the system (eg shareware or freeware). In such cases, it will be important to consider not only purchase cost but also costs associated with compatibility and support of the low cost product compared with fully standard commercial products. The comparison of Microsoft Office and Star Office is one such example.

8.9.2 Provider Purchase

The opposite approach to centralised purchase is the direct school purchase model in which schools and colleges exercise full control over the selection and purchase of software. This approach maximises the choice of software available but generally results in high prices because there is reduced opportunity to achieve economies of scale, and lack of uniformity in the software used across the system, possibly leading to increased training and support costs. This model also assumes that schools and colleges have funds available to purchase software.

Although there are many thousands of educational software titles available, most schools and school systems find that the greatest educational value is derived from a relatively small number of software applications. Many schools find, for example, that

most ICT skills development and creative learning tasks can be carried out using a basic set of office software (word processor, spreadsheet, database, presentation package) and authoring tools (graphics package, multimedia authoring software).

8.9.3 A Model For Thailand

It is likely that the best software procurement model for Thailand will involve a combination of the centralised and provider based model. There is potential to create major savings and give a strong message to the community about the Royal Thai Government's support for the ICT in education by arranging centralised purchase of base software. At the same time, education and training providers need flexibility to select software products that meet specific local needs.

A hybrid model which delivers some of the benefits from both the central and provider purchase models is one in which products tendered by vendors are assessed for suitability and subject to quality approval as well measurable demand in schools. Preferential pricing is negotiated. The results of this process are published on a website. This published list becomes in effect a list of recommended software available at substantially reduced prices. The decision to purchase remains with the school and there is minimal risk of unused licenses. All purchasing of software should be consistent with the procurement model outlined above.

8.9.4 Software Evaluation and Development

Many school systems routinely conduct evaluations of new software products as they are released onto the market. This is a costly process and may not meet the needs of users in schools. In many cases, effort is wasted on evaluating products of questionable educational value. A preferred method is to conduct field evaluations using a panel of schools and other providers with demonstrated expertise, for instance the lead schools involved in the TLT 2010 initiative.

Schools would typically receive free copies of the software and perhaps a grant to support time release that would allow teachers to properly conduct and document evaluations. In this way it is possible, not only to gather an assessment of the educationally soundness of the product, but also information about use of the product in the field.

8 (i) Recommendation

That a model of software development be established that:
- **promotes the creation of high quality Thai language digital learning materials**
- **employs user centred design and extensive user testing**
- **takes advantage of software development capacity of schools, universities and the local software industry**
- **seeks opportunities to repurpose and resell into other markets .**

8.10 Software development

Software and content produced under the TLT 2010 master plan should support the goals of the education reform, and comply with the content suitability and

pedagogical standards described above. In addition it should meet appropriate international technical standards.

In particular, content intended online delivery should comply with:

- W3C standards for content accessibility on the world wide web – this ensures that content is able to be accessed by people with visual and motor impairment (see http://www.w3.org/WAI/ and http://www.edna.edu.au/edna/publish/system/edures/access_guidelines/access_guidelines.html)
- Privacy regulations – many Governments have ratified privacy or data security legislation that guarantees citizens of privacy when submitting information to online systems.
- Discoverability guidelines – many governments, education systems and major digital libraries around the world have adopted the Dublin Core metadata standard. This provides a systematic labelling scheme for online content, making it easier to locate relevant information over the Internet.
- Emerging standards regarding the packaging and delivery of instructional materials over the Internet – the Instructional Management System (IMS) (see http://www.imsglobal.org/) is the most widely adopted to date.

Interoperability standards agreed with partner organisations – Australia's Schools Online Curriculum Content Initiative that is producing a wide range of online learning materials that would potentially be of value in Thailand is establishing a set of technical standards, consistent with those mentioned above, which, if adopted for Thai content would enable exchange of online materials (http://socci.edna.edu.au/). The SOCCI standards are based on the Dublin Core and IMS standards.

8 (j) Recommendation

That a set of technical standards for the production of educational software and online content is developed and enforced.

8.11 Television and radio programming

The benefits and limitations of education television are now well known.

Experience in China dating back to the late 1980s has demonstrated that educational television can be used for the effective delivery of university courses, for assisting teachers in remote areas to gain and upgrade their qualifications, as well as for the delivery of training programs on farming skills, health, child welfare, health, and environment protection (Chunjie, X and Z Yuxia 1994, *Satellite Television Education in China: A Project of Teacher Training through Distance Education*; *Media and Technology for Human Resource Development* 7 (2): 113–17, Yuhui, Zhao 1988, 'China: Its Distance Higher-Education System'. *Prospects* 18(2): 217–28, also http://www1.worldbank.org/disted/Technology/broadcast/broad_television.html)

At the same time, significant pitfalls have been identified, including the difficulty in creating a suitably interactive learning environment and in providing access to multiple classes and programs in real time, as well as the challenge of producing

materials that will be equally applicable in urban and rural areas (Chaudhary, Sohanvir S 1992, 'Television in Distance Education: The Indian Scene' in *Indian Journal of Open Learning* 1(1): 23-31, also http://www1.worldbank.org/disted/Technology/broadcast/tv-03.html).

In Australia, as in other countries, there has also been an observable 'life cycle' in the educational television programming. Some programs, for example, are launched in order to provide students with access to lessons in subjects for which there is an acute shortage of teachers or teaching skills. The value of television delivery may diminish over time as the effect of teacher training and professional development programs has an impact in the field. Typically, other priority programs emerge and new programs are produced.

In Victoria, Australia, for example, priority programs in foreign language learning (http://www.sofweb.vic.edu.au/lem/lote/lpals.htm) and primary school science (http://www.sofweb.vic.edu.au/steps/) were initially delivered as live programs via satellite, but have progressively migrated to other formats such as CD-ROM and VHS cassette. Interactive online learning activities now complement the prepared materials.

Thai educators will be able benefit from local and international experience in making strategic use of educational television in supporting the education reforms. The next generation of education television in Thailand should also benefit from the following technological advances.

- low cost video production facilities and expanded telecommunication infrastructure, enabling local production in most parts of the country with ready access to satellite uplink facilities
- the ability to use high quality videoconferencing linked to the TV infrastructure to further extend the interactivity and local flavour of programming
- increase flexibility of delivery by utilising Internet-based alternative delivery mechanisms such as video streaming and video on demand
- increased flexibility in viewing by using computer networks for video reticulation and use new recording technologies (eg Sony TiVo) that selectively capture programs for off-line viewing
- new services that will be available with the introduction of fully digital television, such as data-casting, interactive television and Internet TV.

8 (k) Recommendation

That in developing educational television programs the RTG:

◆target programs to meet strategic needs such as teacher shortage, professional development and program delivery into remote areas
◆encourage local production of programs and local input into central productions to maximise appropriateness and ownership of content
◆repackage and distribute programs in other formats (eg CD-ROM, video cassette, Internet) to optimise access and meet changing needs

◆optimise interaction amongst teachers and learners using new technology (eg email, discussion groups, Internet chat sessions)
◆support programs with digital interactive learning materials as well as print materials and distribute via the Internet
◆use the educational television infrastructure for non-formal and informal education as well as formal education
◆investigate use of new technology to optimise flexibility in delivery and viewing of programs.

Radio has been used in education for many years and is still the most accessible technology in terms of cost and comprehension. It can be used for school broadcasts, in-service teacher support and training, and adult literacy and basic education campaigns.

In combination with tutorials, print materials, local listening groups, and face-to-face meetings, radio has been used in many countries to teach a wide range of subjects at the school and college level. Universities in Thailand as well as Britain, Indonesia and Spain use radio in many of their distance education courses. Programs can be easily recorded and replayed and reused if required.

Radio also has the advantage over other distance learning technologies of requiring minimal electrical current. Through use of solar-powered and wind-up receivers, educational programs can be received even in remote areas with minimal recurrent cost.

Because radio programs can be received on low cost equipment in a wide range of settings, and while undertaking other tasks, radio programming is able to contribute significantly to promoting a culture of lifelong learning.

Review articles compiled by the World Bank are available at:
http://www1.worldbank.org/disted/Technology/broadcast/broad_radio.html

8 (l) Recommendation

That radio continues to be used for educational delivery, particularly for non-formal and informal education and in remote areas with limited technical infrastructure.

In addition to using dedicated educational radio and television services transmissions, consideration should also be given to the use of domestic broadcast services to extend program coverage. Broadcast services operated by the Australian Broadcasting Corporation (the national broadcaster) are used to deliver courses provided by Open Learning Australia. This would be particularly beneficial in the case of programs aimed at the general public and in areas without access to the special reception equipment required for the existing educational television.

It is likely that existing public and private broadcast systems have capacity to deliver educational programming at little or no cost to the Royal Thai Government, for example late at night and early in the morning. Programs transmitted at these times can be recorded and viewed at the learner's convenience. A program of educational

television using domestic services would also send a strong message to the community about the importance of lifelong learning and Thailand's education reforms in general.

8 (m) Recommendation

That broadcast radio and television services is used to deliver educational programs, particularly those targeted at members of the general public.

8.12 Instructional Design – Need For Research And Expertise

There is a broad range of models of instructional design that apply to learning environments that contain ICTs. Models include Computer-supported Collaborative Learning, Computer-supported Intentional Learning Environments, Discovery Learning, Generative Learning, Problem-based Learning, Situated Cognition, Goal-based Scenarios, and Information Processing. Although consideration of each model is beyond the scope of this document, a summary is available at The School of Education at the University of Denver: <http://carbon.cudenver.edu/~mryder/itc_data/idmodels.html>

Key aspects of instructional design include the design of multimedia and other ICT materials for learning purposes, and the design of learning experiences. In relation to the former, Multimedia Victoria and the Victorian Department of Education (1999) produced a report that summarises key dimensions of good instructional design of ICT materials for schools. The purposes of that report were to provide information to the multimedia industry to assist companies to develop appropriate materials, and to provide schools with information that would assist learning materials selection.

In relation to the design of learning experiences that teachers would design for learners, the Victorian Department of Education commissioned the development of research summaries that outlined key aspects of learning experiences with technology that would have most impact on enhancing learning in each key learning area. Those summaries are available at: <http://www.sofweb.vic.edu.au/lt/integr.htm>

8.13 Supporting The Management And Improvement Of Learning In Schools

There is significant scope for using technology to assist in the management of learning. Many of the software applications rely, however, on teachers having a high level of access to computers. It is unlikely, therefore, that in the foreseeable future computers will be widely used to closely plan and manage student learning. Information and communications technologies will play a major role in supporting the education reforms, however, particularly in supporting of new, data intensive quality assurance processes designed to support improvement in educational outcomes.

8.13.1 A School Management Information System (SMIS) For Thailand - Supporting School Quality Assurance

Considering that all schools are required by law to undertake internal quality assurance by self-evaluation each year, that the progress of every school will reviewed at least every three years by the school district, and that all schools undergo an external review requiring scrutiny of internal evaluations every five years, there is a strong case for using a computer application to assist in the data compilation and reporting of school performance data.

In addition, the storage and analysis of external evaluations, 50,000 in total, with 10,000 being conducted each year, will require a system with a high degree of reliability and security.

Ideally, the quality assurance process would begin with the entry of data into a computer at every school, produce reports that would be accessible to the District office via a data link, and then compiled into review reports as required. Presumably, the same system could be used to facilitate reporting to parents and the local community.

The review reports would then be prepared and transferred online to a secure, central server where they would be viewable by school staff, reviewers, staff at the Office of Educational Standards and Review, and others as deemed appropriate.

In reality it will be some time before all schools are suitably equipped with computers and network connections. It will be necessary, therefore, to operate parallel systems, allowing also for school-based computerised operation with disk-based transfer of information, as well as use of paper forms in the short to medium term.

The Ministry of Education has commissioned the development of a schools Management Information System (SMIS) designed to store information on student enrolment, student health, and student grades. There is a requirement also to include information relating to the national indicators and standards associate with the new curriculum designs. Some reports indicate, however, that the current design is apparently not appropriate for use by all schools.

In order to support the quality assurance process and the management of related data, it will be necessary to review the current SMIS and produce a design that will support end to end data management and guarantee a high degree of data integrity and security. Given that the options for delivering an SMIS span a range of possible models, including school-based systems with minimal data transfer to central servers, to client-server and web-based systems, design work should focus on developing a data model and transfer protocols to support core functionality which could be implemented using a range of different systems.

Once in place, the SMIS will provide opportunities to develop further administrative and management tools, based on the existence of reliable databases of information pertaining to students, teachers and schools. Some school systems provide administrative packages extensive functionality to support business processes associated with data gathering, school organisation (ie timetabling) and communication into the school administration package.

Furthermore, schools are likely to require differing levels of functionality associated with the SMIS. For example, schools may wish to link financial transactions to students and other entities represented in the SMIS, taking advantage of a single database of student information.

8 (n) Recommendation

That a review is conducted of the Schools Management Information System and that a model is developed allowing for immediate support for internal and external quality assurance processes in schools, and for progressive introduction of support for further management and administrative functions in schools and the school system.

9 Professional Development

9.1 Program Principles

Rapidly evolving technology provides an ever-increasing array of educational and administrative opportunities. If schools are to optimise the benefit of their technology investment then they will need to identify, and periodically revise, clear objectives for technology use. Furthermore, teachers, school leaders, and those who support them will need to develop and continuously upgrade their knowledge, understanding and skills.

School systems which are most effective in implementing learning technologies have multiple and complementary professional development strategies, and support both top-down and bottom-up development. The suite of Learning Technology professional development programs proposed is designed to provide diverse programs, catering for the range of existing and emerging concerns and stages of learning technology adoption of teachers and school leaders, and support both whole school (principal led) and classroom level implementation of technology.

Learning technologies professional development programs should:

- identify and build upon leading practice in Thailand's schools;
- draw extensively upon worldwide best practice; and
- be expandable as the demand for services increases.

Even though knowledge is the lifeblood of schools, many schools lack mechanisms to ensure transfer of important knowledge and skills between teachers. In fact, in some schools there may be a culture of teachers protecting their own materials and ideas. If schools are to best serve students, then it is important to build a culture of teachers assisting and, at times, teaching other teachers.

Learning technology professional development programs will be staged as follows:

9.1.1 Stage 1 – Reaching the Early Adopters

It is acknowledged that the first years programs will generally only reach the early adopters, and therefore program participation should initially be elective. This is because of limited resources, the need to establish and refine foundation programs, and because only some teachers, leaders and schools will initially be ready to consider learning technology implementation.

9.1.2 Stage 2 – Mainstreaming Learning Technology Adoption

Research by the US Congress Office of Technology Assessment revealed that:

> *There is abundant evidence that 'one-shot' or short duration training programs have little impact. Teachers need time to learn, plan, try things out, reflect on their successes and failures, revise and try again. This takes time - months, if*

not years.

Follow-up support and coaching after the initial experience are essential to effective staff development … During teachers' initial efforts to integrate technology into the classroom it helps a great deal to have support immediately and continuously available.

9.1.3 Purposes

The professional development programs recommended in this paper are designed to:

- build a strong network of computer using teachers
- provide a diverse array of programs, catering for the range of teachers' concerns and stages of adoption of technology;
- provide ongoing professional development for all staff;
- encourage, support and reward innovation and dissemination of effective practices; and
- support both whole of school and classroom-based implementation of technology.

The programs aim to provide sustained professional development opportunities that will provide stimulation, support and a sense of common direction for teachers learning about computers and which will build a culture of mutual support and collegial learning.

9.1.4 Practicum-Based Professional Development

Practicum-based professional development programs can change classroom practice, if certain conditions are met. Teachers can be facilitated to adopt technology in teaching if they can experience working in classrooms in which the desired teaching practices are being used, and if they are supported to adopt those practices when they return to their own schools and classrooms. Teachers need to understand how to incorporate technology into their classrooms – including classroom management. The Navigator School practicum model, which is based on the ACOT Teacher Development Center model, is an effective way of bringing about desired classroom practices using technology.

9 (a) Recommendation

That the RTG supports the Navigator schools to develop learning technology plans which can be used to guide the development of learning technology plans in other Thai schools.

9 (b) Recommendation

That the RTG undertakes the development of the following materials and programs in order to support other schools in developing learning technology plans:

- **a guide to the key resources available to assist with each of the stages in developing and implementing a learning technologies plan**
- **links to online collegiate support via discussion groups**
- **print and online materials to assist schools to develop learning technology plans**
- **professional development programs to assist schools in learning technology planning**
- **learning echnology district support officers.**

9 (c) Recommendation

That professional development is provided to assist schools to plan and implement LANs.

9 (d) Recommendation

That LAN guidance and professional development is based, inter alia, on the experience of Thailand's Navigators.

10 Organisational Structures

10.1 Central Co-ordination

Rather than establishing a single discrete entity for learning technologies, it is recommended that appropriate units be put in place to lead learning technology programs within schools and vocational education and lifelong learning sectors, and that coordination and knowledge transfer between those units be achieved through appropriate line management structures and oversight of those areas by a Director within the Office of the General Secretary.

Efficient and effective implementation of learning technologies within and across the sectors presents interrelated sets of distinct tasks, with inherently different characteristics, and requiring different skills and leaders. There is a need for:

- Leadership and management of programs to develop corporate and Basic Education Institution and Vocational Education Sector ICT infrastructure, Applications and Information Management;
- Program and project leadership and management to enhance teaching and learning in schools using learning technologies;
- Vocational Education sector program leadership and management to enhance teaching and learning using learning technologies; and
- Leadership and management of ICT initiatives for lifelong learning, including learning centres.

10(a) Recommendation

That four units are established:

ICT Division with responsibility for information management, corporate applications, ICT infrastructure and ICT procurement for the Basic Education Institutions and Vocational Education

Learning Technology Projects Unit to lead and manage the development and implementation of the Ministry's learning technologies plan for the schools sector

Flexible Learning Projects Unit to lead and manage the development and implementation of the Ministry's learning technologies plan for the Vocational Education sector

Lifelong Learning Unit, to lead and manage the Ministry's learning technologies plan for the non-formal and informal education sectors.

10 (b) Recommendation

That the managers of those units report to appropriate senior managers within the Ministry's organisational structure. Appropriate line management arrangements could include:

Chief Information Officer (CIO)/General Manager of ICT Division reports to the Deputy Secretary, Resources
Group Manager of Learning Technologies Unit reports to the General Manager, School Curriculum
Group Manager, Flexible Learning Projects Unit reports to the Deputy Secretary Vocational Education.

10 (c) Recommendation

That a director within the Office of the General Secretary has responsibility and authority to oversee and coordinate the Ministry's learning technology programs.

10 (d) Recommendation

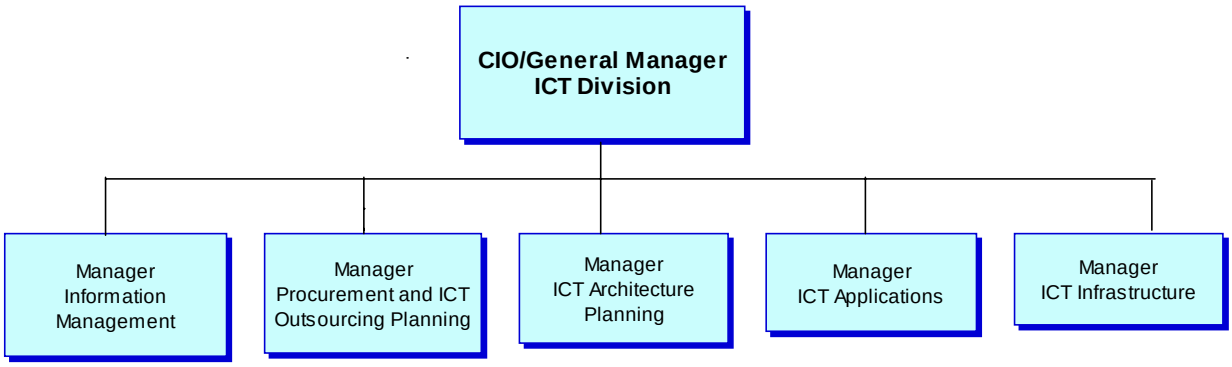
That support structures for learning technology implementation are put in place at District level.

10.1.1 ICT Division

The functions of the ICT Division would be to:

- Manage the development, deployment and maintenance of corporate ICT applications and infrastructure for the Ministry of Education, Religion and Culture;
- Direct information management for the Ministry of Education, Religion and Culture;
- Provide services, including procurement and brokerage of ICT equipment and services, such as computers, networks and software, to achieve optimum outcomes for learning and teaching in each education sector;

The management structure of the ICT Division could be:



The Division would strategically source (a mix of insourcing and outsourcing) services such as: Consulting on infrastructure, software projects, business process re-engineering and ICT training; ICT systems development projects (maintenance of legacy applications, customisation of integrated standard software, development of special software), and ICT Operations (EDP Centre, Client/server support, Network Management, Help Desk).

10.1.2 Learning Technologies Unit – Schools Sector

The purpose of the Learning Technologies Unit would be to support schools to improve the learning of all students through high quality learning and teaching that makes appropriate use of learning technologies. Its functions should be to:

- promote cost-effective, high quality and equitable uses of learning technologies;
- provide advice in the field of learning technologies to enhance learning and teaching;
- conduct and commission research into and evaluation of learning technologies and their use to improve teaching and learning processes;
- collect, coordinate, generate and make available information that will facilitate the development of learning technologies to enhance learning and teaching;
- provide project and program management in matters related to these objectives, including the management of the Ministry's Internet services, digital content services and satellite TV service (ie for all sectors);
- provide and coordinate professional development in fields related to these objectives; and
- facilitate and coordinate international collaboration in fields associated with these objectives.

