ADB Report
#TA3585-THA
Education Sector Reform

ICT for Direct Instruction and In-Service Training

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INFORMATION AND COMMUNICATION TECHNOLOGY (ICT)
IN THAI EDUCATION

ORGANIZATION OF THE REPORT

This document responds to the six tasks described in the request for technical assistance from the Specialist in Information Technology in Education (TA3585). In addition, as requested during the course of the consultancy, the report goes beyond these tasks to propose an Asian Education Network (AEN) that would be piloted in Thailand and ultimately would serve the Greater Mekong Sub-region (GMS).

1. ICT Inputs to Instruction and In-Service

This section reviews models of education reform and learning that have driven Thai education reform, describes the current teaching model of ICT, and identifies ICT inputs to support teacher in-service and student computer assisted instruction (CAI).
Content: ICT and Teacher Models, Information Technology (IT) Support for In-Service, and CAI Provision.
TA Description: Review of the teacher model and identification of IT inputs to support teacher in-service and student CAI.

2. ICT Support through Regional Centers

This section assesses educational capacity to support ICT in schools through regional centers. It contains scenarios for IT dissemination to Thailand and the Greater Mekong Sub-region (GMS).
Content: Analysis of Needs for ICT Regional Multimedia Education Centers and for Mobile ICT Support Centers.
TA Description: Assess IT support through regional centers for providing distance training for teachers and school administrators.

3. ICT Proposals and Recommendations

This section proposes IT support for teachers and students through the development of an Asian Education Network (AEN).
Content: Proposal for an Asian Education Network for ICT Support and Training
TA Description: Construct a proposal for ICT support for teachers and students.

4. ICT and the Assessment of Educational Standards

This section assesses the monitoring of the Office of National Educational Standards (ONES). It recommends that ONES conduct research on ICT effectiveness and equal access. It also proposes that schools develop a technology plan and submit it to ONES prior to the ONES site visit.
Content: Assessment of the ONES.
TA Description: Assessment of the ONES in providing feedback and diagnostic behavior to teachers, administrators, students, and parents.

5. ICT and Support of Rural Schools
This section assesses capacity in rural areas outside Bangkok to deliver support services to teachers and students, including the use of the Internet and multimedia services. It describes issues and constraints to implementation; analyzes infrastructures, personnel, networking, and satellite means of instructional delivery. Recommendations are presented.
Content: Providing Rural ICT Services.
TA Description: Assess capacity in rural areas outside Bangkok to deliver support services to teachers and students including the use of the Internet and multimedia services

6. ICT Proposal: Costs and Implementation of Proposals
This section presents proposed project costs and implementation scenarios.
Content: Estimated Costs and Scenarios for National Implementation of Proposals.
TA Description: Assess estimated costs and scenarios for national implementation.

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Asian Education Network Project Proposal

Executive Summary

As described in the project task documents, a major assignment of the current report is to provide a framework and scenarios for in-service training of teachers and administrators in Thailand, especially at the secondary education level. This report provides not only a framework, but it also lays out a comprehensive design for in-service training and direct instruction through satellite delivery, local support for ICT direct instruction, and regional support for the local level. This is a summary of the proposed Asian Education Network (AEN):

> The purpose of the Asian Educator Network is to deliver direct instruction to students and on-site in-service training to teachers and administrators at rural schools in order to improve school management, classroom instruction, and student achievement. (The AEN arrangement also will make community training in health and economic development possible through the same network.) Instructional delivery will be provided via an existing satellite and equipment based in secondary schools. Initially 12,000 Thailand schools will participate in the pilot project. After the pilot phase, service will be expanded to six participating countries in Southeast Asia and 13 Pacific Rim countries. The project will continue through a self-support model.

The Asian Education Network (AEN) will establish a self-sustaining hybrid television and computer network. The purpose of the network is to provide direct-broadcast satellite programming and data streaming of in-service training for teachers in ICT, learner-centered pedagogy, whole school reform initiatives, and subject matter discipline-related software files and applications. As an extension of the education sector's focus on teacher and administrator in-service training, training in other areas such as health promotion, vocational training, tourism and other economic development, and health-sector related training also will be delivered to community-based sites. Important features of the project are that it will be cost-effective and self-sustaining.

Since similar needs for in-service training exist throughout the Greater Mekong Sub-region, the Asian Education Network will occur over five years in three distinct phases: a three-year prototyping of procedures and processes unique to Thailand, followed by regional dissemination to Southeast Asia and further dissemination to the Pacific Rim. Thailand is uniquely positioned, both geographically and through its satellite assets, to conduct the pilot project and to take and a lead role in the AEN regional project. A pilot project involving 12,000 primary and secondary schools and 2,000 community centers will be set up in Thailand during the project's first phase. The two subsequent phases will expand distribution to six countries in Southeast Asia and 13 nations in the Pacific Rim and South Pacific.

Project deliverables will include television programming and software development that support educational reform, economic development, and health care issues in the GMS and Pacific Rim. School training will include such topics as ICT use and best practices in teaching, school-based management, and school administration.

Smaller Projects Within the AEN

Four smaller projects make up the total AEN project. The following describes the smaller component projects making up the total AEN project. Depending upon the availability and level of funding, these components are separate parts of the project that could be funded separately.

The Asian Education Network project is designed to provide a delivery method for direct instruction for schools in Thailand and subsequently to six surrounding countries. It will use the content of many ongoing projects in Southeast Asia to provide customized content to serve different needs of individual schools in Thailand and in the dissemination phase nations. The project will provide in-service and continuing education training for teachers and school administrators, as well as instruction for community health care and vocational training specialists.

The following smaller project components make up the total AEN project, and will be designed to fit the needs of individual schools of unique regions within Thailand and the countries designated for programming dissemination during its second phase.

1. Data Storage and LAN Hardware. Located at a local school, the direct broadcast dish antenna and satellite receiver connect a local server to the computer data signals provided by the ThaiCom 3 satellite. In turn, an **easiLAB** server connected to the satellite receiver functions as a central multimedia and applications server for the school. The server automatically records video programs for on-demand playing throughout a school. But beyond video, the server provides state-of-the-art access to computer assisted instruction (CAI), software applications, eLibraries, supplementary and advanced placement instruction, and a range of lesson planning, budgeting, and multimedia authoring programs for teachers and administrators. To provide software and lessons efficiently for all teachers, administrators and students at a school, this multi-use computer server is connected to a Local Area Network (LAN).

Teachers have access to their own computers, which may also be used at home for preparing lesson plans, presentations, and grading or marking assignments.

2. Multiuse Computer Laboratory: Each school has a multi-use computer laboratory that has 20 computer stations for students; students access the server from a standardized 20-station computer laboratory. One feature of this computer lab is that it may be scaled easily according to a school's needs and number of students. Called **easiLAB**, the computer laboratory provides both students and educational staff with a multidisciplinary, multiuse computer facility characterized by its simplicity of setup, flexibility in teaching different subject areas, and ease of use.

3. Regional Centers: Hardware and software support is critical to encourage effective use of ICT approaches. Regional and mobile support is an important dimension of AEN services. Regional ICT Multimedia Support Centers provide extensive software libraries, workshops, certification testing, working demonstrations, and coordination for ICT development for the schools in a region.

4. Mobile ICT Support: Various sizes of mobile ICT support vans and buses called MITSupport Vehicles (MITS) will serve a circuit of schools and communities. All MITS vehicles deliver, install, and perform periodic and critical maintenance on schools' computer hardware in a region.

Larger MITS vehicles serve rural areas and also function as supplementary mobile computer labs in discipline areas such as science, languages, and ICT use. Using an extensive Software Lending Library, the MITS vehicle driver/technician delivers, installs, and uninstalls software (on the subsequent visit) for temporary use for schools that may not be able to afford or justify a software purchase.

MITS personnel will provide on-site workshops and training before or after school hours to teachers and administrators in software and ICT development topics.

In the evening hours, MITS vehicles provide residents of nearby communities with access to community and economic development, vocational, and healthcare software and training. MITS vehicles also act as an e-Book Lending Library to communities through use of handheld computers and viewers. These devices are recharged by solar panels on the vehicle's roofs, so service can be extended to even communities without electricity.

ABBREVIATIONS

	Description	*Notes*
ADB	Asian Development Bank	
AEN	Asian Education Network	
CAI	Computer Assisted Instruction	
GMS	Greater Mekong Sub-region	
ICT	Information and Communication Technologies	*New media*
IEA	Information Association for Educational Advancement	
IT	Information Technology	
LAN	Local Area Networks	
MITS	Mobile Technology Training Vehicle	
MOE	Ministry of Education	
NECTEC	National Electronics and Computer Technology Center	
ONEC	Office of the National Education Commission	
ONES	Office of National Education Standards	
ONPEC	Office of the National Primary Education Commission	
PARSIT	English to Thai computer-based translation on the web	*http://www.parsit@nectec.or.th*
RU	Ramkhamhaeng University	*Noted open university*
SEAMEO	Southeast Asian Ministers of Education Organization	
SN	SchoolNet	*School computer network*
STOU	Sukhothai Thammathirat Open University	*Noted open university*
UNESCO	United Nations Education, Scientific & Cultural Organization	
WAN	Wide Area Network	

INTRODUCTION

The objective of this Technical Assistance to the Kingdom of Thailand (TAR: TH31358) is to strengthen the capacity of the Government to carry out the education reforms mandated by the National Education Act of 1999, including measures to improve teaching and learning, administrative leadership, and community accountability. The integration of teacher in-service training in the use of new educational technologies, including Information Technology (IT), is to be a significant part of these measures.

This report addresses the six specific tasks requested of the Specialist in Information Technology in Education. As requested during the course of the consultancy, the report also goes beyond these tasks to propose an Asian Education Network (AEN) that would be piloted in Thailand and ultimately would serve the Greater Mekong Sub-region (GMS).

1. ICT INPUTS TO EDUCATION AND IN-SERVICE

This section describes and reviews the current teacher model of Information and Communication Technology (ICT) use, explores reasons for limited ICT use, and provides a model for ICT teacher in-service.

1.1.0 **INSTITUTING EDUCATIONAL CHANGE**

1.1.1 **Technology and Educational Change:** In examining the spread of technologies in schools, researchers observed in the early 1990s that instructional technologies are only accepted in the classroom after widespread use in society. A general lack of knowledge of the appropriate uses of ICT in the classroom typically relegates schools to the last institutional space in societies to be penetrated by any new technology, such as calculators, VCRs, and computers. This pattern describes many Thailand schools. General interest and contact with computing is growing rapidly in Thailand, especially in Bangkok and in the larger cities, where the growth of computer parlors is now a common business phenomenon. The problem that exists is dealing with constraints to ICT use in schools, many of which are found not only in Thailand but also throughout the region.

1.1.2 **Constraints to ICT Adoption in Thailand**: Two major constraints to adopting ICT approaches appear to exist in the Thai educational system - limited budgets coupled with educators' and administrators' limited experience with and support for ICT approaches.

Budgets

The norm in budgeting has been to treat computers and other electronic media as add-ons. The result of this practice is that computers become little more than "word processors," bearing only a peripheral relationship to the curriculum. Because public school administrators do not know when additional ICT resources will be available to schools, they tend to construct environments and policies that shelter and protect their technology assets from extensive use by students and teachers. This view is reinforced in a very real way by lack of support systems for maintenance.

Experience

Classroom teachers have only incidental knowledge of ICT use. Teachers recruited to fill teacher shortages in Thailand during the 1970s were not required to have a teaching degree or to take pre-service courses in appropriate uses of new technologies. Teachers of this cohort currently hold lead instructor positions, have seniority on school teaching staffs, have little incentive to adopt new teaching methods. Acquiring ICT skills now will not affect their rank, assignments, or pay scale. Practicing teachers need to find pedagogically sound ways to apply technology in the classroom. This is difficult to do when one is not familiar with it and has no motivation to adopt its use.

Unfortunately, typical new teachers have not had much formal education in pedagogies making use of ICT either. Until recently, teachers' colleges and institutions of higher education have not made the integration of ICT approaches into instruction a priority for either professional studies in education or pre-service experiences.