10.1.3 Objectives 2002-2006

Objectives of the Learning Technologies unit for 2002-2005 should be to:

- to foster significant improvements in learning by facilitating the use of the most advanced and proven educational techniques;
- to develop present and future generations of Thai people with a strong command of ICT skills required by employees in a knowledge-based economy;
- to enhance educational opportunities and achievement in all Thai schools by making national and international education resources available to all teachers and students;
- to increase opportunities for parents to understand and interact with classrooms and schools, in order to further strengthen the partnership in their child's learning; and
- to facilitate collaborative learning experiences among teachers and students across Thailand and internationally through electronically based educational projects.

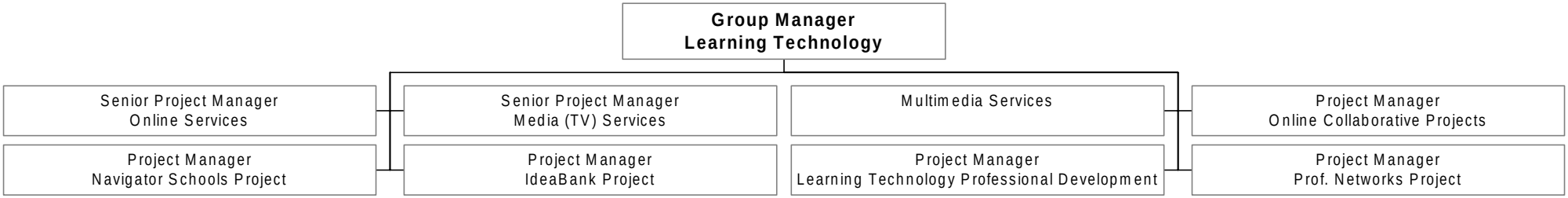
10 (e) Recommendation

That a Learning Technologies Unit is established to lead and manage the development and implementation of the Ministry's Learning Technologies plan for schools.

10.2 Learning Technology Projects Unit

10.2.1 Management Structure

LEARNING TECHNOLOGY PROJECTS



10.3 Learning Technologies – Higher Education

Consultation confirms that, as in Australia, Thailand's universities have their own human and other resources to apply to learning technologies leadership and implementation. Cooperation between the universities would assist the achievement of efficiency and effectiveness in learning technologies development, for example in avoiding unnecessary duplication of effort for example in producing online courseware.

10.3.1 Collaboration and Coordination

It will be important to establish and maintain appropriate liaison with authorities responsible for education and training within Thailand and elsewhere and with those responsible for Thailand's e-Government; e-Society; e-Commerce; and e-Industry agendas including: government education and training authorities and non-government providers at all levels; the University Presidents Committee and any existing and new agencies associated with the e-Thailand agendas.

The purposes of these collaboration activities include collecting, assessing and disseminating information and materials, and fostering and initiating collaborative developments associated with learning technologies, thereby avoiding duplication of effort.

10 (f) Recommendation

That the Ministry of Education establishes and maintains appropriate liaison with authorities responsible for education and training within Thailand and elsewhere and with those responsible for Thailand's e-Government, e-Society, e-Commerce and e-Industry agendas including:

- **government education and training authorities and non-government providers at all levels**
- **the University Presidents Committee**
- **any existing and new agencies associated with the e-Thailand agendas.**

10 (g) Recommendation

That this collaboration has the purposes of collecting, assessing and disseminating information and materials, and fostering and initiating collaborative developments associated with learning technologies, thereby avoiding duplication of effort.

10.3.2 Agreement on and Adherence with ICT Standards

Agreement on uniform, binding communication standards and data exchange formats will provide a guarantee of flexibility, and a platform to enable optimisation of the Royal Thai Government's e-Education technology investment.

10 (h) Recommendation

That the TLT 2010 Advisory Committee is established.

10 (i) Recommendation

That at least one technology initiative which strongly supports each of the other initiative is developed to model the role of technology in facilitating improved outcomes.

10.3.3 Agreement on and Adherence with ICT Standards

Agreement on uniform, binding communication standards and data exchange formats will provide a guarantee of flexibility, and a platform to enable optimisation of the Royal Thai Government's e-Education technology investment.

10.3.4 Resource Mobilisation and Funding Options

This report provides advice on a suite of strategies and programs designed to encourage and support innovation, facilitate widespread access to technology for learning, and develop in individuals, communities and organisations the knowledge, skills and understanding needed to use information and communications technology efficiently and effectively for learning throughout life. There are human, information, technology, structural, and financial resources that must be mobilised. This section focuses on financial resource mobilisation. The remaining resource classes are addressed elsewhere in this paper.

There is a range of options to mobilise financial resources. This section describes several options and provides examples of models for resource mobilisation and funding used overseas. An identification of funding required at a program level is not possible at this early stage.

The context and intent of resource mobilisation affects options available and the characteristics of desired options. The first activities align with the resource mobilisation strategies adopted in Victoria, to support school learning technology initiatives. Victoria had earlier implemented the Schools of the Future program and thus over 90% of the Government's state schools budget had been allocated directly to those schools. The schools were given their resources as a one-line budget, to be deployed by the schools in ways that suited local conditions and priorities, within the Schools of the Future framework. There was a clear understanding at all levels that each school was responsible for acquiring, deploying and managing ICTs, and for the professional development of its staff. In keeping with the initiatives undertaken by the Department of Education local activities were designed to provide stimulus and support for action by the schools, and central activities designed to achieve purchaser power in the competitive ICT marketplace.

Approaches to resource mobilization undertaken elsewhere in the world have been applied in a range of contexts. In some instances governments and education authorities have been operating within systems in which schools do not have school-based management, and therefore initiatives such as the provision of computers and professional development have been centrally controlled.

The mix of resource mobilization and funding initiatives selected for implementation of learning technologies and lifelong learning by the Royal Thai Government will need to be considered in the context of, inter alia, the school management regime in place at the time.

10.4 Examples of Overseas Resource Mobilization Initiatives

10.4.1 National Government Policies And Programs – The National Information Infrastructure Initiative

Whole of government initiatives

The US Government has undertaken an expansive program to prepare the United States for participation in the Information Age. In addition to the physical facilities used to transmit, store, process, and display voice, data, and images, the National Information Infrastructure Initiative (NIII) addresses the information itself, the applications and software, network standards and transmission protocols, and the people who create and manage the information. Key programs under the NIII involve Next Generation Internet, Large Scale Networking/High Performance Computing and Communications, the Information Infrastructure Assistance Program, Information Technology for the 21st Century, and specific initiatives associated with Education and Health. A broad array of programs addressing ICT in education are being funded. under the auspices of the NIII for schools, universities and lifelong learning.

Universal Access Initiatives

In 1996 the US Government created a Universal Service Fund, administered by The Universal Service Administrative Company. The Universal Service Fund has four program elements:

1. a High Cost Program, which provides support to Eligible Telecommunications Companies (ETCs) for defined costs associated with providing basic service to high cost rural and other costly-to-serve customers;

2. the Low Income Program, assists eligible low-income consumers to establish and maintain telephone services by discounting services provided by local telephone companies;

3. the Rural Health Care Program provides reduced rates to rural Health Care Providers for telecommunications services related to telemedicine and telehealth; and

4. the Schools and Libraries Program (the 'E-Rate') provides discounts on the cost of telecommunications services and equipment to public and private schools and libraries. Eligible services range from basic local and long-distance phone services and Internet access services, to the acquisition and installation of equipment to provide network wiring within school and library buildings. Computer hardware and software, staff training, and electrical upgrades are not covered. Discounts range from 20 percent to 90 percent, depending on economic need and rural location.

Similarly, the Australian Government imposes a Universal Services Obligation on Australian telecommunications providers.

Purchase network services centrally

As described elsewhere in this report, the Victorian Government implemented VicOne – a whole of Government wide area network. Funding for that service is provided centrally. At that the time of its instigation, the commissioning of VicOne provided the Victorian Government with a means to stimulate the development of high speed network backbone services throughout the State.

Harness Community Support for Telecentres

Community supported telecentres are being established in many parts of the world. Such initiatives typically receive seed funding from government and significant leverage through the contribution of time and other resources from local communities. In Australia, funding and coordination for telecentres is often by State departments of regional development, anda major focus of telecentres is providing a single point within the community for the delivery of government services.

10.4.2 School Sector Initiatives

It is important to offer incentives to increase schools' level of spending on technology. In Victoria, a tied grant was offered to government schools, through an applications process, to encourage schools to increase their expenditure on computers. For each $2 spent by schools on computer purchases, the schools were provided with an additional $1 grant to be spent on computer purchases.

10.4.3 Reducing The Unit Cost Of ICT Equipment And Services

The Victorian Department of Education, Employment and Training operates a software rolling fund to aggregate software purchases across the system, in order to reduce unit costs of software to schools. Schools can purchase software from the centrally

coordinated fund at a price substantially less than if they were to purchase the titles independently.

In addition, Victoria and several other Australian State departments of education independently purchase software licences from Microsoft on behalf of all government schools in their respective States. As a result, schools bear no direct cost for products such as Microsoft Office and a range of other titles. This has removed a previous cost barrier to school computer purchases, facilitated software upgrades, and has enabled a significant increase in the installed computer base.

Centrally managed competitive tender processes are used by the Australian States and Commonwealth to reduce unit costs of ICT equipment, and, in many instances, to obtain service level agreements associated with equipment warranty and repair.

In Britain, the British Educational Communities and Technology Agency (BECTA) (http://www.becta.org.uk/start/index.html) performs a range of roles including the aggregation of demand for schools' ICT purchases.

10.4.4 Provide Independent Guidance For Schools On Technology Planning And Purchasing

As described elsewhere in this report, the Navigator schools and the Learning Technology Planning and Implementation Guides have played key roles in assisting Victorian government schools to become savvy technology purchasers and managers.

Harness Community input into LAN installation

The Net Day initiative was commenced in the United States, and has been emulated in many parts of the world, including in Australia. It harnesses community resources to install LANs in schools. Information is available at http://www.netday.org/

Provide schools with access to used computers

The Victorian Government undertook a program to source used government and corporate computers for schools. The computers were allocated to schools on a needs basis.

Direct funding by government

In Britain, funding provided by the government for the National Grid for Learning included:

1. funding for investment by schools in ICT infrastructure, services and content;
2. support for the initial equipping and connection of Britain's libraries to the Internet;
3. a fund through the National Lottery to train teachers in the curriculum use of technology in the classroom, and to train school librarians;

4. a fund, augmented by matching public/private funding for the training of public librarians in the use of technology;
5. a fund, augmented by matching public/private funding, for the digitisation of content to benefit lifelong learners; and
6. allocation of Standards Fund resources to support the development of the National Grid for Learning, with a requirement a proportion of each grant be used for content purchase and development by schools.

Options for Accessing Funds for Technology

The UNDP (2001) identifies a range of options for resource mobilization for technology including bilateral donors, diverting government expenditure from other areas to technology development, obtaining interest free loans from agencies such as the World Bank, debt for technology swaps, providing tax incentives to encourage the wealthy to establish private foundations, seeking contributions from high tech industries including in kind contributions through research into non-commercial products, imposing differential pricing, applying fair use of intellectual property rights and trade related aspects of intellectual property rights.

Detailed recommendations regarding funding of the program are beyond the scope of this study. While it is beyond the scope of this paper to recommend further details of resource mobilisation and funding, national coordination at whole of government and education sector level, and a global outlook will be essential to facilitate optimum outcomes for all of Thailand's learners.

10.4.5 Funding ICT Initiatives

Detailed recommendations regarding funding of the program are beyond the scope of this study. A range of funding options exist to fund the implementation of the Thai Technology reforms:

- New government budget initiatives with major funding linked to government policy in the areas of education, economic and social development. Funding could draw on savings from efficiencies created in other areas of reform.
- Strand funding from existing education sector budget and budgets associated with other reform initiatives so that technology projects are built into other reform programs such as curriculum reform and school based management, with technology appearing as a strategic element of those programs.
- Loan funding with potential to support major programs.
- Aid funding options exist for support from existing emerging bilateral and regional programs
- Allocation of funds from local budgets with schools and other provider organisations allocating funds from centrally provided and locally raised sources to support implementation of local learning technology plans. This assumes that deliverers, such as schools, have significant responsibility for budget management.
- Private sector funding could explore the potential for 'value adding' by the private sector (eg percentage of sales devoted to research and development or additional

materials for schools) as a result of the tender process. Support may also be available for special initiatives related to the development of ICT and enterprise skills.
- Philanthropy has potential for support in specific areas. For example, learners with special needs and materials production related to promotion of Thai culture.

Experience elsewhere suggests that success will result from a combination of government initiative funding, demonstrating leadership and commitment, strand funding, ensuring linkage to other programs, and local funding, because it guarantees ownership at the delivery level.

Private sector funding and philanthropy are best associated with specific projects for reasons of transparency and due recognition.

10 (j) Recommendation

That the RTG develops a nationally coordinated information infrastructure initiative (e-Thailand), addressing all dimensions of Thailand's participation in the Information Age.

10 (k) Recommendation

That the e-Thailand initiative includes the establishment of a Universal Services initiative for Thailand.

10 (l) Recommendation

That the e-Thailand initiative includes an e-Education initiative which addresses the use of ICTs in all dimensions of formal, non-formal, and informal education.

10 (m) Recommendation

That the e-Thailand and e-Education initiatives are developed with a view to linking with regional and global information infrastructure and educational technology initiatives.

11 Change Management

11.1 Principles

If schools are to effectively incorporate learning technologies into their classrooms they must resolve a complex array of interrelated issues. In relation to developing a shared understanding of teaching and learning, there is a need to explore such issues as: preferred learning styles, preferred teaching practices in each learning area, barriers to understanding, and the effectiveness of teaching. In addition there are issues that relate more specifically to the integration of technology into teaching and learning. These included questions of how technology can be used most effectively to improve student learning, software and hardware requirements, and the teaching methodologies that are likely to be most effective.

There are also issues related to teacher and student support for the adoption of the new approaches and practical questions focusing on the types of computers to purchase, the need for a local area network, security, technical support and managing the purchase and upgrade of equipment and software. In relation to restructuring teaching and learning and administrative approaches, there are questions about purpose, culture, process, and change in the beliefs of teachers students and parents.

Resolution of these issues will require a mix of strategies including reviewing contemporary research, investigating what has worked elsewhere (and what has not worked), building networks of people to capitalize on the synergies possible through collaboration, determining the characteristics of the school, its students, teachers and community, creating a shared vision, and incorporating a regular dialogue of teaching and learning and action research approaches into the culture of the school.

11.2 Change Management Models

Change management to adopt learning technologies is needed at both system and school levels, with support from district structures. There is a body of knowledge about these processes that brings together learning technology and what has been learned in systemic change programs in the school sector and other education and training sectors elsewhere in the world. Organisational change management models are well documented. Egan (1988) provides a three-stage model for organisational change, comprising:1) Assessment of the current scenario to determine what is going right, and wrong. Identify unexploited opportunities, unmet needs and unmet challenges; 2) Creation of a preferred scenario that describes what the organisation would look like when the change is implemented; and 3) Design and implementation of a plan that moves the system from the current to the preferred scenario.

While the full detail of Egan's and other change management models is beyond the scope of this report, there are elements that deserve particular consideration.

11.2.1 Creating A Scenario – A Vision Of A Preferred Future

'To choose a direction, a leader must first have developed a mental image of a possible and desirable future state of the organisation. This image, which we will call vision, may be as vague as a dream or as precise as a goal or mission statement. The critical point is that a vision articulates a view of a realistic, credible, attractive future for the organization, a condition that is better in some important ways than what now exists'.

At the organisation, project and school level the development of a school vision that incorporates technology is a key initial step in the learning technology planning process. A sample school learning technology vision for Victorian schools is available at: http://www.enps.vic.edu.au/tchlearn/rationale.html. The ACOT project fulfilled an important role in the Victorian learning technologies change management program. It enabled leaders (principals, project officers and vanguard teachers) to experience extended observation and work in classroom environments that approximated those envisaged for Victorian schools, with opportunities and time to reflect upon and plan changes for their own schools and classrooms. Through this and other activities, the principle change agents of Navigator schools developed and achieved a shared understanding of their school's preferred future for learning, teaching and school operations with technology. Further information about the Navigator Schools Program is in Appendix 3.

11.2.2 Leadership

Egan (1988) emphasises the importance of selecting the right person(s) to direct the transition:

'This person may or may not be the top person in the organisation. Managing the transition is best placed in competent, sensitive, persistent and responsive hands. The appointment of a transition manager or team sends an important message to the rest of the organisation: 'This person (this team) embodies how we feel about this change project'' .

Elsewhere in this paper it is recommended that a learning technologies project team be established to fulfil the transition management role at a national level. Leadership at the school level is also a critical factor in the implementation of new learning and teaching approaches with technology (NBEET, 1997).

11.2.3 Seek to Optimise Leverage

Schools will face an array of common issues when implementing technology. The potential for schools to make, and repeat, expensive mistakes is high. Similarly, it is important to avoid unnecessary duplication of effort. It is therefore important to share learnings of other sectors, and the Navigator schools and other schools. Technology can offer highly cost-beneficial ways to provide access to and awareness of knowledge. For example:

- Print material is an effective way of communicating information The Victorian Department of Education developed, published on paper and distributed to schools a Learning Technologies Implementation Guide;
- CD-ROMs and the Internet provide low cost ways to distribute and share documents, data and video; these are used extensively, for example in the Learning with the Internet program;
- Unused broadcast TV timeslots can provide a low-cost method of distributing video materials nationally (most users time-shift by videotaping programs).

11.3 Facilitating Systemic Change

The Concerns-Based Adoption Model provides an effective framework for conceptualising the change process in individuals, focusing on the important role played by the concerns of individuals involved in the change. Havelock and Zlotolow (1995) provide an adaptation of that model, specifically applied to change in school settings. That model argues that individuals characteristically progress through six stages of adoption of an innovation:

1. *Awareness* - in which individuals have passive interest and are not necessarily motivated to seek further information

2. *Interest* - active information seeking about the innovation, open attitude to the innovation, at this stage have not yet made a judgment whether the innovation will be suitable for their particular circumstances.

3. *Evaluation* - a period of mental trial of the innovation, a necessary preliminary to the decision to make a 'behavioural trial'.

4. *Trial* - the innovation is implemented on a small scale to determine how it will actually work in their own situation.

5. *Adoption* - the results of the trial are weighed and the decision to adopt or reject the innovation is taken.

6. *Integration* - true adoption is considered to have taken place when use of the innovation has become routine and fully integrated into the working life of the individual.

The notion of changing individuals' beliefs is central to progression along the stages of adoption. Within any population a proportion of individuals will be 'early adopters', some will be early followers, and there will be individuals who would oppose the change. Recognising that individual teachers and educational leaders will be at different stages of the adoption cycle, it is recommended that the Ministry of Education, Religion and Culture adopt a multifaceted strategy to facilitate progression along the six processes.

11.3.1 Awareness

To encourage Awarenes, it is necessary to provide exposure to the need for change and effective model(s) for the adoption of technology. The primary goal is to instil curiosity: a motivation to seek further information. The message should be brief, interesting, easy to understand, and rewarding. (For example the message could be: 'Learning technologies to improve student learning'.)

Action programs would include: Promoting use of learning technologies through presentations, conferences and videos, and encouraging leaders at all levels of the organisation to understand and promote learning technologies. A powerful way to raise awareness is by advocacy by peers who have adopted the new approaches using ICTs and who can convey the benefits and processes to bring about the new approaches.

11.3.2 Progress to Interest

To encourage those at the Awareness stage to progress to the Interest stage, individuals are encouraged to come to those who are leading the innovation. If interested, individuals will seek information from any other source. In the case of principals and teachers this will commonly be from other principals/teachers. Group discussion should be promoted as a means of satisfying the need for information and as an opportunity to air doubts and develop positive attitudes toward the innovation. Group discussion can also be used to support individual risk taking.

Action programs would include: District briefings by leader principals and teachers, Principal seminars in Navigator schools, teacher practicums, communicating with groups, such as principal and teacher networks. Again, advocacy by peers is a powerful influence in this process.

11.3.3 Progress to Evaluation

To encourage individuals at the Interest stage to progress to the Evaluation stage, individuals need to be taken on a mental journey through the alternatives. They require information and/or experiences that will enable them to envisage the innovation applied to their own situation. A demonstration of the innovation in conditions similar to their own school is powerful. If individuals are shown how the innovation may work for them, they will be more inclined to make a decision to trial the innovation. Action Programs would include: Navigator schools practicums, Global Classroom projects, Leadership Networks.

11.3.4 Move to Trialling

To encourage individuals at the Evaluation stage to progress to the Trial stage, training is needed in order to assist individuals to fulfil new roles and carry out new activities. The possibility of failure becomes real at this stage. Maximum support and encouragement is needed. Individuals should be encouraged to evaluate their experience - results may not be immediately apparent unless pointed out.

The load on teachers at all levels and at all times is heavy, and it is difficult enough for them to conduct existing programs, much less carry out new ones. With a busy person every little bit helps - workshops, materials, guides, consultants - and any one of these may make the difference between adoption and rejection.

Action Programs would include: district consultants, Navigator school practicums, teacher planning meetings, teacher and principal networks, encouraging action research approaches in schools and networks, Learning Technologies Planning Guide. Focus support on those supporting schools and those supporting teachers - including principals.

11.3.5 Adoption

To encourage individuals at the Evaluation stage to progress to the Adoption stage, further training and encouragement is needed. Adopters may encounter difficulties in trying to carry out their intentions. A support structure is needed to assist with problems and unexpected obstacles as they arise.

Action Programs would include: teacher and leader networks, Global Classrooms mentors, district consultants, network leaders, online networks - including for those who have participated in practicums, survey professional development program participants post event to determine ongoing support needs.