Figure 2 below provides a model for developing in-service training for Thai teachers in the use of new technologies. The model makes several recommendations:

1. Develop a long term program. No program will be effective unless it is long term and involves a continuous commitment to training and use of instructional technologies.

2. Establish incentives, tuition, and credit. Teachers and administrators must have clear and positive incentives for participating in ICT in-service. For example, the Ministry of Education (MOE) should provide such incentives as tution for advanced college coursework (delivered on-site by satellite) or promotion in rank.

3. Develop site-based delivery. Delivery of instruction should be site-based over an extended period of time, so that teachers can develop and try the materials and methods with their students.

4. Provide delivery and support methods. Reliable distance delivery and support to local schools must be established. Both hardware and software support at the local level is critical to site based delivery of in-service training.

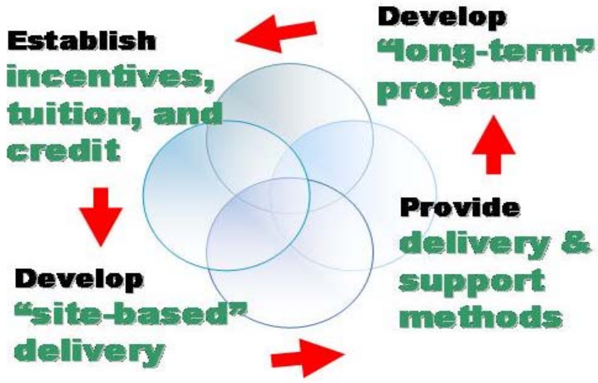


Figure 2: Model for In-Service Program Development

1.2.0 MODELS OF EDUCATIONAL OUTCOMES

Education reform projects are underway in some form in all countries of the Greater Mekong Sub-region (GMS). This section reviews various models that have been used to guide the planning of these educational reforms.

1.2.1 **Economic Effects:** Southeast Asia is recovering from the 1997Asian financial crisis, which widened the gap for educational opportunity among the provinces of Thailand and highlighted weaknesses in the educational systems within the GMS. Throughout the GMS, educational systems in their present form are seen as hindering the ability to compete in the global, knowledge-based economy. Since 1998, however, using educational technologies within the schools has been mandated as a part of educational reform in Thailand. It is viewed as a critical means of strengthening the education system and the economy.

1.2.2 **Workforce Needs:** Before the crisis, Thailand's educational system provided universal basic education through grade 6 (to age 12). In 1997, the average worker in Thailand had less than a grade six education. This level of education was thought to be sufficient to provide skills for the economy. After the financial crisis, it has been widely recognized that to compete economically, a well-trained, computer literate, adaptable workforce must be developed.

1.2.3 **Classes of Knowledge:** Citizens, educators, and educational planners in Thailand have frequently noted that students need to be exposed to various kinds of knowledge in schools. In technical scientific knoweldge, students learn the laws of nature, pattern principles, and other rules of science. In addition to technical scientific knowledge, Thai education reform legislation calls for Thai knowledge to be incorporated into the curriculum. In particular, adding the elements of cultural knowledge and self knowledge are necessary to achieving the desired outcomes of Thai education. (See Appendix 2 for a graphic representation of the classes of knowledge). Enhanced ICT use can be of particular assistance in the area of building socio-cultural knowledge, as students can access information about the different regions and cultures of the country on the Internet.

1.2.4 **Learner-Centered Instruction:** Another significant movement in the reform process has been Thai educators' desire to move away from teacher-centered practices characterized by rote memorization teaching techniques. As a replacement, educators have advanced learner- or student-centered approaches. These also appear as part of the 1999 legislation. As educators at Western Carolina University have noted succinctly, student-centered instruction is a broad teaching approach that includes substituting learning for lectures, holding students responsible for their learning, and using self-paced and/or cooperative (team-based) learning.

All the above models of educational outcomes and learning—economic effects, workforce needs, classes of knowledge, learner-centered instruction—have influenced education reforms in Thailand and across the GMS. Expanding and enhancing ICT is critical to achieving the desired educational outcomes.

1.2.5 **Social Constructivism and Learning:** Examining particular reform movement aims and IT input needed to achieve those aims can best be understood in the context of a constructivist perspective. Educational reform literature contains many references to desired changes for hands-on, activity-based approaches, many with roots in social constructivism and related movements. The following brief review of Vygotsky's seminal work in this area may help place this specific approach in context.

Vygotsky (1978) asserted that learning takes place through the social construction of concepts, and that human development could not be understood without reference to embedded social and cultural contexts. He suggested that intellectual development continually evolves in an overlapping spiral of interrelated concepts. Investigations led him to propose the social constructivist theory of learning. The major precepts of the theory are that individuals learn through social interaction with the environment and through speech, in addition to observing and doing. Vygotsky's experiments illustrated that when a learner is confronted with a perceived problem, s/he uses speech directed at a facilitator to achieve a desired result. Manipulation of the environment externally through speech begins to be internalized. Vygotsky postulated that learning takes place in a zone of proximal development, defined as the distance between learner development as measured by the ability to solve problems without assistance, and the ability to solve problems with an instructor or through peer tutoring.

The Vygotskian approach is the facilitation of active, exploratory learning experiences within a socially interactive environment. This also involves individualizing curricular experiences to each learner's individual needs and interests. The approach relies heavily on manipulating materials and exploring ideas and concepts with peers and the teacher/ facilitator. Because learners collaborate extensively, the instructor actively assumes the role of assessor of learning quality and effectiveness. The instructor often becomes directly involved only when prescribed activity sequences are determined to be ineffective.

Instruction presented in an adaptive manner can be enhanced through instructional technology approaches. Vygotsky suggests that emphasis on textbooks results in a curriculum that is not socially relevant. Of necessity, textbook content is general, geared to average students. Current textbook approaches cannot meet the range of ability levels within any given classroom. Well-designed ICT approaches can deliver effective and adaptive content. Interactive computer learning can play the role of tutor, so that the appropriate level of assistance is provided only at the point that it is needed. In using this approach it is recommended that students study together in pairs or collaborate in small groups around a shared computer. It is further recommended that the use of peer tutoring and Vygotskian approaches be considered in design of software during the proposed AEN project.

1.3.0 ICT INPUTS AND MODELS

1.3.1 **Computers in Schools:** An inadequate number of computers in the school system remains a problem. Table 1 below provides data regarding student access to computers in Thai primary and secondary schools. Figures 2 and 3 compare percentages of computers in primary and secondary schools with the general population. The ratio of computers to students in primary school is such that students cannot have adequate time and opportunity to use computers as part of their daily schooling. Although the computer to student ratio is significantly lower in secondary than in primary school, the ratio is still high, and students generally cannot be expected to develop a high degree of computer literacy in these environments.

Table 1: Current Number of Computers in Thailand for Primary and Secondary Schools

Level	Schools	Students	PC's	Ratio / School	Ratio / Students
Primary	31,171	5,936,174	70,600	2.26	1:84
Secondary	2,553	2,555,491	47,582	19	1:53
	33,724	8,491,665	118,182		

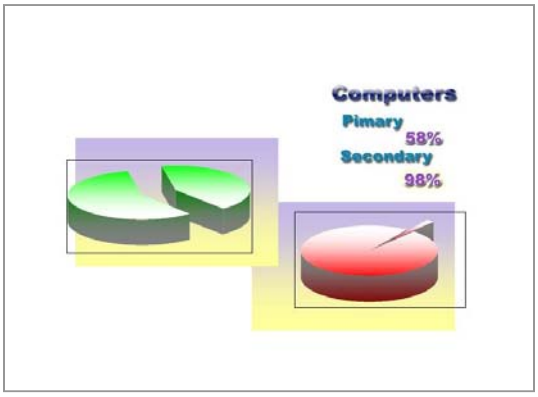


Figure 2: Percentages of Computers in Public Primary and Secondary Schools in Thailand (58% and 98% Respectively)

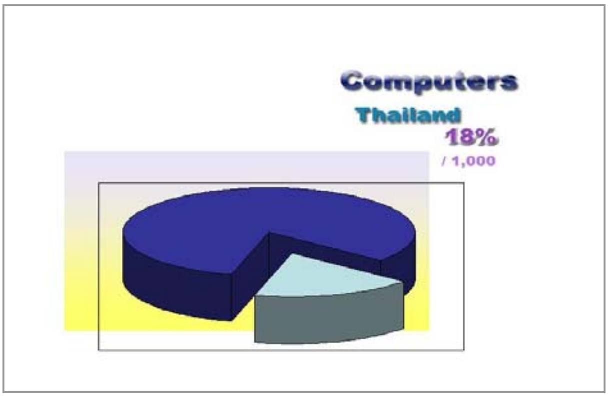


Figure 3: Percentages of Computers in the General Population in Thailand Per 1000 Population (18%)

1.3.2 **Computer Literacy:** Educators have struggled to determine what ICT skills students should have, that is, students' "computer literacy" (Roblyer, 1992). Thai education stakeholders are likely to engage in debates regarding computer literacy similar to those that have taken place in other parts of the world. In the US, for example, although microcomputers have been in schools since about 1978, stakeholders continue to debate the role technology should play in teaching and learning (Roblyer, 1997). (See Annex 2 for additional references on the topic of computer literacy.)

1.3.3 **Computer Self-Efficacy:** Self-efficacy is the belief in one's capabilities to organize and implement a course of action that will bring about expected results. Several researchers have determined that self-efficacy is essential in learning to use and in using computers (Delcourt & Kinzie, 1993; Hill et al., 1987; Jorde-Bloom, 1988; Kinzie et al., 1994; Miura, 1987; Schunk, 1981, 1985). It is distinct from computer literacy and the attainment of specific skills, but it is important to skill improvement. The greater people perceive their self-efficacy to be, the more active they are and the longer they persist in their efforts (Bandura, 1977, 1981, 1982; Bandura & Adams, 1977). Woodrow (1991) specifically claimed that students' attitudes toward computers were a critical issue to consider in developing computer courses and computer-based curricula. (See Appendix 4 for a bibliography of self-efficacy research as related to computer learning. Appendix 5 offers a research study comparing factors affecting student performance under different conditions of self-efficacy.)

People's attitudes about their abilities to use the computer affect their level of performance and interest. If the computer is to be used as a teaching and learning tool, then monitoring users' *attitudes* toward computers should be a continuous part of the teaching and learning process, and in-service training needs to address those teachers with a low sense of self-efficacy. Some teachers are observed to have "computer anxiety," that is, an extreme resistance or aversion to working with computers. Strategies have been and can be developed to address this computer anxiety so that over time teachers will be able to produce computer instruction that they will be able to try out and revise in their own schools and classrooms.

1.3.4 **Technology Standards:** Setting standards for school, teacher, and student use of technology is a recent phenomenon. In the United States, North Carolina and other states have set specific standards for what students at each grade level should know and be able to do with technology (Atkins & Vasu, 1998). In 1998, the National Educational Technology Standards (NETS) project in the United States published standards for student use of technology.[1] (Unlike content areas such as mathematics, no US professional organizations had published national standards until that time.)

Besides standards for student ICT achievement, other organizations have established standards for teachers and for schools. For example, the School Technology Assessment of Readiness (STAR) is a series of questions that helps a school to evaluate if it has the requisites in place to support technology-based approaches to teaching and learning. The readiness questions includes such items as, "Do you have the capability to maintain your hardware?" (For many Thai schools, the answer to that particular answer would be "no.") This assessment tool helps schools understand where they are and where they need to be in order to successfully implement ICT approaches in classroom instruction.

(The standards contained in the US National Educational Technology Standards (NETS) and School Technology Assessment of Readiness (STAR) indicators are presented in Appendix 6.)