11.3.6 Integration

To encourage individuals at the Adoption stage to progress to the Integration stage, they must be encouraged to integrate new skills into day-to-day behaviour. Practice sessions, reminders and brief follow-up questionnaires on frequency of use and usefulness will be effective. The role of internal change agents is crucial.

Action Programs would include encouraging school leadership teams, in particular principals, to establish internal structures that will promote and support innovation (eg design teams, coaching teams), follow-up questionnaires for PD participants, Navigator School Leadership Institutes and follow-up sessions, activities of teacher and leadership networks to draw upon these ideas.

11.4 Implementation factors

11.4.1 The Importance of Local Decision Making

During the *Classrooms of the Future* program, Victorian principals had the freedom to act as instructional leaders and the flexibility to modify key aspects of the school in order to facilitate the desired changes. They had commitment to the change and the ability to commit the required resources.

11.4.2 Communication

Communication within the school and with parents and the broader school community is essential.

11.4.3 Models of the Desired Scenario

Technology and teacher computer skills by themselves will not transform learning and teaching. Similarly, professional development programs that emphasise the development of teachers' technology skills will not change classroom practice with technology. For example, in France in the mid-1980s thousands of teachers were provided with tens of hours of instruction in technology use, focusing on learning skills in word-processing, spreadsheets and databases. Tens of thousands of computers were placed in classrooms. Unfortunately, classroom practices did not change - the teachers did not integrate technology into their classes. Teachers continued to rely on whole-class instructional techniques, and did not understand how to integrate the technology into their classroom practice. This leads into the Navigator schools approach.

11.4.4 Use Project Management Principles

Learning technology projects should be based on project plans, developed before commencing the project. Plan details should define scope, resources, objectives, milestones, success criteria, strategies to be piloted, quality issues and constraints. At a school level, learning technology plans are essential. One example of a plan is at: http://www.wodonga-ps.vic.edu.au/Technologies/learning_technologies_plan_part_.htm

Pilot projects are an important tool. Those projects should be termed 'Stage 1 implementation', rather than piloting, as pilot projects are perceived to be experimental.

11.4.5 Navigators Accelerate Adoption

In ACOT classrooms instruction shifted to team teaching, collaborative learning and interdisciplinary projects. Students were more actively involved in both teaching and learning the new lessons that they and the teachers designed. The first group of ACOT teachers reached this stage after more than a year; the second group arrived in several months. This is because the later group had local experts (more experienced ACOT teachers and students) and a supportive environment to accelerate their growth. The Navigator School Program capitalised on the Navigator concept at two levels: a group of vanguard teachers performed the Navigator role within the school (for other teachers), and the schools themselves were used as Navigators for other schools seeking to transform with technology.

11.4.6 Evaluation and Research

Evaluation was a key element of all learning technology professional development programs coordinated by the Classrooms of the Future project team. Through information collected it was possible to monitor and, if needed, adjust programs during operation

(including an Australian Quality Council self-assessment for the SOFWeb team). For example, research by the Victorian Department of Education approximately 12 months after the commencement of the Classrooms of the Future project indicated that there were, at that time, several factors that limited widespread implementation of learning technologies by Victorian schools. These factors included: lack of teacher conviction that learning technologies would improve student learning; lack of routine access to suitable learning technologies infrastructure in classrooms; and a need for teachers to develop personal expertise in the use of hardware and software. The information was used to inform further development of the Department of Education's learning technology strategy.

11.4.7 Beliefs, Culture and a Supportive Environment

Teachers' beliefs about schooling underlie resistance to change. Teachers' beliefs need to be gradually replaced by more relevant beliefs and practices shaped by experience in an altered context. There is greater likelihood of growth of new practices when teachers work with colleagues and administrators who actively support fundamental change. Teacher and leader beliefs, school culture and a school environment that is supportive of the desired changes were important threads running through the change management strategy adopted in the Classrooms of the Future program. Navigator schools were selected as places with strong leaders (principals) with a commitment to child-centred approaches. Project Officers for the Navigator schools were selected as experienced teachers who used child-centred approaches and who had proven capacity to provide professional development support for other teachers. Vanguard teachers in the Navigator schools were selected because they were excellent teachers already using child-centred approaches (and not those teachers who were good at using computers). Teachers and leaders from Victorian schools selected themselves for participation in the various learning technology professional development programs, including leader seminars. Principals from Victorian schools were encouraged to use criteria for selecting teachers to participate in Navigator school practicums that included motivation, innovative classroom practices, routine access to technology, tangible support from the school leadership team, and alignment with a whole school learning technologies plan. Principals were encouraged to visit their teachers during the Navigator school practicums and discuss and understand teachers' plans for their classrooms and the support they would require to implement those plans.

11.4.8 Align System-wide Accountability and Assessment

Measurement can support or impede the adoption of learning technologies. Alignment between the assessment and accountability and classroom practices id desired. Victorian Navigator school teachers who visited United States schools in the ACOT program observed that classes would spend a substantial part of the school day with drill and practice, rote learning exercises in order to prepare for Statewide standardised tests, and the other part of the day in collaborative, project-based, technology infused activities. The pressure on teachers to prepare students for the standardised tests was high.

11.4.9 Curriculum and Organisation

At River Oaks Elementary School in Canada the principal stressed the importance of curriculum, observing that 'without restructuring the curriculum at River Oaks, students would not be developing the critical and logical thinking skills, problem solving skills, teamwork skills, literacy, communication skills, and other areas, to help them be competitive in a global work force'. Schools also need to become learning organisations so that their practice is informed by new knowledge and systematic evaluation. The achievement of the desired practices should be linked to performance management plans, and bonuses and/or promotion.

11.4.10 Business Process Redesign

Experience indicates that business process redesign (for example the adoption of student-centred teaching and learning practices) where possible should precede technology implementation. In the business sector it is suggested that businesses that implement business process transformation before new software systems are implemented can reduce implementation time by 50 per cent, lessen total project expenditure by 60 percent, and, most importantly, reduce the risk of failure (McKinsey and Co, 1998). In Victoria, the school based management program ('Schools of the Future') was implemented throughout the system prior to commencing the program that focused on transforming teaching and learning with ICTs ('Classrooms of the Future'). In relevance to the Timing of the Change Program, the Office of Technology Assessment in the US congress (1995: 163) observes: 'effective technology implementation takes more time and effort than many anticipate when first undertaking technology initiatives … it appears that five years may be an appropriate time frame for large scale technology infusion.'

11.5 Evaluation and Research

Evaluation is an essential element in all programs of systematic educational improvement. The purposes of evaluation are to inform the process of implementation so that modifications can be made to the program as it is being implemented (often called formative evaluation) and to assess whether the program is impacting on student learning outcomes (often called impact evaluation). An example of formative evaluation would be the identification of the factors that inhibit the adoption of learning technologies by teachers (perhaps these might include antipathy to the learning technologies, lack of personal expertise in using the technologies, lack of access to resources and materials or lack of congruence with other school requirements). Although there are generalisations about inhibitors to the adoption of learning technologies it is important to establish the most important factors in the local context. Impact evaluation would focus on the effect of the learning technologies on student learning processes and outcomes. In terms of processes an evaluation would attempt to establish whether wider access to learning technologies did promote deeper approaches to learning by students. In terms of learning outcomes an evaluation might examine students skills in using learning technologies as well as their broader skills in knowledge management.

Successful evaluation requires the building of levels of expertise amongst a wide range of professionals. The conduct of evaluation studies depends on the application of appropriate evaluation and research methods as well as an understanding of the wider body of knowledge concerned with student learning in technology-rich environments. It is important that this expertise be developed through appropriate training for individuals, regular contact with developments in other countries and providing experience for talented individuals to design and conduct evaluation studies related to the adoption and impact of learning technologies in Thai schools and other institutions. In many instances this will involve working in partnerships with universities but those partnerships will operate best if there is also a group of expert evaluators within ONEC and the Ministry of Education. Participation in international studies such as the Second International Technology in Education Study (SITES) will help to develop this expertise and build a sound framework for evaluation and research. In addition to conducting program focussed evaluation it is also important to plan for ongoing research on more fundamental aspects concerned with the ways in which technologies impact on student learning in the Thai context. Results from local research and program evaluation can be linked to what is being discovered in other contexts so as to understand better impacts on student learning.

11 (a) Recommendation

That a systematic evaluation program is established to monitor the adoption and impact of the *TLT 2010 Masterplan* with a view to providing information that can be used to modify the program as it is being implemented.

11.6 Implementation of Thai Navigator Schools Program

Underpinning the success of Victoria's Navigator schools program are the following key features:

- A strong focus on teaching and learning
- Shared vision-setting and collaboratively developed implementation plans
- The use of international benchmarks to measure success
- An obligation to engage in high quality, long-term professional development
- Networking between schools to share best practice
- The employment of dedicated Navigator project officers to facilitate the program
- Practice-oriented research
- High levels of accountability.

Thailand’s Navigator schools should include these features in their programs and model the reforms planned for education in this country including:

- Increased flexibility in learning arrangements, for example, by block scheduling allowing increased time for projects, some or many of which could be multidisciplinary;

- Breaking down 'classroom walls', in relation to time by enabling home access to the digital learning resources of the school and beyond, and in relation to physical groupings by approaches that utilise teams of teachers;
- Fostering vision, farsightedness, ambition for achievement, dedication to work, knowledge and life experience through encouraging, enabling, supporting and rewarding school leaders and teachers to develop those qualities and incorporate them into programs of the school;
- encouraging inquiry and a thirst for understanding through increased use of guided discovery and project-based learning techniques;
- establishing direct, tangible and accessible links between local wisdom and technology;
- realignment of the learning/teaching-base in classrooms, to teacher and students as learners;
- energising classrooms with the excitement of discovery, structured inquiry and performance;
- strengthening community links, and authentic learning tasks, with new opportunities for families and communities to support and interact with student learning;
- enhancing and encouraging integration of scientific thinking, and directly involving students in projects that deepen understanding of national art and culture; and
- encouraging, rewarding and requiring perseverance, dedication to work and honesty in body, words and mind.

If it is intended that Thailand's students will become capable, routine users of technology as powerful tools of learning, inquiry and expression, then it is important that they have access to the technology. The school environment requires computers in the classroom, immediately accessible as tools for learning, inquiry and expression, and not isolated in computer laboratories, far removed from the general learning experiences of students.

11 (b) Recommendation

That the RTG establishes Navigator schools which will model the reforms planned for education in Thailand.

11 (c) Recommendation

That the RTG establishes in the Navigator schools a leadership development seminar program.

11 (d) Recommendation

That the RTG establishes in the Navigator schools a practicum-based professional development program for teachers from throughout Thailand.

11 (e) Recommendation

That the leadership seminar and practicum programs capitalise on the learnings of the ACOT and Navigator school practicum programs.

12 Moving towards the Vision– Strategic Initiatives

A set of strategic initiatives is proposed to facilitate progress towards the implementation of *TLT 2010 Masterplan*. Some are large-scale capacity building programs, some are designed to pilot and lead innovation, while others link specifically to existing ICT initiatives in progress. It is not a comprehensive list of programs designed to address all areas of need in the application of learning technologies. The proposed Strategic Initiatives will provide the basis for discussion and planning for the proposed Stages of education technology innovation in Thailand.

Section D of this document proposes the development of policies, implementation plans and strategic initiatives as the focus of learning technology reform in Thailand between 2001 – 2001. Each of the strategic initiatives relate to one or more of the four key elements required for successful implementation:

- ICT Infrastructure
- Content and Software
- Human Resource Development
- Change Management

12.1.1 Navigator schools program

A program of exemplar schools (Navigator schools), which will model good practice in information and communications technology and related aspects of teaching and learning identified in the Thai education reforms, should be established. These schools should provide leadership in the educational uses of information technology to other schools from throughout Thailand through a practicum-based professional development program for teachers, and a leadership development seminar program. Experience from the ACOT, Navigator, Discovery and Technology Focus schools should be used to inform the development of a Thai program of exemplar schools. Information about the Navigator Schools Program is in Appendix 3.

12.1.2 Distance Education

A strategic plan for distance education in Thailand should be developed so as to produce a coordinated national management and support structure for distance education, with a charter to best utilise technology and distance education techniques to provide the most effective, most efficiently delivered distance learning within the available budget. The strategic plan should include the development of local materials (integrating good materials design and links with existing materials) as well as the adoption or adaption of commercial and international materials. Access to these materials should be available through the education and training gateway. Consideration should be given to utilising unused broadcast time on television channels to deliver educational TV programs for

distance education including classroom use and teacher professional development in learning technologies. Teachers and students in conventional settings should be able to access distance education materials.

12.1.3 Online Curriculum Communities

Professional development to improve classroom implementation of information and communication technologies (ICT) is most beneficial when focussed on learning and teaching techniques and curriculum rather than on technology skills as ends in themselves. Significant amounts of material exist on the Internet but teachers will benefit from assistance in effectively locating and managing information concerning current activities and issues.

This project will involve the development of materials providing training support for teachers in accessing and using digital and especially online materials for use in curriculum planning and delivery.

Support materials organised in subject areas and selected to provide a range of technology strategies and skills will give practical impetus to classroom use and increase ICT confidence of participating teachers. There are proven models for this approach (eg Aisa EdNet at http://www.curriculum.edu.au/accessasia/network/index.htm) which focus on improving classroom implementation of ICT through peer communication, resource identification and learning area focussed professional development activities. Peak national subject based professional associations could provide access to a specialist consultant in each of the learning areas who would make ongoing contributions to the project.

Appropriate mechanisms will be defined for nominated subject areas to collect and maintain current digital resource information including websites, collaborative activities and learning area specific issues for online delivery. The project will support moderated listserve activities, collaborative project work, communication and resource reviews. It will develop and adapt self-paced online Internet and information literacy resources specifically addressing ICT needs for learning areas. Using tailored sites for each area, while time consuming to develop, provides guaranteed quality of resources, a range of technology approaches and direct curriculum relevance.

The materials and activities will be published online, and replicated to a CD-ROM master, for dissemination to teachers with limited online access. Project staff will ensure the engagement of relevant organisations and peak professional associations in maintaining resources and support services. In collaboration with teacher professional associations and education jurisdictions, train-the-trainer workshops will be held in each district to support ongoing professional development activities.

12.1.4 Community Learning Centres

Models for extending educational facilities to learners, including the piloting of community telecentres as a means of providing learning centres for the community,

should be evaluated in terms of learner access, physical facilities, staff skill profiles for supporting learners, and administrative systems as well as private and public costs. A website showing learning centre locations throughout Thailand should be developed and maintained on the education and training gateway.

12.1.5 Education and Training Gateway – a website

A Thai Education and Training Gateway (website) should be established to provide a single entry point to online information and services associated with education and training, to provide a publishing platform for key stakeholders in the reform, and to facilitate the interchange of online materials. The TLT gateway should be linked to a virtual resource centre for Thai education and training based on the digital library and provide the main access to the World Bank's Development Gateway for Thailand.

12.1.6 Multimedia Content Development

A capacity should be developed in the production of multi-language digital learning materials and in the 'repurposing' of foreign language materials for use in Thailand. A set of standards for the production of educational software and online content should be developed as part of this initiative. The development of multimedia content should be a collaborative venture of ONEC, the Ministry of Education, NECTEC and private sector organisations.

12.1.7 Networks in Thai Education

There is a need to investigate information and communication technology infrastructure options within the Thai context. This investigation should consider options including a wide area network and alternative approaches that would provide Internet connectivity to schools and other centres of learning. It should consider the costs and- benefits of different types of connections from schools to networks and different types of local networks within schools as well as network management software.

12.1.8 Provision of Computers and Peripherals

There is a need to expand the availability of computers and peripherals in Thai schools. Careful consideration should be given to the types of equipment made available to, or available for purchase by, schools. Information should be collated and analysed regarding the number, distribution, age and specifications of computers and peripheral devices in Thai government schools, other schools and related organisations including non-school sites that could act as Learning Centres. This will be necessary to plan the expansion of computer facilities in schools.

12.1.9 Technical Support

A technical support program linked to an ICT skills program to support computer hardware, local area networks and connectivity to wide area networks should be

developed. Models for the engagement of appropriate levels of technical support staff and their recruitment and training should be developed. Suppliers of equipment should be required to guarantee the supply, installation and support of all computers and peripherals for the warranty period of the equipment. Options to extend those service elements beyond the warranty should be considered.

12.1.10 Professional Development and Training Programs

Learning technologies professional development programs should be established which build on leading practice in Thailand's schools and universities and draw upon worldwide best practice. These professional development programs should have a strong focus on instructional uses of technology, including programs such as the practicums that provide teachers with situated learning opportunities. Improving the learning technologies teaching repertoires of primary teachers could enable them to greatly contribute to improving the standard of basic education.

Programs should be designed to be expandable as the demand for services increases. In the early years of this program participation should be elective and focus on early users of the new technologies. Programs will need to provide support and coaching to teachers who have incorporated learning technologies in their teaching. Professional development programs should be designed to build a network of computer using teachers, provide an array of programs, catering for the range of teachers' concerns and stages of adoption of technology, provide ongoing professional development for all staff; encourage the dissemination of effective practices; and support both whole-school and classroom-based implementation of technology.

12.1.11 Resourcing Strategies for ICT Initiatives

The size of the Thai education system should be harnessed to obtain favourable arrangements with computer suppliers through competitive tendering approaches. Procurement guidelines should be established and be based on the requirement for quality, value for money, value adding and, where possible, contributing to the development of local industry.

Procedures should be developed to encourage the donation of surplus computers from industry and government departments for educational purposes in schools. A feasibility study should be conducted into the effectiveness of using low cost and portable computing devices in schools.

When funds permit, programs should be established to provide teachers with access to computers in the workplace and at home.

12.1.12 Research and Evaluation – Towards Continuous Improvement

A research and evaluation program that will support continuous improvement in the application of learning technologies in education should be established. The program should conduct regular reviews of relevant international and national research and make recommendations for the application of research findings to educational practice. In addition, the program should support the planning and implementation of practice-oriented research programs in schools and universities and the evaluation of learning technology initiatives at local, district and national levels. Some parts of this program will focus on what is happening in innovative schools, others will focus on what is happening in representative schools and others will focus on the processes through which other schools take up ideas from innovative schools. A necessary component of this program will be the development and adaptation of methods for assessing the impact of learning technologies on students' information technology skills, capacities to use information technologies in learning and the approaches that they adopt to compiling, transforming and interpreting information.

13 Staged Implementation Summary

It is recommended that the *TLT 2010 Masterplan* program should be integrated in Stages. Timing of the Stages will depend on the availability of financial and human resources, and may in some cases overlap.

13.1.1 Stage 1: 2001–3 Policy Development and establishment of lead programs.

During this stage, policies and Masterplans are developed in consultation with key stakeholders. The visions and plans are promoted and communicated. The need for co-ordination across all areas of education reform is highlighted. These reforms are occurring in a range of areas, including curriculum and assessment, teaching and learning practices, accountability and organisational structures.

During this Stage activities will include the introduction of Stage 1 programs, the establishment of the education network, the introduction of the Navigator school program, professional development and teacher training programs, commencement of procurement processes and development of digital materials. Reforms such as online collaborative projects, website competitions and teacher support networks can be established, providing early adapters across the country to engage directly within the reforms.

This Stage will build upon what has been learnt in successful system-wide and local implementations elsewhere in the world. Consultants can assist in this process, but capacity will be built by Thai education officials, school leaders, teachers and students who experience the application of learning technologies first hand and are able to promote ICT initiatives and successful strategies at the 'grass roots' level. Teams will be

established in educational institutions to coordinate the process of learning technology implementation. Teams must have a deep understanding of the role of ICT in education as well as other aspects of educational reform, change management, human resource development, and student-centred learning.