1.3.5 **Types of Utilization:** Use of educational technologies varies by region, population density, and local expertise. School visitations made over a four-month period by the Asian Development Bank (ADB) project team indicated that typical ICT use in Thai schools was limited on the part of both teachers and students (see Appendix 7 for a list of schools and institutions visited). The project team found the following:

- **Teachers** use the computer very little for direct instruction in the classroom. They have just begun to use word processing for lesson planning and preparing handouts or exercise sheets. Where the Internet is available, teachers sometimes assign topical searches, but these are constrained by low numbers of Internet connections available and the scarcity of local area networks (LAN) in schools.

- **Students** are enthusiastic about using the computer, but are constrained by software availability and Internet access. Classroom use is often limited to the initial software that came with the computer, such as Microsoft Word and Power Point. Internet use is sometimes casual and largely unstructured.

[1] NETS is an initiative of the International Society for Technology in Education (ISTE) funded by the National Aeronautics and Space Administration (NASA), U.S. Department of Education, Milliken Exchange on Educational Technology, and Apple Computer.

Use of ICT varies by school; however, in the schools visited for this report, both teachers and students typically tended toward minimal use of ICT for direct instruction. Using the computer for typing reports and lesson plans were typically observed in most schools. Figure 4 below represents the ICT use continuum from minimal to maximum usage.

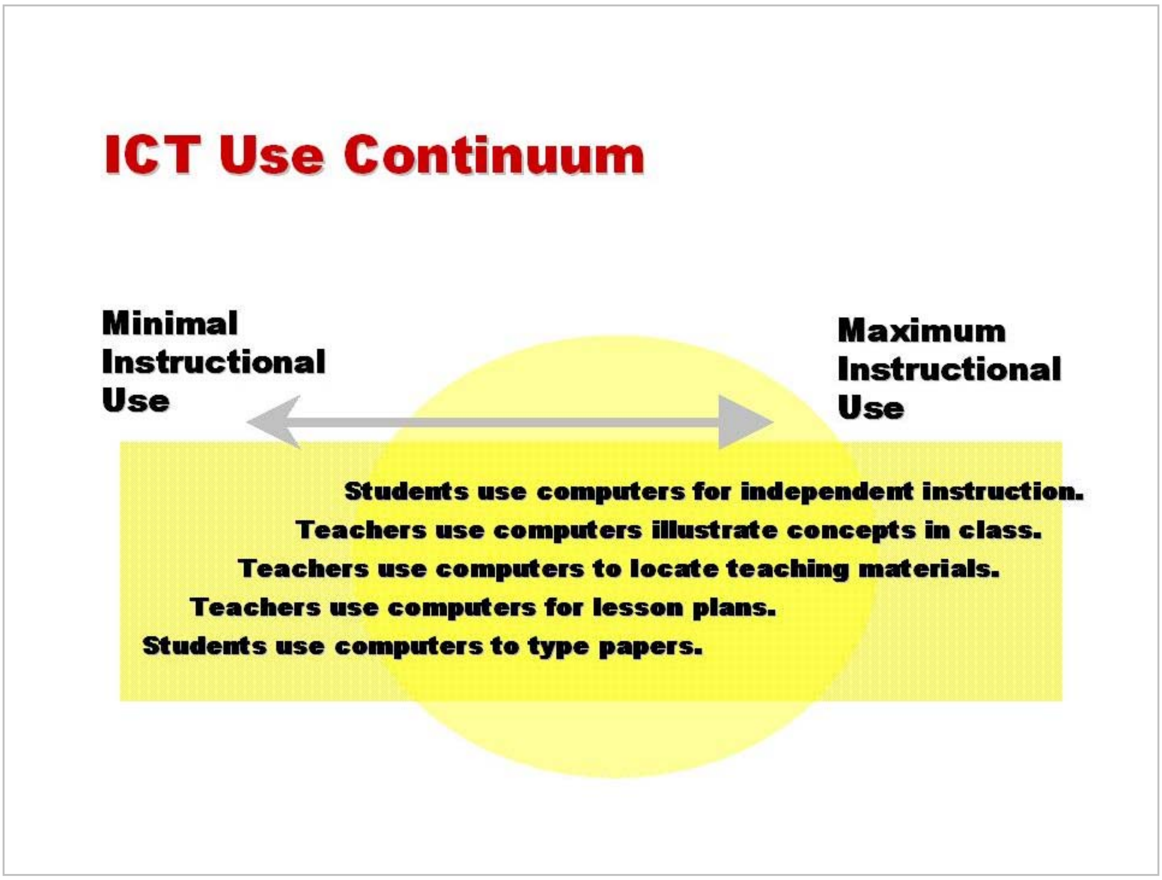


Figure 4: Continuum of ICT Instructional Usage

1.4.0 ICT INITIATIVES IN THAILAND

The education reform initiatives of 1999 set forth broad changes in financial, administrative, and pedagogical policies. This section reviews recent ICT initiatives in Thailand designed to enhance capacity at a national level.

1.4.1 **Networking Projects:** ICT demonstration projects are currently underway that provide resources through computer networks to a variety of constituents. Progress has been made but it has been slow. The three major projects to date are SchoolNet, UniNet, and EdNET.

- SchoolNet started in 1995 with a pilot project of 50 schools and has grown over the past seven years of the project. The project will connect 5,000 schools during 2002.

- The Ministry of University Affairs administers UniNet at the tertiary level. The most developed of the projects, UniNet connects all public universities in Thailand by a fiber optic backbone between campuses and to regional provincial campuses.

- EdNET is a network that will eventually link all public schools and higher education institutions. In the EdNET project, which began the implementation phase in 2002, SchoolNet and UniNet are combined to provide networking services to all schools in Thailand at all educational levels.

As described below, the potential is great for building on some of these projects to support increased ICT instruction for secondary school students, teachers, and administrators.

1.4.2 **Distance Learning Projects:** Use of radio and television for instruction began in the 1970s in Thailand. Early projects were followed by projects that gained momentum in the early and mid-1990s to develop videoconferencing instructional delivery to students. Thus, the use of radio and television as a medium for distance learning is well established in Thailand. Notably, the Distance Learning Foundation project at Hua Hin, currently offers televised courses in primary and secondary school subjects by satellite delivery to Thailand and Cambodia. Six satellite channels provide programming during school hours.

The large, television-based distance learning projects currently underway in Thailand include the following:

- The Educational Technology Center broadcasts educational programming for all departments in the Ministry of Education. Equipment upgrades were scheduled for 2002 to enhance the capabilities of aging hardware.

- The Department of Non-Formal Education is very active in this area, as is the Department of General Education.

- The Distance Learning Foundation has responded to a shortage of teachers in Thailand and the GMS by providing live, interactive teacher training lessons through satellite-delivered video with two-way audio through Distance Learning Television Station at Wangklaikangwon in Hua Hin, Prachuabkhirikhun.

2. <u>ICT SUPPORT THROUGH REGIONAL CENTERS</u>

This section assesses the capacity of the education system to support for distance learning through ICT for teachers and principals through regional centers maintained by Thai universities.

2.1.0 ICT CONSORTIUM

2.1.1 **Thai Universities:** Regionally, several universities have a great deal of expertise in conducting distance learning courses and providing support at the local level for testing and assistance. Given the work in which they are currently involved in materials development in television and multimedia, Sukhothai Thammathirat Open University and Ramkhamhaeng University should play lead roles in these areas. National ICT Education Centers should be established on their campuses to assist project development. University credit from distance learning courses from these universities and the ICT consortium should be part of incentive plans developed by the MOE and the public service commission. (See Appendix 8 for a description of functions of the proposed centers.)

2.1.2 **International and National Projects:** Several computer projects also have been developed regionally, including the Southeast Asian Ministers of Education Organization (SEAMEO) and UNESCO regional training. It is envisioned that these organizations would play a pivotal role in coordinating GMS efforts in developing programming and software for satellite distribution across the region through the Asian Education Network (AEN) described in Section 3 below. The Distance Learning Television Station at Wangklaikangwon School in Hua Hin through the Distance Learning Foundation will serve as one of the three national AEN project centers in the Thailand pilot. The facilities at Hua Hin will coordinate technical aspects of satellite programming and uplink to ThaiCom 3 for the network.

2.2.0 **REGIONAL CENTER FUNCTIONS**

2.2.1 General **Functions.** ICT support through regional centers is needed to: (1) upgrade discipline area teaching in English and Science (including support to teachers for virtual science labs); (2) support teacher in-service training in student-centered and constructivist approaches; and (3) support in-service in “whole school” issues, such as, school-based management.

2.2.1 **Science Lab Materials:** Preparation in the sciences is a key to successful preparation for higher education, and effective science teaching requires access to science laboratories. Science laboratories in Thai schools vary widely in the range and quality of experiments that can be conducted. One solution for schools that do not have access to adequate science labs is virtual lab courseware. Regional ICT multimedia centers should provide support to help teachers learn to work with virtual science labs.

Regional Support	Total	Thailand	GMS
aen Regional Centers	14,400,000	3,600,000	10,800,000
Multimedia and Traning Support:			
$36,000 x 100 (Thailand pilot)	3,600,000	3,600,000	
$36,000 x 300 (GMS)	10,800,000		10,800,000
aenMITS (mobile support)	6,236,000	1,082,000	5,154,000
Site Support Vehicles (Outfitted):			
$223,000 x 2 RV Lab vehicles (Pilot)	446,000	446,000	
$53,000 x 12 Van vehicles (Pilot)	636,000	636,000	
$223,000 x 6 RV Lab vehicles GMS)	1,338,000		1,338,000
$53,000 x 72 Van vehicles (GMS)	3,816,000		3,816,000
Total	**26,872,000**	**4,682,000**	**21,108,000**

2.2.2 **Software Development:** Since software is the key to effective computer use in Thai schools, software programs in the Thai language should be enhanced and adequately funded. ICT materials development centers should be instituted through an ICT Consortium of the MOE, universities, and private businesses. The MOE and the Institute for Promotion of Educational Technologies should coordinate and supervise efforts. Lead development centers are proposed for Sukhothai Thammathirat Open University and Ramkhamhaeng University. Other universities and organizations (e.g., Kasetsart University and SchoolNet) would eventually be part of consortium efforts.[2]

Several projects already are developing new Thai language software. One large project represents a new role for the SchoolNet project, which managed a network for the school system of 2,200 secondary schools during the year 2000 with projections of a target of 5,000 schools by the end of 2002. As SchoolNet is merged into EdNET, project staff increasingly will undertake strategic projects in Thai software development.

Software projects, as illustrated in the budget above, should be undertaken and accompany the distribution of computing hardware in the public schools. Regional centers to support multimedia lending libraries, exemplary “key” and “navigator school” style demonstrations and workshops, and mobile support vehicle resources should also be undertaken.

[2] Adapting existing software to the Thai language (in Biology, Chemistry, Physics, Environmental Studies, and Engineering) is underway at Kasetsart University. www.ku.ac.th.

3. <u>ICT PROPOSALS AND RECOMMENDATIONS</u>

A major assignment of this report is to provide a framework for in-service training of teachers and administrators in Thailand, especially at the secondary education level. This section lays out a comprehensive design for in-service training and direct instruction through satellite delivery, local support for ICT direct instruction, regional support for the local level, and national support for the entire project, called the "Asian Education Network (AEN)."

3.1.0. **ASIAN EDUCATION NETWORK PROJECT**

3.1.1 **Project Description:** The purpose of the Asian Education Network is to deliver direct instruction to students and on-site in-service training to teachers and administrators at rural schools in order to improve school management, classroom instruction, and student achievement. Instructional delivery will be provided via an existing satellite and equipment based in secondary schools. Initially 12,000 Thailand schools will participate in the pilot project. After the pilot phase, service will be expanded to six participating countries in Southeast Asia and 13 Pacific Rim countries. Important features of the project are that it will be cost-effective and self-sustaining.

The Asian Education Network (AEN) will establish a self-sustaining hybrid television and computer network. The network will provide direct-broadcast satellite programming and data streaming of in-service training for teachers in ICT, learner-centered pedagogy, whole school reform initiatives, and subject matter discipline-related software files and applications.

Project deliverables will include television programming and software development that support educational reform, economic development, and health care issues in the GMS and Pacific Rim. School training will include such topics as ICT use and best practices in teaching, school-based management, and school administration.