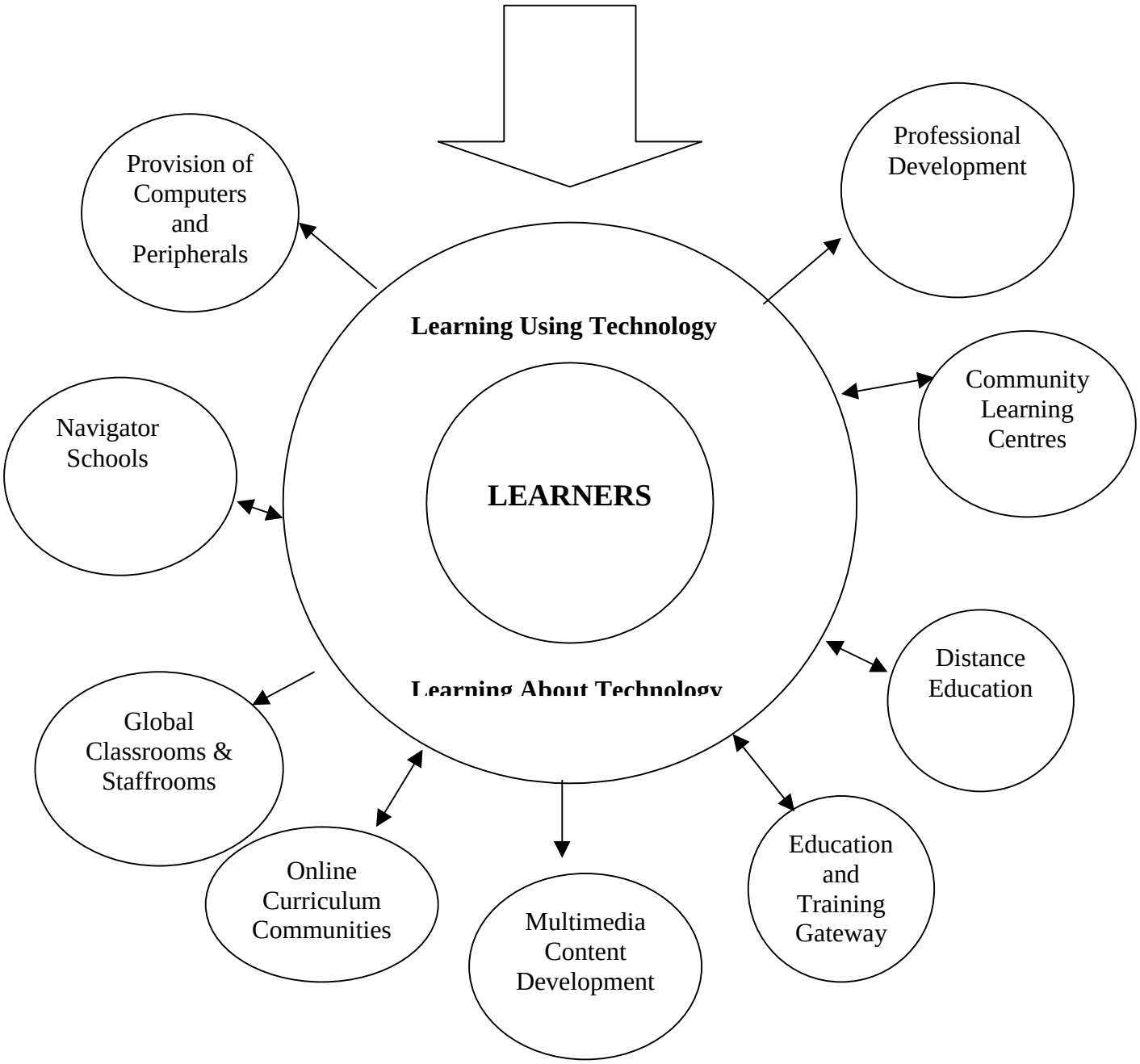
13.1.2 Stage 2: 2003-6 Major rollout of hardware, software and training programs.

Resources and training programs will be provided to support Thailand's education leaders and teachers in all aspects of learning technologies. A diverse range of programs is needed, addressing the broad array of interests and needs of individuals. Programs are required to develop the quality of leadership at all levels while encourage ownership by all stakeholders, to facilitate change and empower individuals as change agents. While computer skills training is needed, the success of the program will be dependent upon developing teachers' ability to integrate the technology into mainstream teaching and learning. Collaborative networks should be developed to share successful practice and provide collegial support. All major targets should be met by the end of Stage 2.

13.1.3 Stage 3: 2006–10 Embedding of practice and commencement of renewal cycles

Having been provided with infrastructure, training, and content, teachers and learners will have embedded the use of technology in mainstream learning. Education institutions and individuals will generate new applications during this process and achieve secondary targets. The upgrade and replacement of infrastructure provided in Stage 2 commences during this period.

Thai Learning Technologies 2010 Masterplan **Stage 1 – 2001–3** Policy Development, Planning, Strategic Initiatives **Stage 2 – 2003–6** Major Rollout **Stage 3 – 2006–10** Embedding Practice			
Infrastructure	Software and Content	Human Resource Development	Change Management



Section C
Review: Using Global Experience to Guide the Implementation of Learning Technologies

14 Learning Technologies in Education and the Australian Experience

14.1 Context

Australia has a population of 18.5 million in an area of approximately 7.7 million square kilometres. Although the overall population density is low it is a highly urbanized society with two-thirds of the population living in cities of more than 100,000 people; the two largest cities, Sydney and Melbourne contain 40% of the population. Outside the cities the country is sparsely populated. With such a small and dispersed population over a large landmass, it is not difficult to recognize the potential value of information and communication technology in the day-to-day lives of many Australian people or the critical importance of its effective integration into the education system. According to surveys conducted by the Australian Bureau of Statistics, more than half (53%) of Australian households had a computer at home and one third (33%) had home Internet access. These represent increases from the 1998 survey data when the corresponding figures were 45 and 16 per cent respectively (ABS, 2001).

14.1.1 Social and Economic Context

The World Bank classifies Australia as a high-income country. In the 1996-97 financial year, per capita GDP was just over A$24 000. Within a generally affluent environment recent years have seen unemployment remain high especially among young people. In November 1996 some 11% of 15-19 year olds were unemployed and not in full-time education. Patterns of employment have shifted away from agriculture and mining and towards service industries such as transportation, communications, sales, finance, education and health. Literacy among the adult population is nearly universal and, in 1997, 43% of the non-school population aged between 15 and 64 had completed a recognised post-school qualification. Just over 12% held bachelor or higher degrees from a university and just fewer than 11% had a skilled vocational qualification.

For the financial year 1996-97 total public and private expenditure on education was A$29 billion, which represented 5.7% of GDP. Of this total, government outlays on education amounted to A$24.5 billion. Australian governments outlaid nearly $13.9 billion on primary and secondary education, and a further $1.3 billion on preschool and other special education. State governments provide about 60% of all public expenditure

on education (90% of the expenditure on school education). The federal government provides 40% (including most of the expenditure on universities).

The Australian population is mainly of European background, although recent immigration has produced greater ethnic and cultural diversity. One fifth of the population was born overseas. In a departure from previous patterns, fewer than half of the post-1945 immigrants came from Britain or Ireland. During the 1950s and 1960s many immigrants arrived from southern European countries. More recently the Middle East and South-East Asia have been important sources of immigrants. English remains the language of most activities in education. About 2.5% of Australian school students are of Aboriginal descent, some of whom live in isolated communities.

Australia is governed at both a Federal, or Commonwealth, level and at a State level. There are six Australian States and two Territories. The Federal Government's main educational responsibility is in funding higher education institutions and in providing supplementary funding for primary and secondary schools and Technical and Further Education (TAFE) institutions. It also oversees the coherence and consistency of provision of education across the States and influences educational policy and programs.

14.1.2 Education Systems

Australia does not have a single national education system. The States and Territories are each responsible for their own educational administrations and funding of the primary, secondary and TAFE sectors. Each State and Territory has its own specific educational priorities, although the overall structures and Stages are similar across the States. Generally, children commence schooling in a preparatory or kindergarten year at around age 5, before completing 12 years of primary and secondary education. About 72% of students remain at school to the completion of Year 12.

Non-government schools enrolled 30% of students in 1999 (27% of primary and 35% of secondary school students), a proportion that has gradually risen since 1970 (ABS, 2000). Most private schools have some religious affiliation, most commonly with the Catholic Church (66% of private school students are enrolled in Catholic schools). A range of funding sources including government grants supports private schools.

Education is compulsory from ages 6 to 15 years and between these ages there is virtually 100% attendance at school. Most children start primary school at 5 years of age (and a majority of 4 year-olds attend pre-school (kindergarten) on a part-time basis). Primary schooling lasts for either 6 or 7 years, depending on the state concerned so that students complete that stage of schooling at the age of 11 or 12 years. Secondary education is provided for either 5 or 6 years depending on the length of primary education in the state. Students normally commence secondary school at about 12 years of age. Students may be exempted from attending school if they live at a great distance from a school or have a physical disability. Tuition would then be given through correspondence lessons, Schools of the Air or information and communication technology means.

Students in Australian primary schools usually have one teacher for most subjects, and are promoted each year. The first one or two years of secondary school typically consist of a general program which is followed by all students, and in later years, a basic core of subjects is supplemented by students being able to select additional optional subjects. Students in secondary schools generally have a different teacher for each separate subject area. In the final two years of secondary schools specialization based on a wider range of options is available.

In 1997, the average size of primary schools was approximately 230 (a scattered rural population necessitates a large number of small primary schools). In the same year the average size of secondary schools was approximately 780. During the 1990s there was a planned reduction in the number of government schools so as to increase the average school size. Almost all government primary schools are coeducational. Most government secondary schools are comprehensive and coeducational; secondary-technical (vocational) schools that previously existed in some states have been Staged out. There are a small number of selective-entry secondary schools in some states. In Tasmania and the Australian Capital Territory and some other locations, attendance for the final two years of government schooling is at separate senior secondary colleges.

In 1997 the ratio of students to teachers in primary schools was 17.9 and in secondary schools was 12.7. These figures include principals, deputy principals, librarians and senior teachers involved in administrative duties, along with some guidance counselling and careers advisers. Official information on the average size of classes is not available on a national basis for recent years. In the two largest systems in 1993 the average sizes of classes in primary schools were 27.4 in New South Wales and 24.5 in Victoria; and in secondary schools the average sizes of English classes were 22.9 in New South Wales and 21.5 in Victoria.

14.1.3 Curriculum

Although there is no common school curriculum across the country, the Commonwealth, States and Territories collaborated in the early 1990s to develop curriculum statements and profiles in each of eight key learning areas. The learning areas were: English, mathematics, science, technology, studies of society and the environment, the arts, health and physical education, and languages other than English. The statements provide an account of the aims and content of each area of learning as a framework for curriculum development in primary and secondary schooling. The profiles provide a broad outline of a sequence of students' development of knowledge, understanding and skills, and a framework for assessing and reporting student progress and achievements. All States and Territories are using the statements and profiles in some form for curriculum development, while incorporating variations that reflect local policies and priorities. The general pattern, even among government schools, is that central authorities specify broad curriculum guidelines while schools have considerable autonomy in deciding curriculum detail, textbooks and teaching methodology. This situation applies particularly at primary and junior secondary level. At the senior secondary level (Grades 11 and 12) the curriculum is more likely to be specified in detail by a state authority responsible for examining and certifying student achievement. At this level students generally have more

scope to specialize and a range of elective studies is provided. In a significant development in 1990, the state and federal education ministers established the Curriculum Corporation, a semi-autonomous body with a charter to develop curriculum materials on a commercial basis.

14.2 Broad Policy Objectives

Since the mid-1990s there have been major influences on the use of information and communication technology in Australian schools. As in many developed countries around the world, the traditional education system is confronted by the competing influences of the global mass media, information and communications technology in the home, and open learning alternatives. The continuing developments in information and communication technology have far reaching consequences for educational infrastructures at the administrative and pedagogical levels across all educational sectors. The traditional classroom environment is in a state of rapid change and is being challenged with a charter of improving the quality of teaching and learning to contribute to an equitable, creative, intelligent and economically sound knowledge society.

14.2.1 National Goals for Schooling

Although there are differences among the States in terms of priorities and resource targets, there are also common developments and objectives. Recently, the Ministerial Council for Education, Employment, Training and Youth Affairs (MCEETYA) agreed on national objectives for teaching and learning in Australian schools. The declaration entitled 'National Goals for Schooling in the 21st Century' proposed broad directions for guiding schools in achieving common outcomes for Australian students. Clearly highlighted were issues of equity, knowledge attainment, problem-solving and communication skills which were linked to the achievement of self-confidence, success, active citizenship and attitudes to lifelong learning. In the preamble it asserted that:

these national goals provide a basis for investment in schooling to enable all young people to engage effectively with an increasingly complex world. This world will be characterised by advances in information and communication technologies, population diversity arising from international mobility and migration, and complex environmental and social challenges.

Among the goals elaborated in the declaration was the following:

be confident, creative and productive users of new technologies, particularly information and communication technologies, and understand the impact of those technologies on society

14.2.2 System Wide Implementation of Learning Technologies

Guidelines for information and communications technology in education and training have been enunciated in a series of action plans. A national education and training action

plan for the information economy has been developed collaboratively with schools, higher education and training sectors (DETYA, 2000). The Ministerial Council on Education, Employment Training and Youth Affairs (MCEETYA) has supported its broad directions. A school education action plan, entitled Learning in an Online World, has also been developed and has been endorsed by MCEETYA (Education Network Australia, 2000a). Similar plans have been developed for vocational education and training and for higher education. Overall the plans establish areas in which strategies are to be implemented. These are the development of general and specialist skills in the application of information and communications technology, the building of an information and communications technology infrastructure with wide bandwidth, the development of education and training content, establishing supporting policies and formulating a regulatory framework. Three priority areas are specified for the school sector: making available connections of sufficient bandwidth to allow schools to integrate online services into curriculum practice; providing effective pre-service education and ongoing development for teachers; and developing high quality online content (EdNA 2000a). In each State action plans have been developed for the government schools in those systems. One example is *Learning Technologies in Victorian Schools: 1998-2001* (Victoria, 1998).

Core priorities identified as major strategic issues and critical success factors for Australian schools in adopting information and communication technologies are:

- Vision and leadership to drive change processes and schools' transformation;
- Infrastructure – hardware, software and networking;
- Connectivity and access;
- Users' knowledge and skills;
- Curriculum content and learning processes;
- Planning and organisational policies to support ICT initiatives; and
- Research and development to underpin and evaluate progress.

(Source: Schools Advisory Group, EdNA, Strategic Analysis discussion paper, April, 1999)

The range of strategies which have been applied to facilitate systemwide uptake of the learning technologies strategy in each state varies, reflecting the environment and availability of resources. Despite this, the strategies have generally resulted in similar outcomes.

14.2.3 Implementation

The autonomy of the States means that policy and funding strategies vary across Australia in education. This also contributes richness to the development of both frameworks of management and pedagogical priorities in the integration of information and communication technology in Australian schools. In most cases, schools themselves

make choices about how these technologies will be implemented (classrooms or laboratories, desk machines or notebooks) and many are exploring the range of potential applications in the schools. Overall there is a broad range of experience in the successful implementation of learning technologies.

14.2.4 Equity and Diversity

With the diversity in the Australian population, an uncoordinated response to managing the advent of information and communication technology in the schools could potentially be highly problematic. Diversity could easily lead to differing levels of opportunities and practices if equity of access to computer resources is not achieved. Currently, this issue is still a major concern in some quarters of education – particularly in schools serving low-income populations or in remote locations, such as those involved in educating indigenous (Aboriginal) students. In Australia, distance education is essential in meeting the learning needs of a considerable number of rural and isolated students. Currently, many distance education programs still utilize print materials, but there is some use of audiotapes and videotapes, HF radio contact, printed self-instructional materials and some audio conferencing. The challenge for Australia currently lies in the provision of resources to remote areas to permit access to the Internet and other communication technologies.

In Victoria there is a network of schools using videoconferencing to link classes for shared teaching programs using videoconferencing and telematics. In South Australia the MINSEC group of schools makes use of communication technologies to provide a wider range of subjects across a network of schools than would have been possible otherwise. In Queensland the Virtual Schooling Service makes subjects available to students in schools where there are too few students to justify providing a subject using conventional means.

NSW HSC Online is an initiative of Charles Sturt University and the NSW Department of Education and Training. It is a Web-based information network designed to service the Higher School Certificate needs of students, teachers, schools and subject associations.

An unpublished review of the service in its early stages of implementation found that it was well received by the students and teachers who use the service. However, expansion to mainstream use was limited by a lack of teacher and student awareness of the service, what it offers and how it may be used; and limited teacher and student access to Internetworked computers, both during and out of school hours. Issues of access, awareness, and teacher and student skills would also be major factors influencing the implementation of fourth generation distance education approaches in Thailand.

The concept of Open Learning is recognised as a particularly efficient and effective means through which all learners can access high quality education and training programs regardless of their social isolation or incapacity to attend educational institutions. A program administered by the Federal government known as ‘The Framework for Open Learning Program’ (FOLP) has been set up to benefit all Australian schools. Funded by

the Commonwealth and States, FOLP aims to promote the coordination and collaboration of open learning techniques with the use of innovative technologies.

Experience in many parts of Australia, undocumented at this stage, suggests that once access to technology and professional development is provided, the uptake of technology systems in educational institutions is more rapid in rural areas than in cities. This is perhaps most marked where initiatives redress the disadvantages of isolation.

14.2.5 Professional Groups

Two prominent professional groups in the field of information and communications technology are the Australian Computer Society (ACS) and the Australian Council for Computers in Education (ACCE). This latter group is the national umbrella association of computer education associations in the States and Territories. It has an advocacy role for the issues of different State groups. Recent positions adopted by members of ACCE to further the development of the use of information and communication technology in the classroom include:

- a central focus on pedagogical issues;
- the integration of IT across the curriculum and within all Key Learning Areas;
- assistance for teachers to work towards effective classroom practice to include greater use of and student access to information technologies; and
- increased linking of curriculum and information and communications technology developments.

14.3 Networked Resources and Information Gateways

14.3.1 Education Network Australia

In Australia's federal system of educational governance, many of the initiatives involving ICT have been at State level. At the Federal and State Government levels, there has been collaborative planning and resource efforts to connect teachers and schools to electronic networks such as the Internet. In 1995, the Federal Minister for Education introduced the Education Network Australia (EdNA) as a project of national interest in linking providers of education and training across all levels of the education system. The aim of this national strategy was to enable Australian educational institutions to adopt new information and communication services and technologies and to disseminate and produce content and services relevant to the Australian experience. The Schools Advisory Group (SAG) of Education Network Australia (EdNA) plays a major collaborative, advisory and advocacy role in analysing and guiding national policy in the use of information and communication technology in education. The EdNA Directory Service provides free access for all sectors of Australian education to quality education resources on the Internet. Effects of geographic isolation are alleviated through this initiative with the opportunity for collaborative access to national and international curriculum materials.

EdNA operates an information gateway, EdNA Online (www.edna.edu.au)

14.3.2 The Schools Online Curriculum Content Initiative

One of the most important recent collaborative initiatives has been the development of the Schools Online Curriculum Content Initiative (SOCCI) (www.educationau.edu.au/socci.html). This has been established as a joint venture of education.au limited and Curriculum Corporation. Its creation recognised the importance of collaborative activity in the area of developing digital curriculum materials. The initiative is to develop and provide high quality digital education content in priority areas to Australian school systems. It is focused on the areas of innovation (Science and Maths initially), enterprise and creativity, languages other than English, and studies of Australia at all Year levels. It is also developing materials in literacy, numeracy and mathematics for the middle years of school (Years 5 to 9) and science up to Year 10.

14.3.3 State Networks

In addition to the Education Network Australia most State authorities have established wide area networks that link schools and education agencies. Though these networks teachers have access to online resources provided by the State as well as resources provided through EdNA. In Victoria, networking has been of central priority with all schools connected to a Wide Area Network (VicOne) and a range of services including the internet. A satellite television network (SOFNet) delivers two channels of television for all primary and secondary government schools. Community organisations such as the Melbourne Zoo, larger industrial and commercial enterprises and small businesses, and the Department of Education (DEET) provide this service. Currently, there are over 2300 receiving sites in Victoria.

A digital resource centre (the Education Channel, www.education.vic.org) has been established as a means of delivering multimedia curriculum resources. DEET's Curriculum Development and Learning Technologies division supports schools by developing high standard materials and programs to support State curriculum frameworks. These are accessible through the Education Channels and the Department of Education's website. A website (SOFWeb) is an award winning interactive site which can be accessed across the State, nationally or internationally via the Internet. This site (http://www.sofweb.vic.edu.au) enables access to high quality educational support materials, networks and forums, and is one of the most heavily used educational websites in Australia. Electronic mail services have been introduced in all Victorian government schools so that individual staff members each have a mailbox. Other States have established, or are in the process of establishing wide area networks and network-delivered services.

14.3.4 Resources

State Education Departments have established strategic implementation plans for integrating and updating information and communications technology developments in

schools and in classrooms. Infrastructure to coordinate resources, delivery and access to information and communication technology at the classroom level in all schools has been coordinated by centralised State agencies. Further, each State and Territory has articulated a commitment to providing increased access to computers, a reduction in student-computer ratios (according to the national plan to an average of about 5:1 by 2001), Internet access for schools, well organised and monitored Professional Development programs for teachers, and increased networking opportunities to effectively and efficiently link schools and classrooms to educational and community interest sites. Sponsorship and entrepreneurial resourcing and partnerships with community organisations are also being pursued.

Funding by Federal and State governments has been provided to a large number of national teacher professional organisations with the aim of enabling them to build and consolidate their electronic networks to provide quality professional development for teachers through collaborative networks with universities, school systems and government agencies. Leading parent, principals and teacher education groups have also received funding to further information dissemination and collaborative opportunities associated with the integration of information and communication technology into education programs.

14.3.5 Use of Computers in Australian Schools

According to a national survey of 339 schools conducted in May 1998 (Meredyth et al., 1999), 71 per cent of schools had a student per computer ratio of 15 to 1 or less. However, as the survey noted, resource levels were improving rapidly and many States are now looking to achieve ratios of one computer to every five students. Since the survey the range of software has significantly expanded to include web authoring tools, data analysis programs and simulations.

At that time 37 per cent of school computers were operating in laboratories and 31 per cent in classrooms. Laptop computers for use by individual students accounted for just 16 per cent of all computers used for educational purposes in Australian schools, and most of these were in the private school sector. Secondary schools generally had lower student-computer ratios than primary (elementary) schools. However, secondary schools were also more likely to place the computers in laboratory settings and offer specific information and communications technology studies rather than integrating computer use in regular classrooms across the curriculum. Even at that time most computers in Australian schools used for educational purposes ran at 100 MHz or faster (this situation has now been improved) and had school-based access to printers, modems, scanners, file servers and digital cameras. Common applications in schools include integrated packages, reference CDs, educational games and virus protection. Very few schools had multimedia creation applications other than those (such as PowerPoint) available through the MS Office package.

14.3.6 Implementation Models in Schools

Two main models of supporting the implementation of information and communications technology at the school level are evident in Australia. The non-government school sector is tending to move towards the formal appointment of information and communications technology resource teachers available across the curriculum and also network managers with high awareness of educational needs and school practices. A number of Government schools are moving towards budgeting for information and communications technology support personnel and sharing information and communications technology resource personnel on a regional or cluster basis. Some interesting initiatives such as mentor staff programs, peer sharing, hiring of student expertise, network and on-line support and industry and community partnerships have been developed.

The identification and broader dissemination of “best practice” in using information and communications technology in classrooms is an important means by which educators can develop practical understanding and confidence in the use of ICT in their classrooms. In Victoria, in the mid 1990s exemplary primary and secondary classrooms in schools known as ‘Navigator Schools’ were resourced to provide working models for teachers to visit and experience information and communications technology and new learning and teaching practices in action. In South Australia a similar strategy was adopted and known as Discovery Schools and in Western Australia ‘Technology Focus Schools’ were introduced.

The Victorian Navigator Schools program was begun at a time when a range of innovations was being implemented in the schools of the system. Child-centred learning had for some time been the prevailing pattern in its primary schools. The Apple Classrooms of Tomorrow (ACOT) program informed early planning and supported implementation. Four primary schools were selected by senior executives of the department to become Navigator Schools. Three secondary schools that were to be selected to become Navigator Schools had previously been funded as Science and Technology Centres (and had received funds for infrastructure under that program). Each school developed its own learning technology plan and school project officers were appointed to assist with its implementation. Focused professional development programs including practicums were conducted in those schools. More detail is provided in Appendix 1.

The South Australian Discovery program includes research and professional development through six Discovery Schools, twenty Discovery Network teachers each year (thus involving 60 teachers over the three years of the project), and three Global Discovery Schools. Discovery Schools undertake school-based research into the measurement and evaluation of the characteristics and elements of learning technologies and their impact upon identified elements of quality schooling - for example, curriculum design, delivery and assessment; student’s attendance, participation, retention, achievement and student pathways; the school's learning culture; and the school's leadership.

In Victoria, where government schools are largely self-managing, financial subsidies were provided directly to schools to encourage the used of and managing school funds to provide access to computer facilities. State-wide licensing of software has been instituted

to encourage efficiency in access to resources. A Curriculum Development and Learning Technologies division supports schools by developing high standard materials and programs to support State curriculum frameworks. These are accessible through the Education Channel and the Department of Education's website. CD-ROMs have also been developed for teachers as an easily accessible resource to support schools in the implementation of curriculum guidelines and outcomes. Software programs designed for tracking, monitoring and reporting student achievement have also been implemented by the Education Department in Victoria (and NSW). This software is supported by Regional Trainers, in-service education opportunities and facilitated visits to schools that are expert at its implementation. A Professional Interaction Networks Project has been established in to facilitate effective professional networking and communications between Victorian teachers. At classroom level, collaborative projects using the Internet and other network learning technologies have been co-ordinated under the 'Global Classroom Project' which enables teachers to set up international and interpersonal learning opportunities. In addition, Victorian teachers are subsidised to lease notebook computers at little personal cost for their own use at school and at home.

14.4 Learning Technologies and Educational Practice

In Australia, there is a well-established practice in primary schooling of embracing and building on the knowledge and individual experience that each child brings into the classroom. The advent of ICT has many implications for the design of the learning experiences and classroom environment for children right from the first year of their schooling. In secondary schools there have been a number of curriculum projects that have focused on student-centred learning. The Australian Science Education Project (ASEP) in the 1970s focused on "discovery" learning based on student experiment, investigation and project work. In social education there were several projects that emphasized student work on authentic projects as the basis for student learning (the Social Education Materials Project is one example). Although these projects had an impact on teaching they lacked the support that modern information and communication technologies could have provided. Recent projects such as the Project for Enhancing Effective Learning (PEEL) have suggested that teacher interaction and development within schools is an important element in changes approaches to teaching and learning. Finding ways of best preparing children to learn and function in the context of rapid change, new technologies, a plethora of knowledge and global awareness is a pedagogical challenge.

14.4.1 Good Practice in Using Information Technologies

An Australian study of 107 schools that had implemented a significant innovation in educational practice included 20 that had sought to enhance learning outcomes by the use of information and communication technologies (Cuttance, 2001). There was wide variation in the ways in which information and communication technologies were being utilised. Four of the innovations focused on the early years of primary school, eight on the middle years (years 5 to 9) and the remainder on the upper secondary school. Five were based on laptop computers (mostly in non-government schools in which students

purchased their own machines). A few of the 20 cases were expanding beyond traditional curriculum structures and approaches to teaching. Most involved ensuring student access to the technology for the purpose of producing a range of products such as reports and presentations. A few made use of access to the Internet but this was restricted by the quality of the connection. One involved the development of on-line programs for students to access resources from other sites. In some cases the new approaches involved learning with technology in which the technologies substituted for activities that would otherwise have been carried out using other methods (eg word processing for writing reports). Other cases involved learning through technology in which the technologies were used to support "constructivist" approaches to learning. In most cases the outcomes being sought (such as engagement in collaborative learning approaches), and for which local evidence was offered, were broader than traditional outcomes assessed by tests.

14.4.2 Supporting Preferred Pedagogies

In Australia there has been an increasing recognition that technological literacy is not necessarily a goal in itself but a means to improve learning outcomes. Students' information and communications technology skills are becoming to be seen as inseparable from their analytical abilities. Likewise, greater work is being done in integrating ICT as a means of facilitating creativity, teamwork, problem solving and communication. Increasingly, the role of teachers is being reinforced as integral to promoting and affirming individual learning styles, assisting children to understand the processes of learning and enhancing student motivation.

Several research studies are investigating the impact of information technologies on teaching and learning. Cuttance (2001) pointed to examples of changes in teaching and learning that were linked to the introduction of information and communication technologies. Those examples included shifts to more student-centred learning, accessing a wider range of resources, greater individualisation of programs for students and enhanced student engagement. Approximately one third of the schools cited evidence of a direct impact on student learning outcomes (Cuttance, 2001: 93-95).

Studies that have obtained information directly from students and teachers report broadly similar results but note that not all students respond in the same way. One of these studies was conducted in ten schools with good levels of technology resources. It examined grade 5 student reports of the implemented curriculum in relation to the intended curriculum in the area of the Studies of Society and Environment (SOSE) (Allan, 2001). That study indicated that ICT was used in just under 60% of SOSE activities planned by the teachers. It was used most frequently to process work and to acquire information and little use was being made of interactive multimedia resources.

The major cognitive processing tasks required of the students in the SOSE learning activities were remembering and understanding. Students who had higher levels of reading achievement showed greater interest in learning new technological skills and students who had lower levels of reading achievement showed more interested in using information and communications technology to acquire information. The results of this investigation seem to suggest that the current use of ICT is tending to facilitate the less

complex cognitive processes of learning and provide an easily accessible entry into a world of facts and figures.

It is known, however, that this use is not the full potential of ICT and somehow the bridge between the powerful multimedia potential of the tool and its inception into classrooms needs to be made. Another study made use of student electronic diaries, and questionnaires, to investigate what students did, and their responses to using technology, while participating in a laptop-based innovation (M. Ainley et al, 2000).

The results indicated that laptops as tools for learning were adopted with enthusiasm, although this was not universal, and that they became valuable tools for learning. At this stage of the program there was little use of the computer as a tool for accessing information. Proctor (1999) investigated the use of computers in a program in the technology learning area in the upper primary school. Proctor found that students in the program that involved the use of computers had enhanced scores on a measure of creativity compared to other programs. It was also found that teachers reported a positive impact on their teaching practices. However, there was considerable variation among students within the different approaches in their responses and in their enjoyment of computer use.

Other studies have suggested that it is important to attend to other aspects of learning environments rather than assume that the introduction of technologies alone will result in changes (McRobbie & Thomas, 1998). Lankshear, Green and Snyder (2000) draw upon detailed case studies to show how schools in different settings can establish appropriate technology infrastructure. They argue for the development of teaching practices that enhance technology skills and a range of literacy skills.

14.4.3 Supporting Change in Schools

Although many Australian schools have generally been quick to grasp the potential tautology and information and communications technology, and many innovative approaches have been adopted, significant areas of concern remain. Cuttance (2001) argues that the schools in the national study of innovation had to overcome a range of technical and skills-related problems. The most common technical issue was hardware or system reliability. In addition there were issues of maintaining software and operating systems. These appeared to be especially issues for laptop programs. Teachers generally did not have the expertise to solve these problems for students.

These issues point to the importance of technical support for ICT programs in schools. The national innovation study also points to the accessibility of connections to the Internet in schools and the problems of adequate Internet bandwidth. Students and teachers alike become frustrated when connections are slow and unreliable. Of course these issues partly relate to meeting costs and schools in these innovations had to devote resources to the implementation of ICT in the schools.

There are personnel issues associated with the introduction of ICT in schools. One of these concerns the wariness of teachers to what is seen as another technical intervention.

Cuttance (2001) argues that persuading staff of the benefits of adopting the technology was a significant feature of schools that had made successful innovations. Allan (2001) argues that progress has been slower than hoped in changing teacher practices, and providing resources for schools, in some sectors of education. There are concerns about gaps in teacher skills and student competencies. This issue is compounded by the rapid rate of change in ICT practice.

A national report identified some key areas of concern expressed by a number of educational authorities in implementing information and communications technology (Meredyth et al, 1999). These included: universities being perceived as maintaining inadequate computer laboratories with out-of-date equipment for teacher training; a lack of teacher role models in good practice in information and communications technology; concerns about the use and monitoring of the use of the Internet, email and chat-rooms by students; dissatisfaction with the maintenance and technical support in primary schools; concerns about the high level of resources needed for computerised reporting of student progressing and inequity in access to computing resources.

A national survey of teachers in Australian schools reported that 44 per cent teachers had completed pre- and/or in-service training in teaching and assessment strategies in information technology (Dempster et al, 2001). Approximately 32 per cent of all teachers had received only in-service training in the use of information technology and 12 per cent had pre-service training in the specified aspects of information technology education. There is currently a national project on models of teacher professional development for the integration of information and communication technology (ICT) into classroom practice. The first Stage of the project has explored existing models of teacher professional development in ICT in school systems across all Australian states and territories, as well as approaches to pre-service education in tertiary institutions. The second Stage will focus on collaborative activities that share information through the use of online networks. Details are available from the project website at www.teacherpd.org.

Australian education has identified as priority areas: a greater understanding of the interdependence of conditions which facilitate success in improving both student and teacher learning outcomes with the use of ICT; the identification and operationalisation of the role of school education in the context of a knowledge society; the need for equity to both access and effectively use ICT; the need to bridge the gap between the potential of ICT and its actual implementation in the classroom; and national monitoring of teacher and student competencies, resources and learning outcomes. Significant progress in achieving these objectives has been made in recent years. However, much work still needs to be done in supporting teachers and school systems in transforming the learning environment of the classroom into one that fully captures the potential of using ICT to improve student learning.

14.5 Changes in Post-secondary Education

14.5.1 Flexible Delivery in Vocational Education and Training

The Australian National Training Authority (ANTA) and State TAFE authorities have funded a range of projects to examine models for flexible learning, frameworks for cost-benefit analysis of flexible delivery programs, and to create tools for the development of online course delivery. For example ANTA has commissioned the development of multimedia *"Toolboxes"* for online product development. The toolboxes provide a range of resources for training providers seeking to develop online training products. There is potential for new models of distance and flexible learning education in Thailand to capitalise on such work.

14.5.2 Flexible Learning in Higher Education

In Australia's higher education sector, increased demand for flexible learning is driven by adult learners whose access to on-campus studies may be constrained by distance from an institution, or who seek flexibility in the time, place and pace of study.

The establishment of the Open Learning Agency of Australia has enabled Australia to substantially improve access to a range of training and higher education programs at very low unit cost, when compared to the capital and recurrent costs that would be incurred by establishing an open university. The Open Learning Agency of Australia is reliant on institutions with existing flexible learning programs offering open access to those programs. The costs to the participating universities are relatively low, comprising mainly administration costs (a proportion of revenue goes to the Open Learning Agency), the marginal cost of duplicating and distributing additional materials, plus the cost of marking student work and providing relatively low levels of tutorial assistance. Some universities have raised concern about the gap between funding provided for Open Learning Agency students and on-campus students impacting on the quality of learning materials and student support services (NBEET, 1997).

Open Learning Agency study materials are largely print based. Some units utilise audio and/or videocassettes, on-line study materials and support via the Internet, CD ROM packages, computer assisted learning (CAL) programs or laboratory kits. In addition, some units are supported by television and radio programs. The Open Learning Agency encourages students to form self-reliant study groups to provide social interaction between learners.

Such approaches suit learners who are highly print literate, motivated and who have a record of successful educational achievement. An early evaluation of the Open Learning Initiative (the Commonwealth program that spawned the Open Learning Agency) found that the program attracted few enrolments from recent school leavers, suggesting that such students, in general, prefer on-campus studies. An evaluation of the Open Learning Initiative found that although the initiative has attracted a diverse range of students, the background characteristics of its students are more similar to distance education and adult community and further education students than to on-campus students (DEET,1997).

14.6 Applications Of Technology In Teaching And Learning

ICT provides a set of tools that can extend the power of thinking and learning. Rowe (1994) argued that the computer could extend the capacity of human short-term working memory, enhance the organisation of knowledge in long-term memory, and expand the learners' use of cognitive strategies. Others have argued that information technology could not only afford the opportunity to extend traditional media but could also create opportunities that would not be available without the use of technology. Computers are tools that can be used for many purposes. Rubin (1996) identified 12 ways that computers could contribute as tools that enhanced student learning in classrooms. For this project the 12 tool categories developed by Rubin have been grouped in four broad groups: an information resource tool, an authoring tool, a knowledge construction tool, and as a knowledge reinforcement tool.

14.6.1 Computers As Information Resource Tools

Computers are resource tools that can provide access to information. Rubin (1996) referred to the Internet, World Wide Web, and reference CD ROMs vastly expanding classroom access to information and learning resources. From these media it is possible to use topical databases, encyclopaedias, and dictionaries as well as Internet search services and expert systems.

14.6.2 Computers As Authoring Tools

Computers enable students to work with and present information. In Rubin's terms computers provide environments for the construction of information. Computers offer opportunities to transform how students construct and present information using word processors, spreadsheets, presentation tools, publishing tools, graphics design and painting tools. Generic information handling tools such as spreadsheets, databases, word processors, graphics packages, and presentation software are office productivity tools that have application to the classroom and to many of the other tasks undertaken by teachers and students. As tools for creating multimedia (such as software featuring video, audio, text and graphics), and interactive multimedia, reports or creating a classroom knowledge base the authoring aspect extended even further.

Computers can also provide even more sophisticated authoring tools by enabling the creation of and interaction in virtual communities. Virtual forums and networks can be used as tools to add real world meaning to classroom activities. International projects ranging from communicating with globe-trotting teddy bears via email to collaborating in global scientific investigations offer new and engaging classroom activities that can support and extend student learning by providing information, tools, experts and audiences for classroom learning.

14.6.3 Computers As Knowledge Construction Tools

Computers assist students to explore knowledge and meaning within a given context. Computers can provide construction environments through software such as LOGO, Lego LOGO, Geo-LOGO, Microworlds, and Intellecta, that allow children to learn through constructing and controlling their own computer-based objects or environments. Cognitive tools such as Tabletop and Inspiration serve a similar function.

Capturing and analysing real-time data can also enable knowledge construction. Dataloggers such as Intellecta, Tain, and Sense and Control can be used to capture data in real time from action in the real world, and to record and analyse it. These tools enable students to investigate how the real world works and to learn how phenomena can be translated into graphical representations.

Another aspect of computers as knowledge construction tools involves simulations such as SimCity2000 and SimTown. These programs allow students to change parameters and run models to see the effects, encouraging student inquiry into complex phenomena.

14.6.4 Computers As Knowledge Reinforcement Tools

Computer assisted learning software (such as typing programs and mathematics programs) and integrated learning systems (such as SuccessMaker) offer drill and practice on basic skills. Educational games (such as Where in the World is Carmen San Diego? and The Incredible Logical Journey of the Zoombinis) support the learning of factual information and the development of reasoning skills.

14.7 Measuring Outcomes

In Australia, as in most other countries, the measurement of information technology outcomes (including information technology skills) is relatively undeveloped compared to the assessment of outcomes in areas such as literacy and numeracy. One set of outcomes concerns information technology skills themselves. Such outcomes are measured in the European Computer Driving Licence (ECDL) which has currency in a number of European countries and is used in the tertiary education sectors of a number of European countries but not in schools. Other sets of outcomes are less specifically concerned with information technologies and relate to higher-order thinking skills, workplace competencies and non-cognitive outcomes. For example the Second International Technology in Education Study plans to assess “knowledge management” outcomes in relation to information technology. Other impacts of technology concern the teaching processes themselves and it is important to know what impact information technology has on teaching and learning processes (Gearhart et al, 1994).

Both information technology outcomes, and broader educational outcomes, are recognised in the plans of education authorities and schools. Australian education systems are currently developing a national system for monitoring students’ information technology skills and knowledge. That process will involve establishing agreement on terminology, definitions and assessment criteria and investigating the possibility of

linking information across systems. It will also involve developing performance assessments for students to be administered periodically to nationally representative samples of students so that achievement trends can be monitored over time and patterns at any point in time can be established.

At the present time information about outcomes is based on teachers' judgements in relation to the curriculum standards frameworks for the technology learning area and self-reports by teachers and students of their acquisition of information technology skills. A national survey conducted in Australia in 1997 included a list of 13 core, and 13 advanced skills for the operation of computers and asked students to indicate which of these skills they had and where they first acquired them (Meredyth et al, 1999). As illustrative examples 49 per cent of Year 6 students and 59 per cent of Year 10 students reported that they could send an email message, 44 per cent of Year 6 students and 54 per cent of Year 10 students reported that they could create a multimedia presentation, and 57 per cent of Year 6 students and 84 per cent of Year 10 students reported that they could use spreadsheets or databases. Thirty-one per cent of Year 10 students claimed to know how to attach documents to an email message and retrieve documents that have been emailed as attachments. Fifty per cent of Year 10 students reported that they could work out which information is useful and reliable when they use the Web for school.

The 1997 survey also gathered information about teacher skills and knowledge. The survey data indicated that more than 95 per cent of teachers possessed the basic skills required to use computers. However a considerable proportion was lacking some of skills necessary to use a range of computer applications. For example, 24 per cent did not know how to use the Web, more than a third could not use email and an even greater proportion did not know how to send and retrieve attachments.

Allan (2001) used self-report data from a smaller sample of Year 5 students to establish a hierarchy of attainment for computer skills. That analysis suggested that basic operating skills and recreational game operating skills are the skills that are first attained, followed by more functional software skills that allow access and exit from word processing programs. After these a student then develops more complex management skills that allow them to manipulate files. Finally skills are developed that can be applied to use the computer as a tool to creatively achieve the outcome rather than being the object of use itself. The development of hierarchies such as this, perhaps based on performance data, can do much to help illuminate the sequence of skill acquisition.

In Australia there has been a number of studies of attitudinal outcomes from the use of information technology but it remains an area in need of clarification and development. In addition there remains a challenge to define and measure outcomes such as "knowledge management" that relate to, and are may be enhanced by, information technology but are not specifically information technology. There may be even broader outcomes of the use of information and communication technologies in schools than are adequately captured by traditional measures. These relate to new skills such as communication, collaboration, and higher level thinking required in education and in the social and economic world outside school.

15 Research Evidence and Impact on Student Learning

Research on the impact of information and communication technologies on student learning is in an early Stage compared with other areas of education where systematic research studies have a longer history. In this rapidly developing field the focus is continuously changing as new technologies emerge and established technologies develop. One review has characterised the changing modes of use of information technologies as follows. Stage 1 modes, characterised as computer-based instruction using discrete computers and instructional programs ("print automation"); Stage 2 modes in which computers were envisaged as tools for learner-centred pedagogies using a variety of applications to access and process information and share products; and Stage 3 involving "data-driven virtual learning" in which technologies are part of the school design used to expand the range of resources available to student and teachers (Valdez et al, 2000). Although the field remains contested there have emerged a number of important research studies and reviews that point to beneficial effects on student learning from the use of information technologies (Valdez et al, 2000; Schacter, 2001).

15.1 Meta-analyses and Reviews

In the early 1990s a meta-analysis synthesised the results from a large number of individual studies of learning outcomes from the instructional use of computers (Kulik, 1994). That analysis concluded that the use of computer-based, or computer-assisted instruction produced a moderate effect on achievement (technically the effect size was 0.35). It was also found that the magnitude of the effect depended on the particular use of the information technology, and the area in which it was applied, with the effects being strongest where the use was part of a highly structured program and where students were involved in developing programs and procedures.

A more recent narrative review concluded that students in technology rich environments generally experienced positive effects on achievement in all curriculum areas (Sivin-Kachala & Bialo, 2000). That review also argued that the impact of the technology depended on role of the teacher, the level of student access to the technology (adequate numbers of computers located in classrooms), the design of the software and characteristics of the student population. It found that learning technologies had been used to stimulate more interactive teaching, facilitate inquiry-based and project-based learning and allow more effective groupings of students in co-operative learning. Importantly, the review concluded that technology was an effective intervention when teachers who had a commitment to student-centred learning used it.

15.2 Conditions for Effectiveness

Several research studies point to the importance of the ways in which information technologies are used for them to influence student achievement. Wenglinsky (1998) investigated the influence of the use of learning technologies on mathematics achievement by more than 6,000 students in Grade 4 and 7,000 students in Grade 8 using data from the National Assessment of Educational Progress in the United States. The analysis incorporated statistical controls for the influence of socioeconomic background, class size and teacher attributes so as to establish better the contribution of technology to student learning. It reported that the use of technologies had positive effects on mathematics achievement in Grade 8, but only small effects in Grade 4. It was found, for the Grade 8 students, that teacher professional development in information technology and the use of computers for simulation and to promote higher order thinking skills were positively related to mathematics achievement.