As an extension of the education sector's focus on teacher and administrator in-service training, training in other areas such as health promotion, vocational training, tourism and other economic development, and health-sector related training will be delivered to community-based sites through the network.

3.1.2 **Smaller Projects Within the AEN**

The AEN project is designed to provide a delivery method for direct instruction for schools in Thailand and subsequently to six surrounding countries. It will use the content of many ongoing projects in Southeast Asia to provide customized content to serve different needs of individual schools in Thailand and in the dissemination phase nations. The project will provide in-service and continuing education training for teachers and school administrators, as well as for community health care and vocational training specialists.

Four smaller projects make up the AEN project. Depending upon the availability and level of funding, these components are separate parts of the project and could be funded individually.

3.1.2.1 Technical Design: Data storage and LAN Hardware. Located at a local school, the direct broadcast dish antenna and satellite receiver connect a local server to the computer data signals provided by the ThaiCom 3 satellite. In turn, an easiLAB server connected to the satellite receiver functions as a central multimedia and applications server for the school. The server automatically records video programs for on-demand playing throughout a school. But beyond video, the server provides state-of-the-art access to computer assisted instruction, software applications, eLibraries, supplementary and advanced placement instruction, and a range of lesson planning, budgeting, and multimedia authoring programs for teachers and administrators. To provide software and lessons efficiently for all teachers, administrators and students at a school, this multi-use computer server is connected to a Local Area Network (LAN).

3.1.2.2 Multiuse Computer Laboratory: Each school has a multi-use computer laboratory that has 20 computer stations for students; students access the server from a standardized 20-station computer laboratory. One feature of this computer lab is that it may be scaled easily according to a school's needs and number of students. Called **easiLAB**, the computer laboratory provides both students and educational staff with a multidisciplinary, multiuse computer facility characterized by its simplicity of setup, flexibility in teaching different subject areas, and ease of use.

Teachers have access to their own computers, which may also be used at home for preparing lesson plans, presentations, and grading or marking assignments.

3.1.2.3 Regional Centers: Hardware and software support is critical to encourage effective use of ICT approaches. Regional and mobile support is important aspects of AEN services. Regional ICT Multimedia Support Centers provide extensive software libraries, workshops, certification testing, working demonstrations, and coordination for ICT development for the schools in a region.

3.1.2.4 Mobile ICT Support: Various sizes of mobile ICT support vans and buses called MITSupport Vehicles (MITS) will serve a circuit of schools and communities. All MITS vehicles deliver, install, and perform periodic and critical maintenance on schools' computer hardware in a region.

Larger MITS vehicles serve rural areas and also function as supplementary mobile computer labs in discipline areas such as science, languages, and ICT use. Using an extensive Software Lending Library, the MITS vehicle driver/technician delivers, installs, and uninstalls software (on the subsequent visit) for temporary use for schools that may not be able to afford or justify a software purchase.

MITS personnel will provide on-site workshops and training before or after school hours to teachers and administrators in software and ICT development topics.

In the evening hours, MITS vehicles provide residents of nearby communities with access to community and economic development, vocational, and healthcare software and training. MITS vehicles also act as an e-Book Lending Library to communities through use of handheld computers and viewers. These devices are recharged by solar panels on the vehicle's roofs, so service can be extended to communities without electricity.

3.1.3 **AEN Levels of Operation:** In summary, the students, teachers, and administrators in schools are the focus, but AEN will operate at various levels.

School

- easiLAB computer laboratories are set up at selected local school and community sites.
- Selected school sites are networked to provide access to server based audio, video and multimedia files.
- Local area networks at selected sites distribute downloaded, on-demand video and computer software to school offices and multipurpose computer laboratories.
- Television and computer data signals are transmitted to schools by satellite. Current direct satellite television receivers are adapted to incorporate the ability to download high-speed computer data in addition to the television signal.
- A cache of Internet sites and video programs are stored on a central server at the school site in lieu of direct connection to the Internet or broadcast television programming.

Regional

- Sukhothai Thammathirat, Ramkhamhaeng University and Ministry of Education sites provide multimedia demonstration and lending libraries and workshops to area schools.
- Mobile support vehicles maintain hardware and provide access for school and community training.

National

- National ICT Education Centers coordinate software and programming development.

Project deliverables will include television programming and software that supports educational reform, economic development, and health issues in the GMS and Pacific Rim. School training will include such topics as ICT use in teaching, best practices, school-based management, and school administrative issues.

3.1.4 **Project Goals:** The following identifies the overall learning environment that the project seeks to achieve and its major goals. Figure 5 below shows the goals for the media environment to be achieved by the project. In this environment, the curriculum, assessment, instruction, and content are responsive to the student.

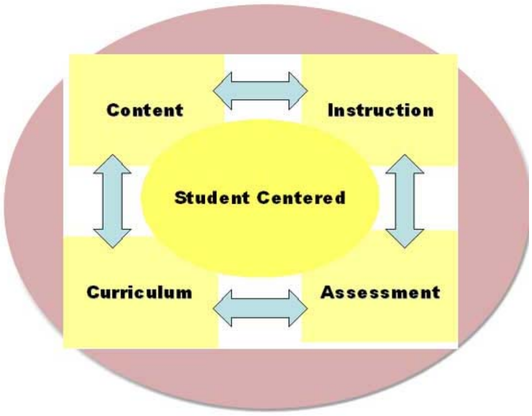


Figure 5: Responsive Elements in Providing a Student-centered Environment

The AEN project seeks to accomplish four (4) major goals:

(1) to develop a sustainable, on-going training program;
(2) that is supported by effective incentives such as awarding university credit;
(3) delivered on-site in schools, communities, and regional support centers;
(4) through advanced instructional delivery mechanisms, such as satellite use.

3.2.0 **OBJECTIVES AND OUTCOMES**

3.2.1 **Alternative Delivery:** The AEN project will establish alternative delivery methods though a combination of advanced techniques for site-based training and Train the Trainer (TOT) workshops at local and regional sites using Mobile Technology Training vehicles (see Figure 9 below).

Outcomes will include site-based training (Rajabhats and Faculties of Education); train the Trainer instruction for use by master teachers; delivery by CAI, on-line training, data streaming via satellite, interactive television, and print-based means.

On-going training will be accomplished by the AEN to provide on-demand television, software and print materials delivered digitally by satellite.

3.2.2 **Curriculum:** The project will work with the Thai MOE and SEAMEO groups to develop in-service curricula, best practice examples from participating countries, and new teacher training coursework developed by participating universities. Curriculum will be developed that reflects the knowledge and skills required for an information society. Outcomes would include international programs for teachers in educational technologies, interactive teaching, and other topics; programs on best practices developed by teacher training institutions; new teacher training curricula for teacher training institutions; and a comprehensive monitoring program for continuing quality assurance.

3.3 **TIMELINE**

Since similar needs for in-service training exist throughout the Greater Mekong Sub-region, the Asian Education Network will be implemented over five years in three distinct phases: a three-year prototyping of procedures and processes unique to Thailand, followed by regional dissemination to Southeast Asia, and further dissemination to the Pacific Rim. Thailand is uniquely positioned, both geographically and through its satellite assets, to conduct the pilot project and to take and a lead role in the AEN regional project. A pilot project involving 12,000 primary and secondary schools and 2,000 community centers will be set up in Thailand during the project's first phase. The two subsequent phases will expand distribution to six countries in Southeast Asia and 13 nations in the Pacific Rim and South Pacific.

The AEN project will provide in-service training for incorporation of school reform issues and ICT training in three overlapping phases during the five-year project. The phases are as follows

Year 1-3 Selected upper secondary schools in Thailand using existing satellite receiving equipment prototype in-service and teaching approaches.

Years 3-5 Expansion of curriculum and programming to six (6) additional Southeast Asian nations using ThaiCom3.

Years 4-5 Expansion of curriculum and programming to 13 Pacific Rim nations using PeaceSat.

3.4.0 **PROJECT ORGANIZATION**

3.4.1 **Coordination:** It is recommended that the Institute for the Promotion of Educational Technologies (IPET) provide coordination and support to schools and educational agencies and the ICT consortium groups involved in the AEN Project. This is in accordance with the organizational responsibilities outlined in the 1999 educational reform legislation.

3.4.2 **ICT Consortium:** The ICT Consortium should develop training and delivery methodologies, coordinate satellite signal infrastructure maintenance, and assist in identifying needed programming content.

3.4.3 **Ministry of Education:** The MOE should oversee the output of the ICT Consortium product development for Thai schools in the AEN project, integrate activities with the Department of Curriculum and Instruction, develop incentives, and identify sets of ICT skills needed by teachers and administrators at various public service commission ranks and levels.

Critical MOE functions are shown in Figure 6. It is recommended that the MOE include these functions within its ICT mission.

1. Oversee network media materials development and delivery by the university consortium and contributing producers;

2. Address curriculum and monitoring issues in conjunction with the Thai MOE Department of Curriculum and Instruction;

3. Establish career pathways and incentives with the MOE; and,

4. Identify a framework of ICT skills teachers need for evaluation and certification at different grade levels and professional ranks.

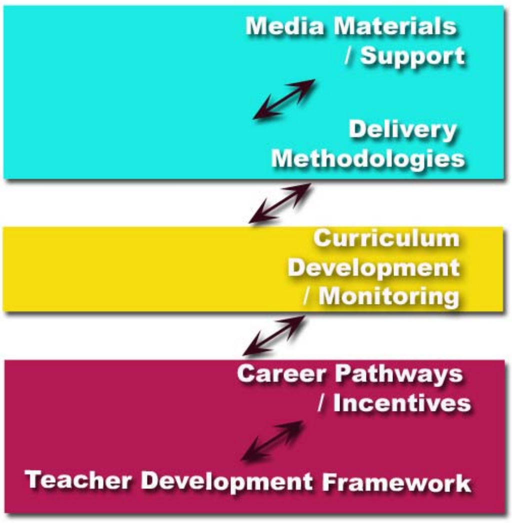


Figure 6: Ministry of Education Functions

3.4.4 **Local School Support:** During the first phase, the project will establish ICT Education Centers at selected university and MOE sites in the region in support of resource centers, technical support, and development of print and software materials. Additional teacher support sites throughout the region will be identified during the second and third phases.

3.4.5 **Uplink Support, GMS:** During the first phase, the ThaiCom3 satellite will be utilized for piloting the proposed network. The signal footprint for ThaiCom3 covers countries adjacent to Thailand. From past projects, such as in Cambodia, it is anticipated that six additional countries will join the regional network and share in support costs for programming and software development.

3.4.6 **Uplink Support, Pacific Rim:** The PeaceSat Project in the United States has indicated that programming time and technical assistance for uplink to the PeaceSat satellite for the Network can be provided. The signal footprint for PeaceSat covers major portion of the Pacific and Pacific Rim nations, including Japan. Thirteen Pacific and Pacific Rim nations may join the network and contribute to support costs during the third phase.

3.5 **PROJECT ACTIVITIES:** Five groups of activities are proposed for the AEN. Three international consultants and five domestic consultants would make up the core staff. Many software development activities within the project activities would be outsourced to university and private organizations.

1. Design a Framework for ICT Teacher Development Standards

1.1 Conduct seminars and workshops on international teacher development practices

1.1.1 Design regional teacher professional development seminars and workshops to be delivered by satellite and interactive teleconferencing.

1.1.2 Construct a framework for teacher development to include:

a. teacher qualifications
b. teacher competencies
c. teacher standards

1.1.3 Develop competencies for teacher training instructors

1.2 Develop policies for teacher professional development. Assist the OER to develop policies to articulate clearly the inputs, processes, and outcomes for teacher development that will promote expected learning outcomes, which in turn will support national economic and labor market plans.

1.3 Identify competencies for teachers in pedagogy, subject areas, and ICT use.

2. Develop Teacher Career Pathways and Incentives

2.1.0 Review policies for teacher career pathways, incentive schemes, remunerations, and other reform issues (with the Teacher Public Service Commission and the National Public Service Commission).