In other learning areas there is evidence of the effects of information technologies and the conditions under which those effects are maximised. Reviews of research have indicated benefits from the use of word processing on students' writing proficiency (Bangert-Drowns, 1993; Cochran-Smith, 1991). Additional perspectives can be found in studies of computer supported intentional learning environments (Scardemalia & Bereiter, 1996). In those environments students use information and communications technology to interact with other students in developing questions, seeking answers from other to those questions as well as reviewing and reformulating their own and other work. Scardemalia and Bereiter (1996) report moderately strong effects of this program on measures of depth of understanding as well as on standardised reading and language tests.

Similar results have been reported for the effectiveness of integrated learning systems (Worthen et al, 1994). An evaluation of the Apple Classrooms of Tomorrow program reported the introduction of new learning experiences involving higher order thinking into classrooms more positive student attitudes to learning and changes in teaching practices but no benefits on standardised achievement tests (Baker, Gearhart & Herman, 1994). Becker (2000) argues that under the conditions of appropriate teacher expertise and support there is an effect of technologies on teaching practices; especially when the practice is consistent with the teaching philosophy of the teacher.

15.3 System-wide Studies

Studies that have examined changes in student achievement as information technologies have been introduced across school systems are more difficult to interpret because of the other potential influences on achievement. Nevertheless, those studies are indicative of positive effects of information technologies on changes in achievement. A study of one statewide basic skills and computer education initiative (as part of an integrated learning system) found that access to enhanced information technology as part of the learning system was associated with increased achievement on standardised test scores (Mann et al, 1999). Another study of New York school districts over three years pointed to increased success in state-wide examinations in mathematics and English in schools that

had introduced more instructional technology and associated teacher training (Mann & Schaffer, 1997).

15.4 Attitudes

There is also a balance of evidence that suggests information technologies enhance students' attitudes to learning, motivation and engagement with learning tasks possibly because they experience higher levels of interaction and collaboration (Valdez et al, 2000; Rowe, 1993; Fisher et al, 1996). A publication based on three major international studies concluded that for the child the use of computers in schools is generally a positive experience (Collis et al, 1996). However, there is a need to recognise differences in students' learning styles and preferences.

15.5 Summary

In general it appears that the extent to which there are improvements in learning outcomes from the use of information technologies depends on the conditions under which the technologies are introduced and the learning outcomes that are being considered. The extent to which teachers have developed expertise (for example through professional development) in the use of these technologies is a crucial factor that shapes their impact (Smerdon et al, 2000; Collis et al, 1996). Technologies are also used more extensively when compatible with a teacher's general approach to teaching (Becker, 2000). It is a matter of matching the application with the intended learning goal. Becker argues that under the conditions of appropriate teacher expertise and support there is an effect of technologies on teaching practices. In addition it is important that the technology is available in sufficient quantity in classrooms, and with other equipment, for them to be effectively used (Smerdon et al, 2000; Means et al, 1993). An understanding of the impact of information technologies on student learning needs to be linked to the approaches to pedagogy that are adopted and the wider support of teacher development in its application.

16 Information technology in non-traditional settings

16.1 Learning Centres

16.1.1 Learning Centre Models

Learning centres have been developed in a number of countries as an important means of providing wider community access to learning resources. Several models for learning centres have emerged. One involves providing access to school learning technology and library facilities after hours (eg in Australia and in the United States). A second is the development and support of single purpose facilities such as those in the higher education sector. A third is providing stimulus for the development of community-based telecentres, which have functions including learner access to technology.

Communities in many parts of the world have established Telecentres. Telecentres are organisations that provide information and communications technology services and training to support rural communities, local businesses, distance education and information access. Telecentres provide opportunities for service delivery to and from all levels of government, and have the potential to enhance many aspects of community life.

An early Australian study cautioned that dedicated learning centres in Australia would be under-utilised, warning against the development of an expensive infrastructure of learning centres noting that 'only a small proportion of students reported using learning centres frequently.' (Mitchell et al, 1995). It argued the evaluation of alternative models for learning centres needed to consider accessibility for learners, physical facilities, staff skills in supporting learners, administrative systems as well as public and private costs.

16.2 Distributed and Distance Learning

16.2.1 A Conceptual Framework For Distance Education

Taylor (1997) distinguishes four generations of distance education, characterised by the technologies used for instruction. The first generation *Correspondence Model* involves the use of print resources and interaction between teacher and learner by mail. The second generation *Multi-media Model* of distance education involves the use of self-instructional resources such as printed study guides, readings, videotapes, audiotapes, computer-based courseware and CD ROM. The third generation *Telelearning Model* of distance education is based on the use of technologies such as audioconferencing, audiographics, videoconferencing and broadcast television/radio. The fourth generation of distance education, the *Flexible Learning Model*, combines interactive multimedia, with access to learning resources and interactivity through computer mediated communication (CMC) through the Internet. Each successive generation of distance education provides enhanced opportunities: for individual interaction between learner and

instructional materials and other resources; for social interaction between learners and teacher, learners and other learners, and learners and the world; and catering for a range of preferred learning styles.

16.2.2 New Models of Distance Education

One example of a new model of distance education is the European Commission's *Telematics for Flexible and Distance Learning Program* (DELTA). It was made up from a series of 30 projects conducted during the period 1992-95. The projects addressed a range of issues consistent with those faced in distance education in other countries. It was found that positive learning outcomes were achieved through technology-based programs particularly when distance teaching and learning was combined with periodic face-to-face interaction in seminars and residential meetings. In addition, training in the use of technology systems for tutors, students and other users was imperative and was often underestimated when projects were designed.

Although the program was initially focused on the development of hardware and software applications specific to teaching and learning, it found that available multi-purpose hardware and software systems were most successful. The program was re-oriented to the development of technical standards to optimise the wide application of distance learning courseware and services developed in individual countries. It initiated pilot projects concerned with cost-effective ways to utilise new technology for education and training. DELTA projects developed models for the production of multimedia learning materials as well as publishing and delivery of course material using computer mediated communications. They also developed software tools for the cost effective design and production of multimedia resources, a process to enable providers to re-use course learning modules, and a system to enable course tutors to package materials for their own courses and to publish the selected materials on demand. The program developed tools and models to co-produce flexible and distance learning materials through international collaboration with delivery and support for learners provided at the more local level.

16.3 Authentic Learning through ICT

Once equipped with the information and community technologies, schools are able to provide a new range of "authentic" learning experiences for students. That is, learning activities which have tangible value to students, aside from being tasks required as part of a learning program (Newman, F, et al 1995 A Guide to Authentic Instruction and Assessment: Vision, Standards and Scoring.). Authentic learning experiences, which commonly involve students in "real world" situations rather than manufactured classroom experiences, can stimulate engagement in the learning process and lead to the development of skills and understandings that are directly applicable in society.

The following technology learning situations provide a context for formal basic education as well as authentic learning experience.

16.3.1 Collaborative Online Student Projects

Collaborative online projects involve students in different locations working together on a shared project, via email and the world-wide web. The project might be solving a an environmental mystery, preparing an anthology of poetry, raising money to support famine victims, campaigning for human rights, gathering scientific data or surveying global opinion on a an issue poll of concern to young people.

These activities are by their nature student centred and focus on the development of skills and such as collaboration, problem-solving and communication. The projects also frequently involve direct communication between students and mentors such as scientists, authors and leading public figures. The projects typically also require only basic technology skills, such as the ability to use email and access websites.

Learning activities of this kind, coordinated through the Global Classroom Project (www.sofweb.vic.gov.au/gc) played a central role in the development of the learning technologies program in Victoria, Australia. In that State, the program not only provided a source of authentic learning activities for students, but also created a network of teachers and students who have acted as project coordinators and online mentors for other teachers wishing to develop skills in the use of learning technologies.

Through online projects students have acted not only as writers and researchers, but also as online editors and managers, gaining experience in roles carrying the responsibility associated with international projects. Teachers have created fulfilling roles for themselves as project leaders and professional developers, that have often led to appointments in new professional roles as project leaders and professional developers.

16.3.2 Teddy Bear Project

For example, in the Teddy Bear project (http://www.iearn.org.au/tbear/) primary school students from different schools provinces or countries exchange a soft toy or mascot. Children treat the visiting toy as a guest who is invited take part in activities at school and at home. The children write about the experiences of the visiting toy in the form of a diary which they send back to the partner school. In return the partner school sends messages describing the far off adventures its plush visitor.

This project, in which thousands of school participate worldwide, generates great enthusiasm for writing amongst young students, as well as promoting understanding and friendship between people from different cultures.

16.3.3 The First People's Project

The First Peoples' Project (http://www.iearn.org.au/fp/) links indigenous students around the world in art and writing exchanges. Students create art and writing on specified themes and these are exchanged with other indigenous students. A magazine and a calendar are produced annually featuring the student art and writing. An annual art exhibition is held featuring local and international art.

A number of Thai students and teachers, including Karen children in four schools in Umphang District are involved with this project. Artwork by these students is available on the First Peoples website. In 2000 other members of the first people's network sent materials to the Karen schools and raised funds to help Karen youths to stay in school.

16.3.4 Web Competitions

Many schools world wide participate in competitions or web challenges involving the production of websites, designed to solve a problem or convey an chosen message or theme. The projects often teams of students in different locations working together on a shared solution.

In addition to providing a challenge to the students' ingenuity, these competitions often provide incentives of prize money, or trips to award ceremonies. Popular examples ate the Childnet Global Awards and (http://www.childnet-int.org/awards/) and Thinkquest (http://www.thinkquest.org/).

The results of the competitions, viewable at the above websites, demonstrate how much can be achieved by students when engaged in a creative educational activity. Many participants are self taught web builders, using only tools freely available via the Internet. Winning entries are often based on simple ideas

16.3.5 Providing Services for the Community

In some communities schools are able to provide valuable services to local businesses, clubs and community groups based on the technology available in the school. Services range from the preparation of business stationary and brochures through to printing of newsletters and development of websites.

Activities of this kind not only produce products of value beyond the classroom, that may in fact generate revenue to the schools, but also strengthen links between the school and the local community.

16.3.6 Connecting with Culture, Science and Industry

Networks of students can also assist in the gathering of important scientific data. School children in Australia participate each year in Saltwatch a program that is helping to understand and manage problems caused by salt pollution of farm land. Each year students in hundreds of school across the country make measurements of the salt content of water in local dams and streams. The results are submitted through a website (http://www.saltwatch.org.au/) which instantly displays the newly submitted results together with results submitted by other schools on a map which is viewable through the web browser.

The students also undertake related curriculum activities linked to the science and geography curriculum.

Using the Internet, students and teachers can also make contact from the classroom with resources and experts from cultural organisations such as museums and galleries that operate websites. This has the benefit of bringing the nation's cultural assets, that would normally only be available to researchers or those able to visit the institutions, directly into the classroom.

There are also many examples of programs that involve students in assisting museums with the collection and classification of items of scientific and cultural significance. The Insectathon operated in conjunction with the National Museum of Namibia (www.natmus.cul.na/insectathon.html) has involved students in the cataloguing of insect collection while using associated sponsorship to support the roll out of Internet services to schools.

The Flying Colours project at eth National Museum of Victoria in Australia (http://flyingcolours.museum.vic.gov.au/) enables students to draw upon and contribute to the Museum's research database covering the distribution of butterflies.

16.4 Applications in the Management of Education and Training

There is significant scope for using technology to assist in the management of learning. Many of the software applications rely, however, on teachers having a high level of access to computers. It is unlikely, therefore, that in the foreseeable future computers will be widely used to closely plan and manage student learning. Information and communications technologies will play a major role in supporting the education reforms, however, particularly in supporting of new, data intensive quality assurance processes designed to support improvement in educational outcomes.

17 Section D
Further Support For Implementing Reform In Learning technologies

This report has identified a range of immediate priority areas which require further technical assistance. It is proposed that this technical assistance be provided to support the implementation time frame for the increased use of learning technologies stipulated in the National Education Act.

17.1 Staged Implementation

It is recommended that the *TLT 2010* program should be implemented in Stages. Timing of the Stages will depend on the availability of financial and human resources, and may in some cases overlap.

17.2 Stage 1: 2001 – 3 Policy Development, Planning and Implementation of Strategic Initiatives

During this stage, policies and plans will be developed in consultation with key stakeholders. The visions and plans will be promoted and communicated, and the need for coordination across all areas of education reform will be highlighted. These reforms will occur in a range of areas, including curriculum and assessment, teaching and learning practices, accountability and organisational structures.

17.2.1 Involving a Range of Stakeholders and Organisations in TLT 2010

A National Advisory Committee on Learning Technologies in Education Reform will be established to develop the *Thai Learning Technologies 2010 Masterplan*. A comprehensive range of stakeholders and organisations should be represented on this committee. The National Advisory Committee on Learning Technologies in Education Reform should advise on the Learning Technologies programs to be undertaken and the agencies responsible for implementation. A high priority for the Committee should be consideration of the recommended new organisational structures to ensure efficient planning and implementation.

Whilst ONEC would take a lead role in the development of policies and plans for the implementation of learning technologies initiatives in Thailand, it is proposed that other agencies play key roles in appropriate areas of planning and implementation. As an example, the Ministry of University Affairs should be involved in the Education and Training Gateway and the Networking and Distance Education initiatives, the Ministry of Education could establish Online Curriculum Communities and the Navigator School

Program, and the Institute of the Promotion of Science and Technology could take a lead role in some professional development programs.

17.3 Employing External Expertise

There is an enormous amount of ICT expertise within ONEC, RTG Ministries, Departments and organisations, in Thai education institutions and other Thai agencies. However, it is proposed that those leading the *TLT 2010* program also utilise world-class expertise from other countries and develop networks with international colleagues and institutions with ICT expertise to support the implementation of learning technologies in Thailand.

For example, it is proposed that those responsible for *TLT 2010* undertake a study tour to Australia to view innovative learning technologies programs first-hand and to meet with the experts responsible for those programs. The Thai leaders can use their direct observations and research undertaken on the study tour to inform their judgements about the kinds of programs and initiatives most suited to Thailand.

Strategic links between professionals and institutions could be made during the study tour which could support the implementation of specific strategic initiatives. For example, formal institutional links could be made between DEET and ONEC (or the MOE) to support the Navigator school initiatives, or between Curriculum Corporation (CC) and the ONEC (or the MOE) to collaborate on the development of Online Curriculum Communities. DEET and CC have specialist expertise to offer the RTG should these initiatives be selected for implementation. Similarly, ACER could provide specialist expertise to a Thai Research and Evaluation initiative. Further detail about proposed technical assistance is outlined in Tables 1 – 6(a).

17.4 Immediate Action

During Stage 1, activities will include the development of implementation plans, the introduction of Strategic Initiatives, the establishment of the education network, the introduction of the Navigator school program, professional development and teacher training programs, commencement of procurement processes and development of digital materials.

This Stage will build upon what has been learnt in successful system-wide and local implementations elsewhere in the world. Consultants can assist in this process, but capacity will be built by Thai education officials, school leaders, teachers and students who experience the application of learning technologies first-hand and are able to promote ICT initiatives and successful strategies at the ‘grass roots’ level. Teams will be established in educational institutions to coordinate the process of learning technology implementation. Teams must have a deep understanding of the role of ICT in education as well as other aspects of educational reform, change management, human resource development, and student-centred learning.

17.5 Stage 2: 2003 - 6 Major Rollout of Hardware, Software and Training Programs.

Further resources and training programs will be provided to support Thailand's education leaders and teachers in all aspects of learning technologies. A diverse range of programs will be needed, addressing the broad array of interests and needs of individuals. Programs will be required to develop the quality of leadership at all levels while encourage ownership by all stakeholders, to facilitate change and empower individuals as change agents. While computer skills training is needed, the success of the program will be dependent upon developing teachers' ability to integrate the technology into mainstream teaching and learning. Collaborative networks should be developed to share successful practice and provide collegial support.

17.6 Stage 3: 2006 –10 Embedding of Practice and Commencement of Renewal Cycles

Having been provided with infrastructure, training, and content, teachers and learners will embed the use of technology in mainstream learning. Education institutions and individuals will generate new applications during this process and achieve secondary targets. The upgrade and replacement of infrastructure commences during this period.

17.7 Proposed Assistance

The key elements of the proposed assistance are:

17.7.1 National Workshop

A national workshop led by ONEC to consult with key stakeholders on the recommendations and strategic initiatives outlined in Thai Learning Technologies 2010 report.

17.7.2 Study Tour

A study tour to selected sites in Australia by senior ONEC staff and selected representatives from other agencies to identify suitable programs for Thailand and to explore implementation issues. The tour should be coordinated by a national education agency in consultation with key national and state/territory stakeholders.

17.7.3 Development of Detailed Implementation Plans

Based on the policy recommendations and strategic design contained in the report, it is proposed that detailed implementation plans be developed which will detail strategies, deliverables, timelines and costings for programs to support:

- Human resource development

- The development of software and content
- ICT infrastructure
- Change management

These plans will make reference to the strategic initiatives suggested in the report and others initiatives already planned or established by ONEC. Australian consultants should work closely with senior ONEC staff and selected representatives from other agencies, as required in the development of these plans.

An overview of the scope, timing and resources required for development of these plans is provided in the following tables. The detailed implementation plans will be developed in line with relevant existing and planned policies.

It is beyond the scope of this report to give a comprehensive overview of the implementation plans required at national, regional and local levels to adequately address all areas. However, Table 6 (a) has been developed as a draft example of one component of the Human Resource implementation plan required to provide support for the national strategy to increase the use of learning technologies in education.

17.8 TABLE ONE - Further Technical Assistance To Implement Learning Technologies Reform WORKSHOP

DATE	ACTIVITY	INPUTS	OUTPUT	BUDGET	
				ONEC (Staff/Baht)	**AUSAID (Staff/$)**
Oct 2001	Development of workshop program in consultation with ONEC	ONEC staff Australian consultants (4 days)	Workshop program	Provision of office and staff	1consultant
Nov 2001	Preparation of workshop program and papers	ONEC staff and secretariat Australian consultants (10 days)	Workshop academic and discussion papers	Provision of office and staff	2 consultants
Dec 2001	National Workshop – 2days	ONEC staff, staff from selected national, regional and local agencies Australian consultants (10 days)	Refined and agreed priorities and recommendations, on which to base Stage One	Provision of office	2 consultants
Dec 2001	Workshop Evaluation	ONEC staff and secretariat	Workshop Report	Provision of staff	

17.9 TABLE TWO - Further Technical Assistance To Implement Learning Technologies Reform AUSTRALIAN STUDY TOUR

DATE	ACTIVITY	INPUTS	OUTPUT	BUDGET	
				ONEC (Staff/Baht)	AUSAID (Staff/$)
Aug 2001	Plan study tour to observe learning technologies programs and meet with leaders in planning and implementing effective learning technologies in education programs	ONEC staff organising committee Australian consultants (2 days)		Staff	1 consultant
Sept 2001	Select group of senior Thai officials drawn from ONEC and other agencies visit Australia for 14 days	ONEC staff Australian consultants (16 days)		ONEC staff and coordinating body	2 consultants

17.10 TABLE THREE - Further Technical Assistance To Implement Learning Technologies Reform

DEVELOPMENT OF DETAILED IMPLEMENTATION PLAN FOR CHANGE MANAGEMENT

DATE	ACTIVITY	INPUTS	OUTPUT	BUDGET	
				ONEC (Staff/Baht)	AUSAID (Staff/$)
Dec 2001	Establish a project team of experts, stakeholders and end-users to guide the development of the Implementation Plan.	ONEC Secretariat Australian consultants (8 days)	Project team meets to devise and document guiding principles and process for implementation plan development	ONEC staff	2 consultants
Dec 2001	Review existing Masterplans and CABTER Ed Technologies Report to identify key visions and goals in Organisational Change and Management	ONEC Secretariat Australian consultants (24 days)	Australian consultants and ONEC staff conduct and document a series of site visits and meetings planned by ONEC	ONEC staff	2 consultants
Feb 2001	Visit a range of education institutions and community centres in metropolitan and rural areas to ascertain the training and professional development requirements of leaders of the change process, gather	ONEC Secretariat Australian consultants (20 days)	Draft Implementation Plan sent out for consultation and feedback via, email, post and facilitated	ONEC staff	2 consultants

	information about existing programs and to identify available facilities		focus groups.		
Jan 2002	Draft Organisational Change and Management Implementation Plan for ICT developed	ONEC Secretariat Australian consultant (20 days)	Final Implementation Plan delivered to ONEC	ONEC staff	1 consultant
Feb 2002	Consultation and review of draft plan	Australian Consultants (10 days)		ONEC staff	1 consultant
	Revise Implementation Plan				

17.11 TABLE FOUR - Further Technical Assistance To Implement Learning Technologies Reform

DEVELOPMENT OF DETAILED IMPLEMENTATION PLAN FOR THE DEVELOPMENT OF SOFTWARE AND CONTENT

DATE	ACTIVITY	INPUTS	OUTPUT	BUDGET	
				ONEC (Staff/Baht)	AUSAID (Staff/$)
Feb 2002	Establish a project team of experts, stakeholders and end-users to guide the development of the Implementation Plan.	ONEC Secretariat Australian consultants (8 days)	Project team meets to devise and document guiding principles and process for implementation plan development	ONEC staff	2 consultants
March-2002	Review existing Masterplans and CABTER Ed Technologies Report to identify key visions and goals in software and content	ONEC Secretariat Australian consultants (24 days)	Australian consultants and ONEC staff conduct and document a series of site visits and meetings planned by ONEC	ONEC staff	2 consultants
April 2002	Visit a range of education institutions and community centres in metropolitan and rural areas to ascertain the software and content requirements of end-users, gather	ONEC Secretariat Australian consultants (20 days)	Draft Implementation Plan sent out for consultation and feedback via, email,	ONEC staff	2 consultants

	information about existing programs and to identify available facilities		post and facilitated focus groups.		
May 2002	Draft Software and Content Development Implementation Plan for ICT	ONEC Secretariat Australian consultant (20 days)	Final Implementation Plan for Software and Content in Education delivered to ONEC	ONEC staff	1 consultant
June 2002	Consultation and review of draft plan	Australian Consultants (20 days)		ONEC staff	1 consultant
	Revise Implementation Plan				

17.12 TABLE FIVE - Further Technical Assistance To Implement Learning Technologies Reform

DEVELOPMENT OF DETAILED IMPLEMENTATION PLAN FOR PROVISION OF ICT INFRASTRUCTURE

DATE	ACTIVITY	INPUTS	OUTPUT	BUDGET	
				ONEC (Staff/Baht)	AUSAID (Staff/$)
Nov 2001	Establish a project team of experts, stakeholders and end-users to guide the development of the Implementation Plan.	ONEC Secretariat Australian consultants (8 days)	Project team meets to devise and document guiding principles and process for implementation plan development	ONEC staff	2 consultants
Dec 2001	Review existing Masterplans and CABTER Ed Technologies Report to identify key visions and goals in ICT Infrastructure	ONEC Secretariat Australian consultants (24 days)	Australian consultants and ONEC staff conduct and document a series of site visits and meetings planned by ONEC	ONEC staff	2 consultants
Jan. 2002	Visit a range of education institutions and community centres in metropolitan and rural areas to ascertain the training and professional development requirements of end-users, gather information about existing programs and to identify available facilities	ONEC Secretariat Australian consultants (20 days)	Draft Implementation Plan sent out for consultation and feedback via, email, post and facilitated focus groups.	ONEC staff	2 consultants

Feb 2002	Draft ICT Infrastructure Implementation Plan for ICT developed	ONEC Secretariat Australian consultant (20 days)	Final Implementation Plan for ICT Infrastructure delivered to ONEC	ONEC staff	1 consultant
March 2002	Consultation and review of draft plan	Australian Consultants (20 days)		ONEC staff	1 consultant
	Revise Implementation Plan				

17.13 TABLE SIX - Further Technical Assistance To Implement Learning Technologies Reform

DEVELOPMENT OF DETAILED IMPLEMENTATION PLAN FOR PROVISION OF TRAINING AND PROFESSIONAL DEVELOPMENT FOR LEARNING TECHNOLOGIES EDUCATION

DATE	**ACTIVITY**	**INPUTS**	**OUTPUT**	**BUDGET**	
				ONEC (Staff/Baht)	**AUSAID (Staff/$)**
Dec 2001	Establish a project team of experts, stakeholders and end-users to guide the development of the Implementation Plan.	ONEC Secretariat Australian consultants (8 days)	Project team meets to devise and document guiding principles and process for implementation plan development	ONEC staff	2 consultants
January -2002	Review existing Masterplans and CABTER TLT 2010 Report to identify key visions and goals in ICT training and development	ONEC Secretariat Australian consultants (24 days)	Australian consultants and ONEC staff conduct and document a series of site visits and meetings planned by ONEC	ONEC staff	2 consultants
March 2002	Visit a range of education institutions and community centres in metropolitan and rural areas to ascertain the training and professional development requirements of end-users, gather information about existing programs and to identify available facilities	ONEC Secretariat Australian consultants (20 days)	Draft Implementation Plan sent out for consultation and feedback via, email, post and facilitated focus groups.	ONEC staff	2 consultants

April 2002	Draft Training and Professional Development Implementation Plan for Learning Technologies developed	ONEC Secretariat Australian consultant (20 days)	Final Implementation Plan for Training and Professional Development for ICT in Education Delivered to ONEC	ONEC staff	1 consultant
		Australian Consultants (10 days)			
	Consultation and review of draft plan			ONEC staff	1 consultant
May 2002	Revise Implementation Plan				

17.14 Table Six (a) Learning Technology Professional Development for Schools

This table has been developed as a draft example of one component of the proposed Human Resources Implementation Plan

Professional Development Strategy	**Action Item**	**Description/Comments**	**Timing**
Promote and facilitate the development of schools/districts/Ministry as learning organisations which utilise technology	Allocate adequate professional development funding directly to schools, enabling capacity to buy and sell PD programs between schools	Promotes learning culture, encourages schools to take initiative and rewards them for doing so, capitalises on currently untapped potential resource of teachers teaching teachers	As soon as school-based management is implemented
	District support for learning technologies implementation	Districts provide support programs, such as seminars, conferences, training workshops	When districts are established
	Actively develop, distribute and promote quality professional development support material	Use a range of media (CD ROM, Internet, paper, video tape) to distribute materials that can be used "in-house" for district based, principal and teacher network, and school-based learning technology professional development programs	
	Use train the trainer approaches	Train and accredit "expert" teachers to conduct professional development programs for other teachers on a fee for service basis Incorporate central evaluation via web-based forms	
	Require each school to have a learning technology plan	Publish model plans on the ONEC Website Learning Technology Plans to incorporate learning and teaching, restructuring and technology planning	12 months after Navigator School program implemented
	Schools develop subject area plans for learning technology within the their learning technology plan	Assist the development of a shared vision of technology use Encourage the sharing of curriculum and technology materials Inform curriculum decisions across disciplines and year levels Facilitate the discussion of instructional issues involved with technology Provide information that will assist the efficient and effective purchasing of software and infrastructure Provide insights into training and support needs	

Learning Technology Professional Development (Continued)

Professional Development Strategy	Action Item	Description/comments	Timing
	Require each teacher to have a learning technologies professional development plan	Align with teacher and classroom access to technology	Coincide introduction with school learning technology plans – Stage 2
	Provide guidance on school-based professional development programs	Publish and distribute document, also publish on ONEC website	
	Establish, maintain and develop the network of Learning Technology Mentors	Mentors (who are themselves teachers) can provide effective support for teachers wishing to incorporate learning technologies into school programs Contact can be made face-to-face, by telephone, by email, online discussion group, etc	
	Stimulate local and community learning technology initiatives	Provide funding for local learning technology initiatives.	

Link classroom practices to research	Publish Learning Technologies Research	Commission (or purchase) research summaries of the most effective/ineffective uses of technology to improve student learning in each subject area/year level. Maximise awareness of and access to this resource through promotion, Web-based and CD-ROM based distribution. Involving Thailand's university teacher education faculties in gathering analysis and publication will encourage awareness and alignment with this program.	As soon as possible
Promote learning technologies leading practice	Online learning technologies newsletter	Promote discussion and dissemination of successful strategies for technology use, as well as opportunities for teachers, school leaders, and "key influencers" to access information, advice and professional development in this area.	

Learning Technology Professional Development (continued)

Professional Development Strategy	Action Item	Description/Comments	Timing
Provide accessible models of new classroom practices	Global Navigator Schools Collaborative Projects	Collaborative projects enhance engagement by all staff	
		Online mentor program	
	Learning With the Internet professional development program	Focus on models of educational use of the Internet – for student and teacher research, for publishing student work, collaborative online projects, and teacher professional development. Program to be delivered by schools on a fee-for-service basis	As soon as possible
	Computers Across the Primary Curriculum	Capture best practices in computer use in Thailand and elsewhere in primary schools, and make this accessible to all teachers (primary and secondary) through online and CD ROM – based materials, as well as through a professional development program to be delivered by schools (on a fee-for-service basis)	As soon as possible
	Computers in the Secondary Curriculum	Capture best practices in computer use in Thailand and elsewhere in secondary schools and make this accessible to all teachers (primary and secondary) through online and CD ROM – based materials, plus a professional development program to be delivered by schools (on a fee for service basis)	As soon as possible
	Leading Practice IdeaBank	A growing pool of ideas and strategies for teaching and learning which have proven effective in helping students achieve learning outcomes	As soon as possible
	Conferences	Convene an annual learning technologies conference. Use it to build and maintain momentum on a national scale. If possible, repeat conferences at regional levels.	
		Facilitate inclusion of learning technologies to improve student learning as an integral element of mainstream educational conferences in all key learning areas	

Learning Technology Professional Development (continued)

Professional Development Strategy	Action Item	Description/Comments	Timing
Provide accessible models of Whole school and classroom environments	Navigator Schools Project	Provide accessible models of classrooms, schools, and lessons that reflect leading practice in the application of technology in actual schools. Principals and teachers from other schools spend extended periods in the Navigator Schools, in order to change beliefs, understand how technology can improve teaching and learning, and how this can be led and managed at a school and classroom level.	Commence as soon as possible, run professional development programs for leaders and teachers from other schools after 6-8 months
Provide guidance and advice on learning technology planning and implementation	Learning technologies planning guide	Develop, publish and support with professional development programs a guide on planning for learning technologies (sample provided). Draw from the experiences of Navigator and other schools.	As soon as possible.
	Learning technologies implementation guide	Develop, publish and support with professional development programs a guide on implementing learning technologies (sample provided). Draw from the experiences of Navigator and other schools	As soon as possible.
	Navigator schools	Navigator schools as a contact for advice by other schools in relation to learning technology planning and implementation	
Provide teachers with access to learning technologies	Teacher notebook program	Notebook computers enhance productivity and teacher skills in technology use. Routine personal and classroom access to the technology is essential if teachers are to learn to use computers	As soon as possible
Promote adoption of learning technologies in schools	Set targets for teacher and leader learning technology capabilities		Needs to align with access to technology – Stage 2
	Seek tertiary recognition and accreditation for the suite of		

	learning technology professional development programs		

Learning Technology Professional Development (continued)

Professional Development Strategy	Action Item	Description/Comments	Timing
Alignment with other programs	Align existing and new programs to support ongoing teacher professional development		
Develop leadership skills and understanding of learning technologies	Navigator School leader seminars	One day seminars in the Navigator schools attended by school leadership team members	3-6 months into the Navigator school project
	Establish learning technologies leadership network	Conduct workshops, seminars for school leaders dealing with learning technologies implementation. Maximise access using technologies such as videotapes and the Web	
Local and Central Performance Improvement/Quality Assurance Function	Incorporate evaluation into all centrally coordinated professional development programs	Use the Internet and backend databases for data collection and analysis. Teachers complete Web-based forms at the end of the programs – and must do so before receiving program certificates. Enables a central quality assurance function, including the capacity to monitor professional development quality, quantity, timeliness and cost – at overall program, district, and individual principal and teacher levels	Implement immediately

Program continuous improvement	Collaborate with districts to identify and encourage program participation by schools (in particular school leaders) not currently implementing learning technologies	Beliefs/concerns are a major factor determining whether schools will adopt an innovation school leaders play key roles this process	

Learning Technology Professional Development (continued)

Professional Development Strategy	Action Item	Description/comments	Timing
Encourage alignment of teacher pre-service programs in universities with the new approaches	Collaborate with universities and schools to develop and provide pre-service opportunities in schools with leading practice in the use of technology		
Capitalise upon and model the use of technology to enhance teacher and leader access to professional development	Develop and support on-line "communities of practice" to share expertise and provide peer support		
	Develop and implement professional development programs and resources to assist teachers to "work smarter"	Areas such as: preparing lesson plans and materials tracking student progress professional interaction and collegial support interacting with parents maintaining up-to-date professional knowledge, understanding and skills.	

	Adopt flexible learning practices	Aim to make many programs modular, provide multiple entry and exit points, and be accessible via a range of modes, including via flexible delivery approaches	

18 APPENDIX ONE

18.1 POTENTIAL APPROACHES TO USING ICT IN THE CLASSROOM: A DISCUSSION PAPER[1]

18.1.1 Introduction

This paper has been developed to provide insights into how learning technologies may be used as a tool for transforming schools into high performance learning environments for students of the 21st Century. It is designed to be read on a computer and contains hyperlinks to Internet sites and video clips and is available on CD-ROM with TLT 2010 Report. The paper is based on experience in using technologies in schools internationally, and includes video and Internet examples from Victoria, Australia.

18.1.2 Envisioning a Possible Future of Schools - A Preferred Future?

Siam and Guda are learning Japanese at Phun Phin Primary School.

Siam scans the e-mail received overnight and finds a message from Keitaro. Attached to the message are several images of his family and home in Osaka, which Siam had requested yesterday. Keitaro's message asks for information about her school, and so Siam e-mails information about her classroom, to which she attaches a digital image of her class. Her message also directs Keitaro to the school homepage, which contains further information and pictures of the school and samples of her recent work.

At 11 o'clock Siam and Guda smile into the computer's camera as they welcome their team-members in Chaiya, who appear in a window on the screen. The group has several weeks to complete their report to the 20th Century Retrospective Forum, which will link them by videoconference with teams in sister schools in Ko Samet and Shanghai. The children chat excitedly as they view the introductory animation prepared by their classmates in Chaiya. For several minutes they discuss the tasks to be completed. Guda reduces the size of the video window, and the pair settles down to work.

Click here to see videoconferencing clip

Observers would notice that despite the plethora of different kinds of information available to these students, accessed through a wide range of media, they are involved and effective managers of the information they acquire. In one corner of the room a group of students are discussing a web site that they have just accessed,

[1] Derived from a paper developed by members of the Learning Technologies Section of the Victorian Department of Education.

deciding how they might authenticate the information they have found. Another group of students is involved in a round-table critique of a joint project, deciding how they can best present their material. Some of the students in this project are in a classroom tens of kilometres away, using Internet video and a collaborative WWW browser to complete their work. Another student is writing an e-mail to a student in Japan, as part of an on-going dialogue they have been involved in, comparing Australian and Indonesian culture.

Click here to see collaborative project clip

In an adjacent class, the Grade 2 children are learning to program using MicroWorlds. They are building robotic devices with Lego and program their movements using Lego MindStorms. During the year the class will also learn to routinely use telecommunication, database and graphics software.

Teachers at Phun Phin Primary encourage collaboration between their students. They work with other teachers as members of teams, working across the disciplines, altering the physical arrangement of classrooms to facilitate group and computer work, providing opportunities for students to use a broad mix of learning and communication tools, and modifying class schedules to accommodate class projects.

This begins at an early age. Children in the early years of schooling use projects such as *Travel Buddies*, in which they exchange a soft toy with classes overseas, who correspond daily over the Internet.

Click here to see a video clip on the Travel Buddies project

Global collaborative projects provide an important audience for student writing and cultural perspectives from other countries.

Click here to see a video clip providing an example of how collaborative projects deepen understanding in the senior level of schooling.

The teachers use Thai Education Network discussion groups to discuss learning activities, exchange experiences, plans, resource materials and examples of student work - with other teachers in Thailand and overseas. The Ministry's Education Channel provides a highly valued set of resources for teachers and students.

During breaks you will often see teachers using computers to check for messages from parents, and returning calls as appropriate. Parents find the voicemail system helpful as a means of confirming homework requirements, excursions, project details, interview times and for leaving messages. At times, students use telephones to contact experts and community members for advice and information for their projects.

Daily notices to teachers arrive via email, and the attendance roll is recorded directly onto the computer network - providing instant information on attendance to school administrators.

The teachers' notebook computers remain connected to the school's wireless network as they move around the school. You would see teachers accessing and

sending email, tapping into the resources of the school's network and external networks, and interacting with their students and teachers from their own school and from around the world. The school's network provides a similar facility for teachers, and students, to connect from home.

At times students lead classes, become peer tutors, and spontaneously organise collaborative work groups. Students have come to appreciate "the value of a good question". In an environment in which such questions form the focus for interdisciplinary investigations, teacher roles have broadened to include assisting students to generate and refine questions for investigation, guiding research approaches, and coaching student presentations.

If you visited the school you would still see relatively traditional school activities such as whole class teaching, writing assignments and mathematics activities. But you would notice differences even in those activities. In Language you might find students drafting and editing short stories on a computer, embellished with multimedia special effects. In mathematics, students collaboratively solve problems, exchange homework, and criticise one another's solutions. Sometimes they build multimedia presentations that demonstrate problem-solving techniques for use as tutorials with other students.

In less traditional moments you might observe groups of students building multimedia presentations about a diverse range of topics, or you might see work in progress on a whole-class interdisciplinary effort. Students solve problems using information downloaded from the Internet, Thai Education Network, or from CD ROMs, which may be located in the school's library, or the library of another school.

18.1.3 Students on a field trip

The year 6 students are working on a local salinity project, in association with the *Saltwatch* project.

TANOO and JIPSAI have just completed a series of freshwater ecology activities, which had been selected by their teacher, from Thai Education Network's IdeaBank. As part of the activity they have collected data on the salinity of water at various points along a local river.

The two students check their results with their teacher.

When they get back to school, they log onto Thai Education Network and add their measurements into the *Saltwatch* online database. A map of salinity measurements across the creek's catchment area appears, which has automatically incorporated their readings with those of other students. They smile as they see their readings appear on the map, knowing that their work has helped scientists and farmers inform the way they use the land.

Click here to see students using the Internet in field studies

TANOO and JIPSAI then search Thai Education Network for information needed to complete their report. They discover that colleagues across the Nation have been

involved in a collaborative Internet project, *Stream Patrol* – a water quality project involving schools in other countries. They send an email message to the project's resource manager, a year 8 student from Na Thon, who directs them to some useful Internet sites and recommends an Internet video conference with a class at Moyhu in the King River Valley who have involved with Stream Patrol for several years.

During their class presentation, several days later, they report that their research reveals that salinity is also an increasing problem in Laem Son and Takua Pa.

Students display and annotate selected work in digital portfolios, accessed via the school's network. From the middle years, students are expected to index the work in their portfolios against the Thai curriculum. Student portfolios contain sample performances - video clips of drama presentations, audio clips of musical performances, images of drawings and written work - along with annotations by themselves, peers and teachers. As the portfolios are located on the school's LAN, those people with appropriate access rights - students, their parents and teachers - may examine evidence of student achievements, assessed against the Thai curriculum – on their computer at school or home.

Students use computer assisted learning software to practice basic skills, such as keyboarding, and to undertake structured learning programs. The software allows individual progression, provides remediation as needed, and tracks and reports on students learning.

Students draft and edit reports on computers and then publish them, in some cases onto the Internet for international readership. They gather and manipulate the resources for some reports using digital cameras, video cameras, VCRs, CD ROMs, animation tools, scanners, and sound digitisers and multimedia development software.

Students have opportunities to explore their world through interactive simulations, computer models that are not hampered by the complexity of the real world. Through engagement in simulations, students gain experiences they can apply to other situations, develop cognitive skills, and are posed with problems and scenarios which challenge them to think in new ways.

Teachers at Phun Phin Secondary School have also moved to similar teaching and learning approaches. Teacher teams, comprising teacher specialists in areas such as humanities, science, English and mathematics, are responsible for cohorts of eighty or so students. Teachers generally work with the same group of students for three consecutive years, providing a source of continuity in the lives of their students, many of whom experience substantially changed family arrangements during the course of their schooling.

The school has implemented a mentoring program for some students, enabling children to have regular dialogue and support from an adult with experience in a field of student interest. In many instances this dialogue is primarily online, enabling discussion each day.

Block scheduling has given students and teachers more time for each learning experience, enabling (and requiring) teachers to restructure their teaching and learning approaches. Through an increased focus on group-based project work, students are developing work habits, skills, knowledge and understanding consistent with the project-based adult world of work in the global, information-based economy of the 21st Century.

Many other secondary schools have also made such structural changes. Teachers in those schools now see each student regularly, developing an understanding of each student's achievements and support needs. Learning Map now provides a vital tool for teaching teams to track individual student's progress, and for school design teams to monitor and analyse the effectiveness of the school for individuals and groups of students.

Teaching teams meet regularly for several hours each week to discuss student achievements, teaching and learning strategies, develop curriculum plans, and to undertake professional development. The school's leadership team place a high value on team meetings, which are scheduled as an integral part of the school day.

Time for teacher learning has been achieved through re-conceptualising the school day - scheduling specialist teachers such as music and physical education, and using vocational education experience to provide time for the core teaching teams to meet. Technology also plays a crucial role in creating time for teacher learning. Electronic mail allows the principal to inform and consult teachers more readily than ever before, enabling the number of business staff meetings to be reduced.

Click here to see a clip on teacher planning meetings

Technology is a major tool for teacher and school leader professional development. Teacher learning increasingly reflects the learning approaches used with students.

Teaching and learning coaches, and individual teachers, draw upon multimedia materials in Thai Education Network as resources for their own professional development, and to provide tools for professional development activities with other schools in their District. The portability of such materials, notebook computers and network access have expanded learning opportunities to times, places, pace and approaches which suit individual learners (both students and educators).

Universities and other providers are competing to provide educators with access to their post-graduate courses through flexible delivery arrangements. As with busy professionals in other industries, technology savvy teachers have strong demand for such programs. Global networks have broken down geographic boundaries for accessing professional development and continuing education for teachers and school leaders. The principals and several teachers of the two Phun Phin schools are completing post-graduate studies on-line through universities in Bangkok, Hong Kong, Boston and London.

Growing demand for teachers has placed pressure on pre-service teacher education courses. The importance of strong links between schools and teacher education institutions is well recognised. Pre-service and in-service teacher development programs are increasingly conducted in school settings. Several days each week the children benefit from additional teachers gaining pre-service and in-service practicum experience in their classes. Several school staff, including the principal, are faculty members of the local university education faculty.

As at Phun Phin Primary School, student learning experiences are structured around authentic tasks undertaken in a high performance workplace, expanded to include genuine opportunities to engage with people and places beyond school. The curriculum is international, vocational, and technological.