2.1.1 Recommend alternative career pathways, including evaluation and monitoring guidelines and criteria**.** Include an analysis of linkage with the National Teacher Development Framework.

2.1.2 Conduct satellite-delivered workshops on the AEN to train and educate Thai educators regarding alternative methods; develop criteria for evaluation and monitoring their effectiveness.

2.1.3 Develop policy guidelines and operational procedures to provide interface between national and provincial level responsibilities in Thailand.

2.1.4 Review proposed incentives to broaden the scope for rewarding teachers.

2.2.0 Review teacher registration system issues. Establish sufficient flexibility to accommodate the various levels and types of teachers within the professional teaching ranks in Thailand.

2.2.1 Develop legislative requirements to set up teacher registration.

2.2.2 Develop operational manuals and procedures for conducting the business of the teacher registration commission.

2.3.0 Develop quality assurance guidelines and mechanisms to include pre-service, in-service and other professional development training, on-going practices, and teacher training institutions.

3. Provide skills and training development.

3.1 Assist development of AEN delivered training and curricula that reflect the knowledge and skills required by teachers in a "knowledge society."

3.1.1 Identify and coordinate with international programs of teacher training and skills development courses, new educational technologies, interactive methods of teaching, and non-traditional methods for skill development.

3.1.2 Coordinate development of best practice programs with identified teacher-training institutions.

3.2 Train teacher education instructors to use effectively the new curriculum and new approaches to teaching and learning.

3.2.1 Conduct a series of training programs on AEN for instructors of the Rajabhats and faculties of education.
3.2.2 Conduct AEN training for identified master teachers on mentoring and school-based education.
3.2.3 Train TEI and master teachers in becoming “reflective practitioners” in action research.

3.3 Establish staff development training in on-site programs using AEN.
3.3.1 Establish a creative working group on evaluation of the existing programs of staff development (SD) courses.
3.3.2 Train and consult with identified working groups.
3.3.3 Monitor and report the development of renewed programs of SD.

3.4 Establish expanded training at regional multimedia centers using AEN.

3.4.1 Identify criteria and assist selection of teachers to participate in programs for training and re-training in six Southeast Asian countries in Year Three, 13 Pacific Rim countries in Year Four.

3.4.2 Provide training to 30,000 teachers by Year Three; 60,000 by Year Four; 120,000 by Year Five.

4. Develop alternative methods of In-service Teacher Training Using the AEN Satellite.

4.1 Construct a framework for alternative methods of site delivery of in-service training for teachers at the local school level, to include

4.1.1 an Asian Education Network, using distance learning vi satellite and interactive television, print-based materials;

4.1.2 site-based training (delivered by Rajabhats or Faculties of Education)

4.1.3 Train the Trainer approaches, using a master teacher model for demonstration of interaction and teacher preparation skills.

4.2 Build capacity in local teachers to use new technologies in collaboration with teacher training activities in the following areas: teaching and learning, professional development activities, teacher networks, and other reform issues.

5. Develop alternative methods of in-service teacher education through ICT Development Centers.

5.1 Build capacity in local experts to develop effective and high quality teaching and learning materials in accordance with active learning and constructivist approaches using multimedia and print-based material and manuals.

5.2 Develop local expertise in evaluating quality learning materials; and

5.3 Foster private sector involvement in developing quality education materials.

4. <u>ICT AND THE ASSESSMENT OF EDUCATIONAL STANDARDS</u>

This section describes the issues that the Office of the National Education Standards (ONES) should include in assessing ICT school performance.

4.1.0 **RESEARCH DATA**: ONES has undertaken an ambitious assessment process similar to accreditation processes in higher education. ONES plans to gather much of the information from this process through external evaluator site visits and written reports prepared prior to the site visit. ONES leadership expects that this process will help Thai schools shape their responses to educational reform.

4.2.0 **ICT ISSUES:** In order to measure a school's (a) level of ICT use in instruction and (b) systematic planning to acquire and use ICT resources, ONES should assess the following ICT issues:

4.2.1 **Comparative Outcomes Data: ONES** should collect data on an ongoing basis to evaluate and compare ICT effectiveness in schools where ICT has been fully deployed. That is, ONES should monitor and assess the outcomes of teaching and learning where ICT approaches are being used. The data from this assessment can then be analyzed, and the effectiveness of ICT approaches compared to compare the effectiveness of these teaching methods with other methods that do not use ICT approaches.

Many Thai schools will choose to apply technology in the teaching and learning process to varying degrees. Data regarding levels of technology use should be collected during school evaluation site visits, and levels of technology should be compared to levels of student achievement.

4.2.2 Equal Access and Outcomes: Equal access to education remains a problem in Thailand and the GMS. Students in urban areas tend to remain in school longer than in rural areas. In some GMS countries, more boys complete primary and continue on to secondary school than girls. Supply-side inequity (i.e., unequal distribution of schools in the nation or children's unequal access to school for economic and cultural reasons) contributes to rural students' educational disadvantage and to their not continuing on to secondary school. Differences in the quality of schools, including the quality of the learning environment, also contribute to unequal access and outcomes of schooling.

To monitor this, during a site visit ONES staff should verify the actual numbers of all ICT resources at each school as well as levels of ICT use at each school. This would include the number, condition, frequency and level of use of computers, peripherals, radio, television, telephone and television cable access, and direct satellite hardware.

4.2.3 **Technology Planning:** ONES should ask schools to conduct technology planning and submit a technology plan to them before the ONES site visit takes place. This ensures that the school administration, teachers, and parents have agreed upon a clear strategy for incorporating technology into their school curriculum and into classroom instruction. Based on the technology plan and site visits, readiness indicators gauging a school's potential for using technology meaningfully in curriculum and teaching should then be assessed and approved before delivery of new ICT hardware to a school. The STAR chart or similar instrument (see Appendix 6) is a recommended model that can be adapted for use in the Thai context. Participation in many federal funding programs in the US demands that the grantee establish a viable technology plan, and this has worked well in prompting schools to carefully think through the use of technology in their settings.

5.0.0 ICT AND SUPPORT OF RURAL SCHOOLS

This section assesses capacity in rural areas outside Bangkok to deliver support services to teachers and students, including the use of the Internet and multimedia services. It presents issues and roadblocks to implementation, and analyzes infrastructure, personnel, networking, and satellite means of instructional delivery. See Appendix 9 for a description of a site visit to a rural school outside of Bangkok.

5.1.0 **THAI DIGITAL DIVIDE**

5.1.1 **Background:** The "digital divide" refers to the gap or the divide between those who have access to new technologies and those without access. The National Telecommunications and Information Administration, a department of the US Department of Commerce, argues that the digital divide is now one of America's leading economic and civil rights issues. An October 2000 report described the groups in the US without access to the new technologies:

> Minorities, low-income persons, the less educated, and children of single-parent households, particularly when they reside in rural areas or central cities, are among the groups that lack access to information resources.

These are also the groups with least access in the GMS. Given its relatively large rural population, the rural/urban divide is particularly obvious in this region. While notable efforts are being made to address this divide, (e.g., http://www.developmentmarketplace.org/thailand.html, for a discussion of innovations using ICT in Thai rural areas displayed on "Thailand Innovation Day") its ramifications for rural schools are of particular concern.[3]

The Benton Foundation refines the definition to refer to the gap between those "who can effectively use new information and communication tools, such as the Internet, and those who cannot." They note that while there is no consensus on the extent of the divide (and whether it is growing or narrowing), researchers are nearly unanimous in acknowledging that some sort of divide does exist. (See http://www.digitaldividenetwork.org/content/sections/index.cfm?key=2)

5.1.2 **Rural ICT Roadblocks:** As shown in Figure 7 below, based upon interviews with educators and governmental officials, five major obstacles impede the spread of ICT use in rural Thai schools and contribute to the digital divide in Thailand. Telecommunications infrastructures and networking obstacles largely deal with project redundancies; content, personpower, and investment involve lack of support personnel.

1. Telecommunications are unaffordable to the rural education sector.
2. Networking is lacking in most rural schools.
3. Content for ICT approaches is minimal, and relatively little Thai content is being developed.

[3] For more information on the digital divide, see: http://www.ntia.doc.gov/ntiahome/fttn99/introduction.html; the Benton Foundation's "Digital Divide Network" at. http://www.digitaldividenetwork.org/content/stories/index.cfm?key=168; and Education Week's report series, "Technology Counts" that have been influential in the education marketplace: http://www.edweek.org/sreports/tc01/tc2001_default.html http://www.edweek.org/sreports/tc99/

4. Investment in ICT development and training is currently under-funded.
5. The personpower for supporting, developing, and training ICT approaches on a large scale is not currently established.

5.1.4 **Rural Utilities:** Installation of telephone and electrical utilities will be necessary in support of ICT use in rural schools, as shown in the Figure 7 below.

Figure 7: School Electrical Hookups and Telephone Connections

Current plans are for provision of network services to rural schools through dialup telephone hookup. As seen Figure 7, primary schools currently have only a 21% connection rate for telephones.

5.2.0 **ICT Delivery**

5.2.1 **Lack of Infrastructure:** The recommended way to download computer assisted instruction and multimedia efficiently to rural schools within Thailand is through satellite distribution of video and computer multimedia. This method can be used to overcome lack of high-speed computer networking and bandwidth capacity in rural schools.

It is recommended that rural schools make more appropriate and efficient use of Internet resources in caching complete Internet websites delivered automatically by satellite to a central school server and networked to computer labs and classrooms. Also, concurrent, continued development of high-speed optical networks should continue for Internet, live teleconferencing, chat, and eLearning applications where interaction over a wide area network is necessary.

5.2.2 **Personnel Shortages:** The supervisor most commonly assigned to supervise computer laboratories in rural Thai schools is a teacher supervisor, usually who lacks training or experience in ICT use. A specialist to assist teachers in ICT usage and to provide oversight of computing facilities is essentially nonexistent in rural areas of Thailand. It is recommended that rural schools share computer specialists through regularly scheduled hardware maintenance and training visits.

5.2.3 **Wide Area Network (WAN) Issues:** Problems involving implementation and continuing use of wide area computing networks in rural Thailand raise digital divide issues regarding bandwidth capacity and speed as compared to metropolitan areas of the county. Ancillary use of satellite distribution of computer data would resolve many of these access and quality issues.

Concomitant satellite broadcasting of video programming and computer software to local schools as envisioned in this report will not compete, but rather will enhance current plans for infrastructure development of computer networks to public education. Downloads of Computer Assisted Instruction (CAI), in-service training, and administrative software would be automatic and not tie up valuable WAN bandwidth capacity. In addition, concurrent use of ThaiCom 3 for support of rural ICT development incorporates flexibilities inherent in television broadcasting and will provide future enhancements when interactive television becomes widespread.

5.2.4 **Satellite Delivery:** Figure 21 below shows the proposed satellite distribution mechanism. An IRD (i.e., a type of satellite receiver) would receive both video and computer data. Both composite (broadcast) video and computer multimedia and applications files would reside on a central server available to all computers in the school or community center. The server is maintained remotely. The component laboratories are named EasiLAB because of their ease of use and their ability to overcome a lack of skilled IT personnel at the school site.

Further support to instruction would be provided by ICT centers regionally, and through use of Mobile ICT Centers for maintaining hardware and providing on-site lab facilities and training.

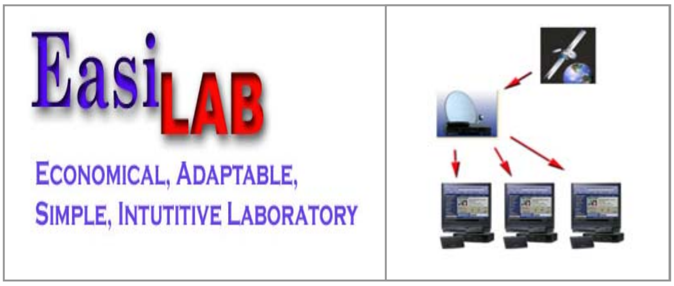


Figure 8: EasiLAB - A Flexible Approach to Providing CAI and Internet to Rural Thailand.

5.3.0 **HARDWARE RECOMMENDATIONS**

5.3.1 **Central Servers:** Rural schools should use of an applications and multimedia server to reduce costs and increase efficiency over current stand-alone designs found in virtually all rural school settings.

A 2 GHz CPU should be the minimum CPU speed to allow efficient multimedia processing and greater replacement intervals.

Remote server administration software, such as Ghost by Norton Utilities, is strongly recommended due to the lack of qualified computer specialists in rural schools. Where rural schools are connected to EdNET via high speed access, the server can be maintained directly through a WAN connection. However, many rural schools will be using dialup connections, so server administration is recommended through use of satellite transmission of hard drive imaging to school servers.

5.3.2 **Client Workstations:**
At least 1.5 GHz should be the minimum CPU speed. This greatly adds to functionality using multimedia software applications. Optical wheel mouse input hardware is recommended. Of the several rural Thai schools visited during the TA, all had problems with ball roller assemblies. Utility software should be included in the software specifications. A utilities suite is recommended of the Norton Utilities Suite style, and would include the anti-virus software.

5.3.3 **School Cable Television:** Use of live satellite television and playback of archived video is an essential recommendation for regional multimedia centers and larger rural schools. Coaxial cabling to link laboratories and classrooms from the satellite and central server hardware is relatively inexpensive and reliable. This permits live and on-demand video from the receiver and server. It is important to loop through a television signal when more than one multipurpose laboratory is configured in a school. Many S-Video inputs are not looped through, so RCA Phono connectors should be also specified.

5.3.4 **Cameras and Peripherals:** Digital still cameras and camcorders are recommended as a part of a rural school's computing assets. Purchase and use of photographic and science-related peripherals should often be a greater priority than purchase of additional computers. An additional external memory card and a transfer device should be added at some point to a school's basic equipment.

5.3.5 **Laboratory Space:** Use of glass tops on computer workstations to permit viewing of a monitor within the desk area is recommended where feasible. This improves functionality greatly, since this permits the computer laboratory facility to be used for other activities. The laboratory design and arrangement of workstations should be assigned to the Institute for Advancement of Educational Technologies. In those schools where student-centered approaches are emphasized, arrangement of workstations in non-traditional patterns will be desirable.

6.0.0 COSTS AND IMPLEMENTATION OF PROPOSALS

6.1 IMPLEMENTATION

6.1.1 **Mobile IT Support:** Installation of easiLAB components should be done through use of a Mobile ITC Support Vehicle (MITSupport™). US Peace Corps Technical Assistance in Thailand and vocational electronics programs in selected Rajabhats will assist in providing personnel for mobile technical support on a rotating basis.

Figure 9: Mobile ITC Support Vehicle available to Rural Schools for Installation, Maintenance, and Training

6.1.2 **Support Functions:** The MITC would provide service to a set circuit of rural schools for the purpose of initial computer installation, continuing computer maintenance, local technical training, and applications training for teachers and administrators.

6.1.3 **Component Upgrades:** Using an MITS approach for maintenance support of computer labs in rural schools, upgrades to a school's computer hardware would be purchased as components and upgraded on-site by the mobile specialist. This will permit economies of scale and cost efficiencies over schools contracting out separate support to each individual school. Figure 10 to the right illustrates the easiLAB satellite receive package which can be upgraded as needed by MITS.

Figure 10: easiLAB satellite receive package

6.2. **EasiLAB™ SPECIFICATIONS**
This subsection of implementation and budgeting provides specifications for basic configuration of EasiLAB™.

6.2.1 **Overall Specifications**

6.2.1.1 Original instruction manuals will accompany the monitor, keyboard and mouse. All manuals will have Thai and English instructions. To promote uniform appearance, items will be "unbranded" with no product logos, if from different manufacturers.

6.2.1.2 The country of origin for all products will be displayed.

6.2.1.3 All products must be previously certified by

United States (UL) or
European standards or
Thai Industrial Standards Institute (TISI) or
National Electronic and Computer Technology (NECTEC) or
other appropriate Thai governmental organization

Adherence to the following specific standards must be demonstrated:

Factory and company certification: ISO 9001 or ISO 9002
Electromagnetic Radiation Standard: TISI 1956 - 2542 (CISPR22)
Safety Standard: TISI 1561 - 2542 (IEC 950) Thai Industrial

6.2.1.4 All products listed will include all applicable software drivers on CD-ROM (fully-licensed versions; one set per appropriate device)

6.2.1.5 All products will include accessories appropriate to their use, such as equipment covers, mouse pads and maintenance/cleaning supplies (e.g., disk drive or CD-ROM drive cleaning sheets). One accessories pack per appropriate device.

6.2.2 **Central Multimedia Server**

Inexpensive 1.6 GB hard drive(s) effectively make the server very useful as a video and applications server and for multimedia storage.

6.2.2.1 Mainboard

1. Dual processor support
2. CPU Clock Signal Speed (at least 2 GHz)
3. L2 Cache Memory (at least 256 KB)
4. Main Memory SDRAM at least 512 MB 133 MHz (including diagnostic functions in Memory ECC or better, exclusive of Memory for Display)
5. Flash BIOS
6. Parallel, Serial, Mouse, Keyboard and USB ports (at least one each per server)
7. Video Ram (at least 4 MB, if no other video ram included and main memory is used for graphic display, main memory must be no less than stated 1.2.1.2 issue 4)
8. Disk Controller (SCSI Ultra 2 interface or better)
9. Expansion slots (at least four PCI slots and one PCI 64 bit slot)

6.2.2.2 Main storage

1. Floppy disk drive (Internal, 3.5 inch, 1.44 MB standard)
2. Hard disk drive (Internal, Ultra ATA/133, IDE; at least 160 GB; no less than 5,400 rpm)
3. CD-RW drive (Internal; IDE interface; at least 20x write, 10x rewrite, 40x read)

6.2.2.3 Input

1. Keyboard: at least 101 keys; Thai and English characters
2. Mouse: Optical wheel mouse; PS/2 or USB

6.2.2.4 Monitor

1. LCD Monitor: Color, at least 15 inches diagonal measurement; Formal guarantee of Low radiation compliance, as per the MPR II standard and energy saving, as specified by the US Environmental Protection Agency.

6.2.2.5 **Network interface** (Internal; Ethernet type, 10/100 Mbps; RJ 54 connectors; the unit will be able to check linking, system and type)

1. NDIS 5.0 miniport driver support
2. Full duplex and auto-sensing checks
3. IEEE standard network topology: 10 BASE-T, 100 BASE-TX or l0/l BASE-T or higher
4. IEEE standard network: lEEE 802.2 and 8Q13
5. Port auto-sensing
6. Plug and play support
7. Multi-protocol support

6.2.2.6 **External modem** (at least 56 Kbps; V.92, V.44 compliant; software installed and ready to use)

1. V.42, V.90, V.44, V.92 standard support
2. Data compression &
3. data error checking
4. Signaling: tone and pulse
5. Auto answering
6. RS232C, USB Port support

6.2.2.7 **Server Software**

1. Server Operating System compatible with international, full license and must be an operating system equivalent to or better than the operating system used in schools and Units under Department of National Education Committee. The proposed server operating system must be able to give services of IIS, WWW, FTP, Mail, DHCP, and DNS

2. Anti-virus program with full license with update database support for without charge within the period specified in the contract
3. Utilities suite (Norton SystemWorks or equivalent to include remote administration software, such as Ghost.)

6.2.3 **Client Workstations**

Units will be designed for workstation use; LAN Industry Standard

6.2.3.1 **Mainboard**

1. Dual processor support
2. CPU clock signal speed: at least 2.0 GHz
3. L2 cache memory: at least 256 KB
4. Main memory SDRAM at least 256 MB 133 MHz (including diagnostic functions in memory ECC or better, exclusive of memory for display; upgradeable to 2 GB including at least 2 slots for further RAM installation
5. Flash BIOS
6. Parallel, serial, mouse, keyboard and USB ports (at least one each per server)
7. Graphics card: AGP 64 bit or better, Speed at least 4X
8. Video ram: at least 16 MB, if no other video ram is included and main memory is used for graphic display
9. Disk controller: SCSI Ultra 2 interface or current technology
10. Expansion slots: at least four PCI slots
11. Sound system: to support AC' 97 standards or higher

6.2.3.2 **Disk Storage**

1. Floppy Disk Drive 3.5 inches (standard) 1.44 MB at least 1 drive
2. Hard disk Drive (Ultra ATA/133 IDE at least 160 GB; >5,400 rpm
3. CD-ROM Drive (IDE; at least 60 X)

6.2.3.3 **Input Devices**

1. Keyboard: at least 101 keys; Thai and English key characters
2. Optical Wheel Mouse: PS/2 or USB

6.2.3.4 **Monitor** (energy saving as specified by US Environmental Protection Agency, with formal guarantee of compliance)

1. Type: color, non-glare, non-interlaced
2. Size: at least fifteen inches diagonal measurement
3. Resolution: at least 1024 x 768
4. Dot pitch: not over 0.27 mm
5. Features: low radiation and certified to the MPR II standard

6.2.3.5 **Network Interface** (Internal; Ethernet type, 10/100 Mbps; RJ 54 connectors; the unit will be able to check linking, system & type

1. NDIS 5.0 miniport driver support
2. Full duplex: autosensing checks
3. IEEE standard network topology:
   10 BASE-T, 100 BASE-TX or l0/100 BASE-T or higher
4. IEEE standard network: lEEE 802.2 and 8Q13
5. Port auto-sensing
6. PCI standard Linking: support for bus mastering
7. Plug and play support
8. Multi-protocol support

6.2.3.6 **Headphone arrays** (two sets per workstation; must be used simultaneously)

1. Microphone: with sponge protector
2. Tone & volume: adjustable controls

6.2.3.7 **Software**

1. Operating System compatible with international, full license and must be an operating system equivalent to or better than the operating system used in schools and units under Department of National Education Committee. The proposed server operating system must be able to give services of IIS, www, FTP, Mail, DHCP, and DNS
2. Anti-virus software: fully-licensed product; with update database support without charge within a period specified
3. Utilities suite (Norton SystemWorks or equivalent)

6.2.3.8 **HUB** (certified to FCC, EN, or IEC standard)

1. Connectors: RJ 45
2. Ports: 24 ports; Dual Speed 10 Base-10,
   10/100 Base-T or better; autosensing
3. Port Uplink Type: 100 Base-TX, at least 1 port
4. Features: Status indicating light for every port
5. Rack: 19 inch, 6 U Wall mount for installing HUB
6. Accessories: Instruction Manual, Thai and English

6.2.3.9 **Uninterruptible Power Supply** (UPS)
(at least l KVA capacity)

1. Certified by TIS 1291-2538 (1995), FCC, EN, or IEC standard
2. Command control program to work with server
3. Installed to be readily used with server
4. Instruction Manual, Thai and English

6.2.3.10 **Printer** (Laser Jet, 1 installed and ready to be used)

1. Output Speed at least 12 ppm
2. Resolution 1200 x 1200 dpi
3. Paper Sizes A4, Letter and Legal
4. Memory at least 8 MB RAM
5. Interface Parallel
6. Input Tray at least 250 sheets
7. Printing Language PCL 5e or PCL 6
8. Driver Software compatible with Lecturer PC; Full license
9. Accessories: Thai and English instruction manual; spare cartridge

6.2.3.11 **Scanner**

Scanner for black & white and color pictures, texts and three-dimensional objects. Installed with Lecturer Desktop PC

1. Optical resolution: at least 600 dpi; Enhanced mode > 9,600 dpi
2. Scanning area: at least A4 paper
3. Bit depth: at least 42 bit
4. Interface: USB or better
5. Driver software compatible with operating system in Computing Lab
6. Accessories: cover sheet, Thai and English instruction manual

6.2.3.12 **Digital camera**

1. Resolution: at least 2.1 mega pixels built-in flash
2. Removable storage: at least 128 MB
3. Port: USB
4. Software: compatible with operating system in computing laboratory
5. Batteries: two chargers with sets of rechargeable batteries
6. Accessories: Thai and English instruction manual

6.2.3.13 **Television**

Screen size of at least 25-inch diagonal measurement. To be installed on walls or rack, adjustable vertically 45 degrees downward, left to right 80 degrees; to link S-video signal from Lecturer PC to television and link signal among room television sets by RCA (phono) connectors. The television is to be a product of a factory certified by ISO 9001 or 900.