Phun Phin Secondary School maintains the vocational education program of its primary feeder school, through which students from Grade 5 onwards have spent half of one day each week working in businesses and other work places in their local community. This program enables students to develop an understanding of the requirements of the world of work, and entrepreneurship and provides the community with access to students' up-to-date technological skills.

Some of these students have operated successful small businesses over several years - occupying positions such as chief executive, quality assurance coordinator, and client services manager.

During free periods students are encouraged to attend the school's "self-help" room, where they can catch up on missed lessons or gain additional assistance from teachers. As in all other learning spaces, the self-help room provides routine access to computer technology. As all students are encouraged to use the room and its services there is no stigma attached to its use.

Some senior students opt to undertake specialised subjects online, using the Ministry's virtual school facility, or HIGHER EDUCATION programs through the Virtual Campus. For many students such access provides the only viable means of completing school studies while working part-time. As for other 21st Century students - including those in hospitals and learning at home - technology has broadened access to high quality learning beyond the physical and temporal boundaries which characterised traditional 20th Century schools.

The school day at the Phun Phin schools has been extended from 7am to 9.30pm on weekdays. Although few students and teachers are at school for more than 6 hours, the school's technology rich facilities are used as learning resources for the local community, which provides adults to supervise during the extended hours. Adults and some students are studying courses to develop and refine their skills for the rapidly changing job market; others are undertaking tertiary studies, delivered via the Virtual Campus and other on-line providers.

Children involved in before and after school programs at the schools benefit from access to specialised environments in which they can relax, have fun and learn. Some senior students from Phun Phin Secondary take the opportunity to gain a HIGHER EDUCATION certificate in early childhood studies, by integrating

practical experience gained through paid involvement in these programs with theory learned through flexible delivery programs from the local TAFE School or in optional classes at the school.

That evening…

Jira is a science teacher with ten years experience. He is adjusting his teaching program to suit the outcomes-oriented approach now required by the Thai Curriculum.

Jira finds the new CD-ROM based Curriculum @ Work a useful planning tool. Connecting to the Internet, he scans the Thai Education Network IdeaBank to see how colleagues across the nation have tackled the topic he has chosen for next week. On the way to the IdeaBank he also discovers an updated version of a familiar textbook on-line, and in it finds a unit of work that will be a useful reference for his term 3 program. He purchases a single user licence to the chapter, and downloads it.

Ratri's year 7 students have come from a primary school which made good use of the SOFNet/Thai Education Network – based English language series. The students bring a keen interest in English and Australian culture to her class.

As the only teacher of English in her school, Ratri finds the Thai Education Network-based Professional Network an invaluable way of maintaining contact with her Australian teacher colleagues. She notices that a teacher in Khuraburi has posted information on a new software product that makes it much easier for students to build their knowledge of English characters.

Ratri logs into the English Language Teachers Association website. Although she has little experience using computers for specialised teaching applications, Ratri uses the website to trial and purchase the software, and to gain help in its use from an online mentor. While online, she books into a Computers in English Teaching professional development program at the district office.

Although Ratri must wait for several weeks to undertake the face-to-face professional development program, the online support gives her confidence to commence using the software with her students.

The transition to using ICTs as routine classroom tools has posed significant challenges for all teachers, and has provided substantial benefits for student learning and teacher enthusiasm. Teachers and school leaders emphasise the importance of a co-learner approache to adopting ICTs in the classroom. They acknowledge that students will often have a more detailed understanding of computers than teachers.

Click here to see how teachers and students are becoming co-learners

This is one possible future. Other futures are also possible.

19 APPENDIX TWO

19.1 A WHOLE OF GOVERNMENT NETWORK - VICONE

All Victorian Government schools are connected to VicOne, the State government's WAN (diagram overleaf). VicOne is operated by *AAPT*, a national telecommunications company. *Telstra*, another national telecommunications company, provides Internet services and a third company *myInternet* provides the SINA[2] product.

Telstra is the preferred supplier to the DET, however schools can use any ISP that has a connection to VicOne.

All external links to VicOne are via a secure gateway. This centrally managed security removes the need for schools to establish and maintain firewall security.

VicOne services DEET via two VPNs – one for curriculum, the other for administration.

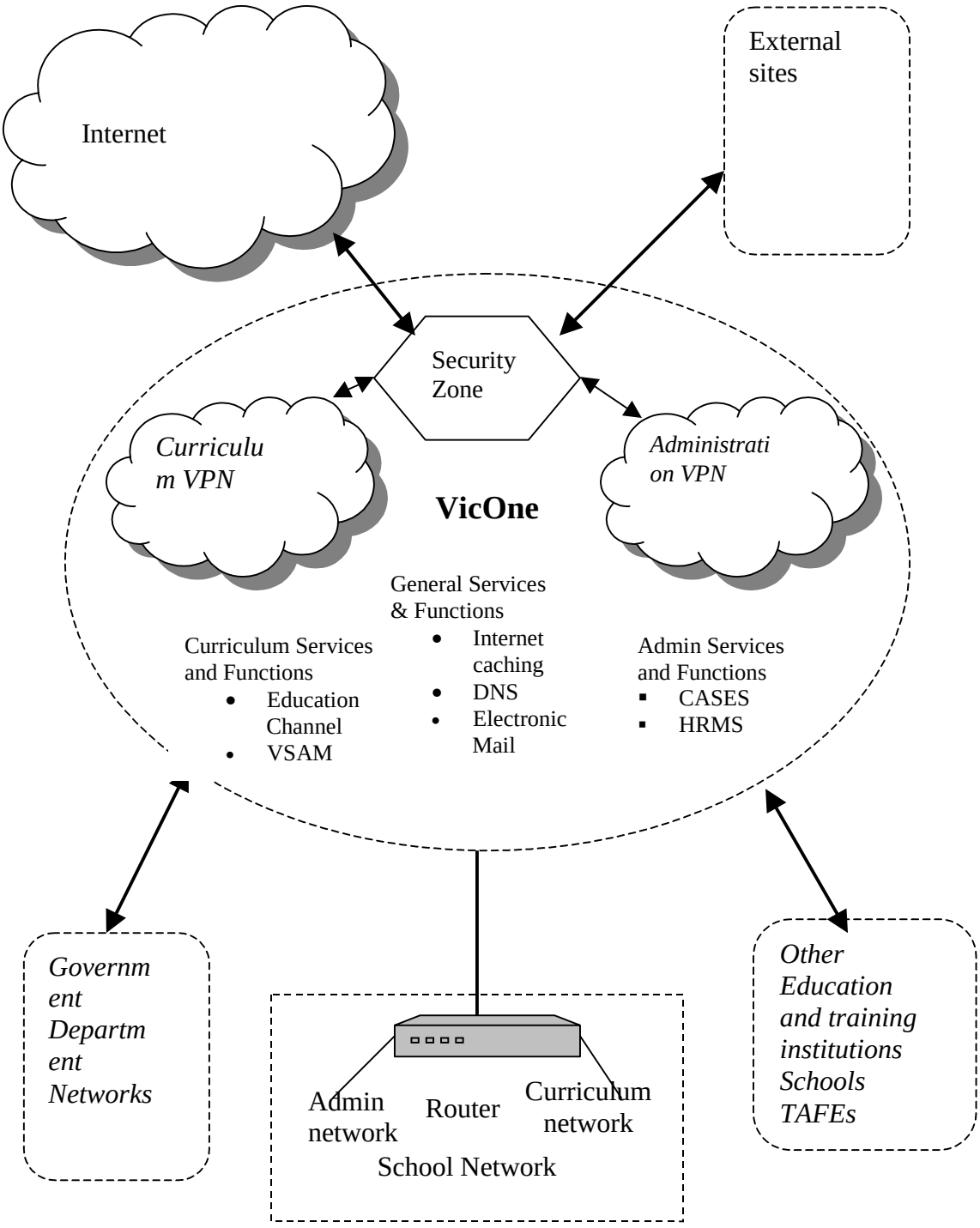
The Education Cache stores commonly accessed Internet data. It has two levels – the *Selected Cache* and the *Standard Cache*. The *Education Selected Cache* contains only quality educational pages and websites that have been selected by DEET staff. This provides a "safe" area for students to access the Internet. The *Education Standard Cache* contains all recently requested pages other than those in the Selected Cache. Schools pay an annual fee to access the *Selected Cache* and a megabyte download cost for access to the *Standard Cache*. Many schools also cache data locally.

19.2 NATIONAL GOVERNMENT INITIATIVES

In the United States, the National Information Infrastructure Initiative was founded on principles of promoting private sector investment, providing affordable services for all, promoting technological innovation and new applications, constructing the NII as a "network of networks", ensuring information security and network reliability, managing radio frequency spectrum as a NII resource, protection of intellectual property rights, and coordination at all levels.

[2] Schools Internet Network Administrator

FIGURE … *Diagrammatic Representation of the VicOne WAN*[3]



[3] Adapted from Victorian Department of Education, Employment and Training (1997) *Learning Technologies Planning Guide*

20 APPENDIX THREE

20.1 NAVIGATOR SCHOOL PROGRAM

This appendix contains a detailed project description of the Navigator Schools project in Victoria and guidance on a project plan for a Navigator Schools project in Thailand.

The Navigator Schools Project was a linchpin in the learning technologies reforms program in Victoria "Classrooms of the Future". The State's four Primary and three Secondary Navigator Schools served to provide accessible models of schools that were effectively implementing learning technologies to improve student learning and school operations. During the five years of the program (1995 – 2000), the Navigator Schools provided structured professional development programs for school leaders and teachers from Victoria's 1,700 government schools, and hosted programs for many visiting school system administrators, school leaders and teachers from other systems, Australian States and overseas.

20.2 NAVIGATOR SCHOOL PROGRAM PROGRAM CONTEXT AND SEQUENCE

20.2.1 1. Context

The Navigator Schools program was begun at a time when schools, and the system, were inviting innovation. The Schools of the Future program had been implemented. Schools were self-managing; principals had received professional development in leadership practices, and many saw themselves as instructional leaders and not only as administrators. There was a culture of innovation that had been fuelled by government policy. Political and educational rhetoric in Victoria held that there was a need to transform a range of aspects of public sector activities – including schools – in order to better position the State for economic growth. There was a dominant paradigm, particularly in primary schools, of child-centred learning. A Science and Technology Centres project had been commenced (the three secondary schools that were to be selected to become Navigator Schools had been funded as Science and Technology Centres). Certain principals and schools were identifying themselves as potential candidates to undertake innovative programs; some had submitted proposals to the Minister to develop their schools as leaders in technology implementation. Those principals and schools were to prove of great importance to the Navigator School program, and the dissemination of its benefits to other schools.

20.2.2 2. Introduction

The following provides an overview of key features of the structures and processes established to implement the Navigator Schools program, which was to lead routine learning technology use to enhance learning in Victorian schools. It is approximately chronological, however there was overlap and interaction between program elements.

A vision of a "Classroom of the Future" was drafted for consideration of the Minister for Education, at his request.

The Minister, Chief of Staff and Project Team Leader travelled to the United States for two weeks to visit an Apple Classrooms of Tomorrow[4] (ACOT) school site, and meet with the manager of the ACOT program and with organisations responsible for key ICT in education projects. The major outcome of this study tour was a shared broad understanding of the direction, challenges issues and strategies that would apply in implementing a Navigator School program.

The Team Leader developed a project plan for the Navigator Schools program.

Senior Executive approved that project plan and the bulk of requested resources.

A Project Officer was selected (by the Team Leader) to work with the Team Leader on the project. (The Project Officer worked full time in this project, whereas the Team Leader directed project officers who were responsible for the full range of learning technologies programs, including the Global Classroom Project, SOFWeb, SOFNet, Science and Technology Centres and Telematics).

The Team Leader negotiated with Apple Computer for one of the four primary Navigator Schools to be Australia's first ACOT School. An agreement was signed with Apple that provided benefits to the School/Department including practicums in US ACOT schools for the ACOT School's Principal, Project Officer and Vanguard teachers, fully funded by Apple (except for teacher replacement costs).

In addition, the corresponding staff-members from the other Navigator Schools were funded by the Department of Education to attend ACOT practicums (and/or Summer Institutes) in the US. This arrangement was of pivotal importance to the success of the Navigator School program. During the practicums the principals, Project Officers and vanguard teachers experienced being in classrooms that approximated the environments that they might create in their own schools[5], and were able to discuss the ACOT schools' experiences in conducting practicums for teachers and leaders from other schools. It also enabled communication between pairs of Navigator Schools, and provided time for planning and reflection. Vanguard teachers attended practicums at least one month after the principal and project officer from their school. The practicums provided benefits for vanguard teachers (all four of whom attended

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[4] The ACOT project was a school-based longitudinal study of the effect of high access classroom computing environments. The project was funded by Apple Computer Inc.

[5] The principal and project officer attended practicums/summer institutes soon after the project officers were appointed. For the primary schools the schools attended these programs in pairs (the principals of two schools along with the two project officers). This encouraged collegial discussion to inform the initial learning technology planning for those schools. Those pairings developed into strong support networks, and the pairs of schools commenced joint staff professional development programs.

the program together) similar to those received by principals and project officers: beliefs in the value of the program and their capacity to implement it in their classrooms were strengthened, the teachers had opportunities to plan and discuss their own classroom implementations of technology, and to build collegiality. The earlier attendance at the program by the principals and project officers ensured the entire school-level change agent group (principal/project officer/vanguard teachers) could readily achieve a shared understanding of the direction of and plans for change. Members of the Classrooms of the Future Project Team accompanied each group of school-based change agents to the ACOT practicums – strengthening the Classrooms of the Future Team members' understanding of the changes and change processes that were to be put in place, and fostering collegiality between school-based and centrally located change agents. There was ongoing input from ACOT into the ACOT School, and the other Navigator change agents were at times invited to participate in those sessions. In addition, key leaders from the ACOT program met with members of the Classrooms of the Future Team at times during the project.

Four primary schools were identified by senior executive to become Navigator Schools (there was no application process – this streamlined that aspect of the project). The three secondary schools that had previously been funded as "science and technology centres" were also selected. The secondary schools had already received substantial funding for ICT infrastructure, whereas the primary schools received the ICT resources through the Navigator School program. Details of school resourcing are contained in Part II of this appendix.

The principals of the seven schools identified were invited – individually – to meet with the Team Leader to discuss their interest in becoming Navigator Schools. The principals were presented with the project outline and conditions of involvement in the program at those meetings, and took the proposals to discuss, confidentially, with their school councils and school leadership teams. All accepted. (Participation in the "Critical Friends" program proved to be the most sensitive aspect of the project for some principals.) All Navigator Schools signed a Memorandum of Understanding with the General Manager, specifying the commitments of both parties to the program. (Details are contained in Part II of this appendix.).

Soon after acceptance by the schools, the job and person specifications for the seven school-based Project Officer positions were finalised, in consultation with the seven principals. The Classrooms of the Future Team advertised the seven positions. Interviews were held at each school by panels comprising the Principal (chair), another member of the school's leadership team, and a member of the Classrooms of the Future team. The project officers played key roles in the Navigator School – accelerating the rate of change in pedagogy by supporting, coaching, training teachers.

Members of the Classrooms of the Future project team collaborated with the Department's Information Technology Division to develop specifications for the technology that would be provided to the primary schools. This included LANs, which had not been fully deployed in primary schools previously. Advice and experience of the secondary Navigators was invaluable in developing those specifications. Whereas the Science and Technology Centres had been provided with the funding to purchase their own technology, it was decided that the Classrooms of the Future Project Team would select and coordinate the purchase of the technology

for the Primary Navigators (in consultation with the schools) so that the schools could focus on the learning and teaching and restructuring aspects of the change program, and not be distracted by technology planning and purchasing. That decision had the dual benefit of accelerating the change process in the schools, and providing IT Division and the Classrooms of the Future team with "hands on" experience of technology implementation at the school level. In addition, the Department's Facilities group reviewed security and electric power arrangements for the schools – with a member of the Classrooms of the Future Team. It was decided that schools would receive funding for software purchases, rather than software being purchased centrally.

The schools also received funding to assist the provision of technology and facilities for a Teacher Development Centre – a room in the school in which practicum teachers would be based.

The first technology received by the schools was notebook computers for all teaching staff. There was a time lag of approximately two months between teachers receiving their computers and the classroom computers arriving. Some of this time was a holiday period. This was important, as it provided the teachers with time to develop their skills with the technology, time for the schools to run technology professional development, and time for teachers and schools to develop learning technology plans – before implementation.

As soon as all Project Officers were appointed a two-day workshop was held for the Navigator School Principals and Project Officers. The program comprised a series of presentations from a school leader who had led successful technology programs in their schools and university staff who had supported those projects, "hands on" sessions with technology, and planning sessions. Increased understanding of a vision for technology in schools, time for change management planning, and increased collegiality were major outcomes.

Soon after, a week-long program was conducted for the 35 Navigator School vanguard teachers and the school project officers. The program was conducted by the same university-based group that had led the principal/project officer workshop, and was substantially supported by the project officers, and was attended by members of the Classrooms of the Future Team. This provided a focus to bring the project officers together to collaborate on a significant task (thereby assisting the formation of that group), and established relationships between project officers and vanguard teachers – including collegial relationships between change agents from different schools. Importantly, it established the project officers as leaders/learners. Classroom-level change management and the development of vanguard teachers' technical skills were major focuses of the program.

Each Navigator School devised and implemented a learning technology plan. This report does not go into detail of activities in individual schools.

Monthly meetings were held between the Classrooms of the Future Team Leader and Navigator School Principals, also attended by the Navigator School Project Officer. Those meetings were held in the Navigator Schools on a rotational basis. The agenda of each meeting included a tour of the Navigator School, led by the principal and other school leaders, and a discussion of learning and teaching, technology integration

and restructuring in each school. Principal meetings were important as a leadership group for the Navigator School program. Collegiality and friendly competition between the principals accelerated the pace of change in the program.

Meetings of the school-based project officers were held fortnightly in the first year, and thereafter on a monthly basis. The meetings, chaired by the Project Team's Project Officer, were held in the Navigator Schools on a rotational basis. A guided tour of the school was a key element of each meeting. Change management and "hands on here's how I do it" sessions, led by the project officers were a key feature of those meetings.

Leadership Seminars were commenced in the Navigator School after several months. The timing of commencement and nature of the seminars was discussed at the principal meetings and project officer meetings. Commencement dates were set separately for schools, based on the level of readiness of the school. The change management process, including planning the change, was the main focus of the seminars. Experience in observing classrooms and discussing the change with their peers were designed to change school leaders' beliefs – so that they would believe that learning technologies could improve student learning. Evaluation reports from the seminars demonstrated the great benefit that principals and other leaders received.

Practicums were commenced at the Navigator School after approximately six months. Again, the commencement dates were set separately for the schools, depending on their readiness levels. As with the Leadership Seminars, the practicum program featured teachers observing classrooms and discussing the change with their peers were designed to change teachers' beliefs – so that they would believe that learning technologies could improve student learning. In addition, the program length and structure encouraged teachers to observe and reflect on the new classroom arrangements, including management practices, used in the Navigator Schools' classrooms. (As noted elsewhere in this report, there is an absence of such details in skills-based teacher training programs, resulting in such programs not being effective in changing classroom practice with technology.) As with the Leadership Seminars, evaluation demonstrated significant benefits of the Navigator School Practicums.

In the second year of the Navigator School program the Navigator School adopted a new structures to further embed the new practices in classrooms – appointing teams of "learning and teaching coaches". Most of the schools appointed four or five teachers as coaches, providing them with release time and incentives to perform that role. Coaches were assigned cohorts of teachers, supporting them with model lessons, team teaching, teaching and curriculum ideas. In most of the schools the coach positions were for 12 months, and selected on a competitive application basis. In many cases the initial coaches had been vanguard teachers the year before. The schools maintained this coaching structure for several years, with a competitive selection process for coaches each year. The project officers also continued to support the new teaching and learning practices within the Navigator Schools.

21 ABBREVIATIONS

ACCE	Australian Council for Computers in Education
ACOT	Apple Classrooms of Tomorrow
ADB	Asian Development Bank
ACS	Australian Computer Society
ANTA	Australian National Training Authority
APEC	Asia – Pacific Economic Cooperation
ASEP	Australian Science Education Project
CABTER	Capacity Building for Thai Education Reform
CAI	Computer Assisted Instruction
CAL	Assisted Learning
DETYA	Department of Education, Training and Youth Affairs
DFA	Department of Fine Arts
DGE	Department of General Education
DNFE	Department of Non-Formal Education
DOVE	Department of Vocational Education
DPE	Department of Physical Education
EdNA	Education Network Australia
FOLP	Framework for Open Learning Program
HRMS	Human Resource Management System
ICT	Information and Communication Technologies
IEA	Information Association for the Education of Educational Achievement
IPST	Institute for Promotion of Teaching Science and Technology

MCEETYA	Ministerial Council on Education, Employment, Training and Youth Affairs
MIS	Management Information System
MOE	Ministry of Education
MUA	Ministry of University Affairs
NECTEL	National Electronic and Computer Technology Centre
OLA	Open Learning Agency
ONEC	Office of the National Education Commission
ONESDB	Office of the National Economic and Social Development Board
ONPEC	Office of the National Primary Education Commission
OPEC	Office of the Private Education Commission
PEEL	Project for Enhancing Effective Learning
RIHED	Regional Centre for Higher Education and Development
RiS	Rajabhat Institutes
RTG	Royal Thai Government
SEAMEO	The Southeast Asian Ministers of Education Organisation
SINA	Schools Internet Network Administrator
SITES	Second International Technology in Education Study
TAFE	Technical and Further Education
TLT 2010 Masterplan	Thai Learning Technologies 2010
TGIST	Thailand Graduate Institute of Science and Technology
UNESCO	The United Nations Education, Scientific and Cultural Organisation

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