1. VHF and UHF
2. Picture: 625 lines
3. Color system: NTSC and PAL
4. Sound: stereo with built-in speakers
5. Inputs/Outputs: S-video, phono for both picture and sound
6. Automatic Voltage Adjusting System,
7. Voltage supply: 220 V; Fluctuation +/-10 %
8. Built-in control panel and remote control
9. Instruction manual: Thai and English
10. Technical service manual: one per site installation

6.2.4.0 Lab Furniture

6.2.4.1 Student workstations

Computer table with keyboard tray; assembled and ready to use

1. Frame: wood or other material equivalent or better
2. Top surface: abrasion and thermal resistant; electrically insulated
3. Thickness: at least 19 mm, with a hole for wiring and cables
4. Size: 600 mm width x 1000 mm L x 750 mm H; +/- not over 0.5 mm.

6.2.4.2 **Lecturer desk**

Table designed specifically for computer use; keyboard tray; at least two lockable drawers; assembled and ready to use

1. Frame: wood or other material equivalent or better; support at middle
2. Top surface: abrasion and thermal resistant; electrically insulated
3. Surface edges: reinforced in exposed use areas
4. Thickness: at least 19 mm, with a hole for wiring and cables
5. Size: 800 mm width x 1200 mm L x 750 mm H; +/- not over 0.5 mm

6.2.4.3 **Server table**

Designed specifically for computer use; keyboard tray; assembled and ready to use

1. Frame: wood or other material equivalent or better
2. Structural features: support at mid-table; front & side covers
3. Top surface: abrasion and thermal resistant; electrically insulated
4. Surface edges: reinforced with plastic in heavy use areas
5. Thickness: at least 19 mm; hole for wiring and cables access
6. Size: 600 mm width x 800 mm L x 750 mm H; +/- not over 0.5 mm

6.2.4.4 **Printer stand**

Designed specifically for printer use; supplies storage; rigid design to eliminate vibration and noise during printing; assembled and ready to use

1. Frame: wood or equivalent; front and side covers
2. Structural features: structural support for rigidity; front & side covers
3. Top surface: abrasion and thermal resistant; electrically insulated
4. Surface edges: reinforced with plastic in heavy use areas
5. Thickness: at least 19 mm; feed slot from paper storage
6. Size: 600 mm width x 800 mm L x 750 mm H; +/- not over 0.5 mm
7. Tray: for feeding paper

6.2.4.5 **Lecturer chair**, one per computer laboratory

Executive office style; designed for ergonomic use.

1. Structural features: one support post; five branch supports; castors
2. Arms: adjustable
3. Backrest: adjustable
4. Covering: artificial leather or better

6.2.4.6 **Student chairs**, two per workstation

Secretarial style; designed for ergonomic use

1. Structural features: one support post; three branch supports; castors
2. Backrest: adjustable
3. Covering: cloth, artificial leather or better

6.2.5 **Other specifications**

1. Bidding is by complete package.

2. Bidders must prepare installation plan/warranty period and maintenance program and a training plan.

3. Products must be produced according to industrial product standards to be applicable to electrical power supply as follows: AC 180 V - 240 V, Frequency 50 Hz, and 1 phase with ground line system.

4. The capacity of memory (RAM, ROM, BIOS, flash, Firmware, cache, buffer) is defined as follows:
1 KB = 1,024 B
1MB = 1,024 KB
1 GB = 1,024 MB

5. The transmission and receiving speeds and disk storage capacity are determined as follows:
1KB= 1,000 B
1MB= 1,000 KB
1GB= 1,000 MB

6. Equipment must be produced in an industrial equipment production line.
Installation

1. The transmission cable of the server must be a UTP cable of a quality equivalent or better than CAT 5e with RJ-45 plugs and connectors to the server, client computer, and lecturer computer using a HUB.

2. The electrical power supply to equipment be working properly and use breakers connecting between main power supply and equipment.

3. Cables and wiring must be run in rigid duct pipes arranged on the floor, wall and/or under the ceiling.

4. Establish an earth ground line to the electrical circuit board and to every plug.

6.3.0 **AEN™ PROJECTED BUDGETS**

Initial and continuing (operating) costs are often the only elements planned. Training and Support elements are often overlooked in planning. Training and ongoing Support Costs (human resources, continuing training, software, and hardware) are also involved in the total costs of technology support.

The following presents scenarios for the Asian Education Network project and its' constituent smaller budgets. Each budget presented is optional and scalable.

Thailand & GMS	Total	Thailand	GMS
aenRECEIVE			
Receive Equipment Package:			
$87 x 12,000 sites upgrade (Pilot)	1,044,000	1,044,000	
$374 x 3000 new sites (GMS)	1,122,000		1,122,000
aenSERVE			
School/Site Server Package:			
$5,200 x 1,500 sites (Thailand Pilot)	7,800,000	7,800,000	
$5,200 x 3,000 sites (GMS)	15,600,000		15,600,000
EasiLAB (student lab)			
Computer Laboratory Package:			
$23,200 x 1,500 sites (Thailand pilot)	27,900,000	46,500,000	
$23,200 x 3,000 sites (GMS)	69,600,000		69,600,000
EasiLAB Software			
Virtual Science Lab Kits	123,000	61,500	61,500
English Language (Upper Secondary)	140,000	70,000	70,000
English Teacher Training	90,000	45,000	45,000
School Budgeting	110,000	55,000	55,000
Software Adaptation and Translatiin	175,000	77,500	77,500
Learning Objects Project - Buddhism	145,000	72,500	72,500
Learning Objects Project - Math	75,000	37,500	37,500
Learning Objects Project - Science	75,000	37,499	37,500
ICT Learning series	150,000	75,000	75,000
Targeted Software Development	25,000,000	12,500,000	12,500,000
EasiLAN (site network)			
Wireless Networking Package:			
$2,600 x 1,500 sites (Thai pilot)	3,450,000	3,450,000	
$2,600 x3,000 sites (GMS)	7,800,000		7,800,000
aen National Centers			
Lead Content Development:			
$225,000 x 2 lead sites (Thailand pilot)	450,000	450,000	
$225,000 x 6 sites (GMS)	1,350,000		1,350,000
aen Regional Centers			
Multimedia and Traning Support:			
$36,000 x 100 (Thailand pilot)	3,600,000	3,600,000	
$36,000 x 300 (GMS)	10,800,000		10,800,000
aenMITS (mobile support)			
Site Support Vehicles (Outfitted):			
$223,000 x 2 RV Lab vehicles (Pilot)	446,000	446,000	
$53,000 x 12 Van vehicles (Pilot)	636,000	636,000	
$223,000 x 6 RV Lab vehicles GMS)	1,338,000		1,338,000
$53,000 x 72 Van vehicles (GMS)	3,816,000		3,816,000
Total	**182,835,000**	**76,957,499**	**124,457,500**

Thailand Pilot Budget, Years 1-3

Thailand Pilot	Total
aenRECEIVE	
Receive Equipment Package:	
$87 x 12,000 sites upgrade	1,044,000
aenSERVE	
School/Site Server Package:	
$5,200 x 1,500 sites	7,800,000
EasiLAB (student lab)	
Computer Laboratory Package:	
$23,200 x 1,500 sites	46,500,000
EasiLAB Software	
Virtual Science Lab Kits	61,500
English Language (Upper Secondary)	70,000
English Teacher Training	45,000
School Budgeting	55,000
Software Adaptation and Translation	77,500
Learning Objects Project - Buddhism	72,500
Learning Objects Project - Math	37,500
Learning Objects Project - Science	37,499
ICT Learning series	75,000
Regionally Targeted Development	12,500,000
LAN Networking (site)	
Wireless Networking Package:	
$2,600 x 1,500 sites	3,450,000
National Centers	
Lead Content Development:	
$225,000 x 2 lead sites	450,000
Regional Centers	
Multimedia and Traning Support:	
$36,000 x 100	3,600,000
Mobile IT Support	
Site Support Vehicles (Outfitted):	
$223,000 x 2 RV Lab vehicles	446,000
$53,000 x 12 Van vehicles	636,000
Total	**76,957,499**

SE Asia Dissemination Budget

GMS Dissemination	Total
aenRECEIVE	
Receive Equipment Package:	
$374 x 3000 new sites	1,122,000
aenSERVE	
School/Site Server Package:	
$5,200 x 3,000 sites	15,600,000
EasiLAB (student lab)	
Computer Laboratory Package:	
$23,200 x 3,000 sites (GMS)	69,600,000
EasiLAB Software	
Virtual Science Lab Kits	61,500
English Language (Upper Secondary)	70,000
English Teacher Training	45,000
School Budgeting	55,000
Software Adaptation and Translation	77,500
Learning Objects Project - Buddhism	72,500
Learning Objects Project - Math	37,500
Learning Objects Project - Science	37,500
ICT Learning series	75,000
Regionally Targeted Development	12,500,000
EasiLAN (site network)	
Wireless Networking Package:	
$2,600 x3,000 sites	7,800,000
aen National Centers	
$225,000 x 6 sites (GMS)	1,350,000
aen Regional Centers	
$36,000 x 299	10,800,000
aenMITS (mobile support)	
Site Support Vehicles (Outfitted):	
$223,000 x 6 RV Lab vehicles GMS)	1,338,000
$53,000 x 72 Van vehicles (GMS)	3,816,000

School Site Satellite Equipment Budget

Satellite	Total	Thailand	GMS
aenRECEIVE			
Receive Equipment Package:			
$87 x 12,000 sites upgrade (Pilot)	1,044,000	1,044,000	
$374 x 3000 new sites (GMS)	1,122,000		1,122,000
Total	**2,166,000**	**1,044,000**	**1,122,000**

Central Network Server Budget

Site Server	Total	Thailand	GMS
aenSERVE			
School/Site Server Package:			
$5,200 x 1,500 sites (Thailand Pilot)	7,800,000	7,800,000	
$5,200 x 3,000 sites (GMS)	15,600,000		15,600,000
Total	**23,400,000**	**7,800,000**	**15,600,000**

Activity	Total	Thailand	GMS
EasiLAB (student lab)	97,500,000	46,500,000	69,600,000
Computer Laboratory Package:			
$23,200 x 1,500 sites (Thailand pilot)	27,900,000	46,500,000	
$23,200 x 3,000 sites (GMS)	69,600,000		69,600,000
EasiLAB Software	26,083,000	13,031,499	13,031,500
Virtual Science Lab Kits	123,000	61,500	61,500
English Language (Upper Secondary)	140,000	70,000	70,000
English Teacher Training	90,000	45,000	45,000
School Budgeting	110,000	55,000	55,000
Software Adaptation and Translation	175,000	77,500	77,500
Learning Objects Project - Buddhism	145,000	72,500	72,500
Learning Objects Project - Math	75,000	37,500	37,500
Learning Objects Project - Science	75,000	37,499	37,500
ICT Learning series	150,000	75,000	75,000
Regionally Targeted Development	25,000,000	12,500,000	12,500,000
Total	**123,583,000**	**59,531,499**	**82,631,500**

Local Area Network (LAN) Budget

Regional Support	Total	Thailand	GMS
aen Regional Centers	14,400,000	3,600,000	10,800,000
Multimedia and Traning Support:			
$36,000 x 100 (Thailand pilot)	3,600,000	3,600,000	
$36,000 x 300 (GMS)	10,800,000		10,800,000
aenMITS (mobile support)	6,236,000	1,082,000	5,154,000
Site Support Vehicles (Outfitted):			
$223,000 x 2 RV Lab vehicles (Pilot)	446,000	446,000	
$53,000 x 12 Van vehicles (Pilot)	636,000	636,000	
$223,000 x 6 RV Lab vehicles GMS)	1,338,000		1,338,000
$53,000 x 72 Van vehicles (GMS)	3,816,000		3,816,000
Total	**26,872,000**	**4,682,000**	**21,108,000**

Mobile Support Vehicles (Extended Regional Center) Budget

Mobile Support	Total	Thailand	GMS
aenMITS (mobile support)			
Site Support Vehicles (Outfitted):			
$223,000 x 2 RV Lab vehicles (Pilot)	446,000	446,000	
$53,000 x 12 Van vehicles (Pilot)	636,000	636,000	
$223,000 x 6 RV Lab vehicles GMS)	1,338,000		1,338,000
$53,000 x 72 Van vehicles (GMS)	3,816,000		3,816,000
Total	**6,236,000**	**1,082,000**	**5,154,000**

Appendix 1

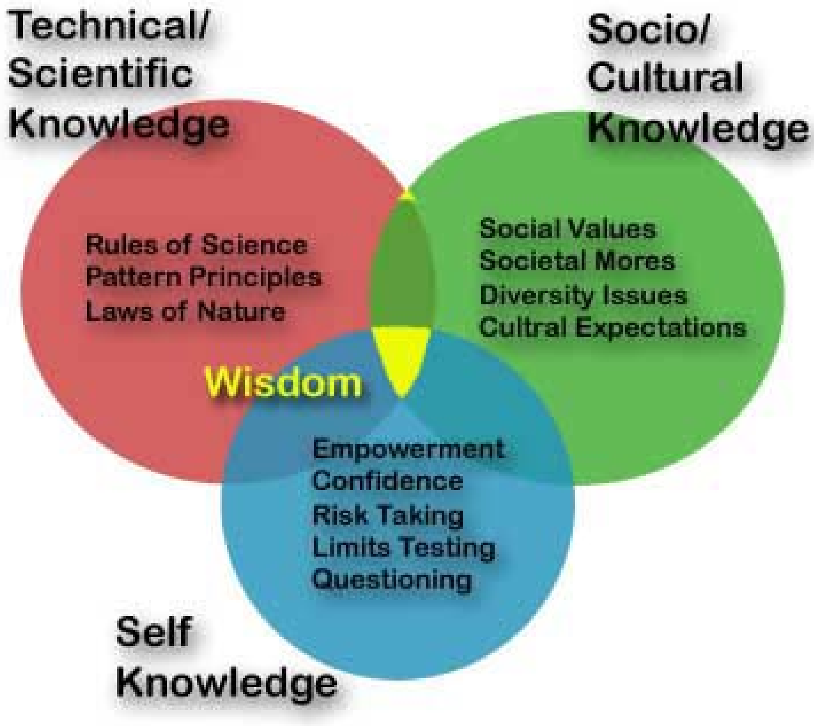
Glossary

Definitions of some technical terms used in the document:

Collaborative Learning	*Students working together on a shared project*
Flexible Learning Model	*Use of interactive multimedia plus CMC by internet*
Multimedia model	*Use of various self-instructional resources*
PARSIT	*English to Thai computer-based translation*
Tele-learning model	*Use of "broadcast" and "narrowcast" communications*

Appendix 2

Classes of Knowledge



Appendix 3

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Appendix 4

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Appendix 5

Research: Self-Efficacy

Relationships Among Computer Self-Efficacy, Attitudes Toward Computers, and Desirability of Learning Computing Skills

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This study examined the relationships among (a) computer self-efficacy, (b) attitudes toward computers, and (c) perceptions of desirability of learning computing skills among undergraduate students. Researchers have proposed that positive attitude and self-efficacy are important factors in helping people learn about computer skills (e.g. Delcourt & Kinzie, 1993). Sproull, Zubrow, and Kiesler (1986) recognized that some college students felt confusion and a loss of personal control when they encountered technology. DeLoughry (1993) addressed this issue by citing an estimate from two researchers that "as many as one-third of the 14 million college students in the United States suffer from 'technophobia " (p. A25) and implied that the effectiveness for computer literacy in higher education might not be realized without research foundations and corresponding planning.

Kinzie, Delcourt, and Powers (1994) defined self-efficacy as an individual's confidence in his or her ability which may impact the performance of tasks; self-efficacy reflects an individual's confidence in his/her ability to perform the behavior required to produce specific outcomes and is thought to directly impact the choice to engage in a task, as well as the effort that will be expended and the persistence that will be exhibited. (p. 747).

Miura (1987) has suggested that self-efficacy may be an important factor related to the acquisition of computing skills. Self-efficacy, as defined by Bandura (1982), "centers on people's sense of personal efficacy to produce and to regulate events in their lives" (p. 122). According to Bandura (1982), the judgment of perceived self-efficacy in the course of action may produce and regulate a person's capability to deal with his or her environment. Distinct self-concepts toward efficacy may function differently; positive self-efficacy may encourage learning new skills, whereas negative self-efficacy may create resistance in operative capabilities.

The meaning of self-efficacy has been frequently cited from Bandura (1977), who indicated that efficacy expectancy, or self-efficacy, resided between the person and the behavior. If serious uncertainties regarding performance of necessary activities existed in efficacy expectations, then efficacy expectations would no longer impact behavior. The greater people perceive their self-efficacy to be, the more active and longer they persist in their efforts (Bandura, 1977, 1981, 1982; Bandura & Adams, 1977).

Woodrow (1991) specifically claimed that students' attitudes toward computers were a critical issue in computer courses and computer-based curricula. Monitoring the user's attitudes toward computers should be a continuous process if the computer is to be used as a teaching and learning tool. Aiken (1980) described attitudes as "learned predispositions to respond positively or negatively to certain objects, situations, concepts, or persons" (p. 2). Attitudes toward computers were believed to be related to other attributes, such as the relationship with gender, household, age, and years of education (Morris, 1988-1989); the effects on training and learning (Ford & Noe, 1987); and positive and negative attitudes related to learning how to edit on the computer (Paxton & Turner, 1984).

Several studies have recently examined the relationship between computer self-efficacy and other attributes. Self-efficacy was found to be associated with attitudes toward computer technologies by Delcourt and Kinzie (1993) and Zubrow (1987). Computer attitudes, tested by comfort/anxiety and usefulness specifically, were found to be significant predictors of self-efficacy in three computer technologies--word processing, e-mail, and CD-ROMs. Hill, Smith, and Mann (1987) and Miura (1987) found that the role of self-efficacy was a factor in determining individual recognition of the importance of computer in the future and predicting individual intention to learn about computers. Computer self-efficacy was related to the enrollment in computer courses. Past enrollment in computer programming course(s) was found to be positively related with self-efficacy expectations, and computer self-efficacy positively related to plans to take more computer science courses. Kinzie et al. (1994) used hierarchical regression to investigate predictive effects of self-efficacy on six computer applications--word processing, e-mail, spreadsheets, databases, statistical packages, and CD-ROM databases. Learners' characteristics, course experience, frequency of the use of computer technologies, and attitudes toward computers served as independent variables and were entered hierarchically. Each computer application was counted as an individual outcome. Results confirmed that computer attitudes of comfort/anxiety and usefulness contributed significantly predictive effects on self-efficacy of computer technologies. Schunk (1981) proposed that self-efficacy could be used as a predictor in academic performance. Based on his research, the question arose as to whether self-efficacy could predict students' learning and use of computers.

Previous studies on self-efficacy toward computer technology have determined that self-efficacy was essential in the learning and use of computers (Delcourt & Kinzie, 1993; Hill et al., 1987; Jorde-Bloom, 1988; Kinzie et al., 1994; Miura, 1987; Schunk, 1981, 1985). Studies of self-efficacy in education have focused on children, undergraduate students, and administrators (Hill et al., 1987; Jorde-Bloom, 1988; Miura, 1987; Schunk, 1981, 1985). Delcourt and Kinzie (1993) investigated self-efficacy toward computer technology for both undergraduate and graduate education students, and Kinzie et al. (1994) conducted studies on attitudes and self-efficacy among undergraduate students at all levels. None of these studies examined the connection of self-efficacy to the construct of desirability of learning. Furthermore, many of the previous studies in this area did not include the current expansion of computer technologies such as CD-ROM database and electronic mail (Kinzie, Delcourt, & Powers, 1994). Educators in higher education have recognized that computer literacy is essential for college students (Mehlhoff & Sisler, 1989; Tannenbaum & Rahn, 1985). However, Hignite and Echternacht (1992) noticed that previous studies of the significant intercorrelations between computer-attitude variables and computer-literacy levels have produced conflicting results.

Based on the analysis of 383 returned questionnaires from a total of 465 student teachers, Kay (1990) noticed that cognitive attitude, awareness, and knowledge of application software were found to be the best predictors of commitment to the use of computers. Factors influencing the regular use of computers could be availability of hardware, software, and training; however, personal willingness was a priority factor that related to a person using the computer effectively. Other factors, though less effective, were affective attitude, locus of control, and gender.

Kay (1993) surmised that researchers had assessed more than 15 different constructs related to attitudes toward computers in more than a decade, but, because of a lack of theoretical justification, clearer explanations remained to be resolved. He believed that further research was needed to identify specific contextual elements. Conclusions drawn from previous studies indicated that research in this area should include perceived (a) self-efficacy, (b) attitudes, and (c) desirability for learning computing across undergraduate disciplines including updated expansion of computer technologies (Geissler & Horridge, 1993; Kinzie et al., 1994).

Geissler and Horridge (1993) suggested that commitment of learning computer technologies would precede actual use of computers. Further, "though adoption rates vary, the reinforcement stage of acceptance indicates a commitment to gaining additional knowledge and skill in the use of innovation" (p. 349). Mehlhoff and Sisler (1989) indicated that desire to learn, or willingness to make a commitment to, computer technologies would be a prerequisite to help gain necessary computing skills in the information age.

Other researchers have assessed faculty and students' desired needs for computer technologies (Geissler & Horridge, 1993; Ronald, 1983). However, the variables of both computer self-efficacy and attitudes have not been combined with perceived needs. Hignite and Echternacht (1992) maintained that future study should include "individual values and opinions or other personality characteristics" (pp. 387-388).

The current study explored relationships across computer self-efficacy, attitudes, and desirability of learning computing skills, using a linear combination of two attitudinal variables (comfort/anxiety and usefulness) and three self-efficacy variables (beginning computer skills, advanced computer skills, and telecomputing) with a linear relationship to two computer factors (computer self-efficacy and desirability of learning computing skills). This provided an opportunity, as Hignite and Echternacht (1992) suggested, that "some of the more complex relationships that exist between certain combinations of variables might be identified" (p. 382) so that the combination of the variables "could be better understood" (p. 382). The following hypotheses were tested.

Hypothesis 1: There is no statistically significant predictive effect of attitudes toward computers on computer self-efficacy.

Hypothesis 2: There is no statistically significant predictive effect of attitudes toward computers on the desirability of learning computing skills.

Hypothesis 3: There is no statistically significant predictive effect of computer self-efficacy on the desirability of learning computing skills.

METHOD/PARTICIPANTS.

Subjects participating in this study were students from three computer courses and one non-computer course at a regional state university in the southwest United States. Computer classes were offered through the Department of Computer Science and Information Systems, Department of Secondary and Higher Education, and Department of General Business and Systems Management. The non-computer class was offered by the Department of Health and Physical Education. All students enrolled in these four classes were initially included in the study. The investigator distributed and collected questionnaires to a total of 296 subjects, in 14 classrooms from four courses. Students completed the questionnaires on a voluntary basis. Questionnaires with any missing responses and questionnaires from students who were taking two or more of these courses at the same time were eliminated to avoid confounding variables. The resulting sample size was 220 students.

INSTRUMENT: The Computer Technologies Survey (CTS), the survey in this study, was actually a combination of two instruments--Attitudes Toward Computer Technologies (ACT) by Delcourt and Kinzie (1993), and Confidence and Desired Knowledge with Computer Technologies (CDK), which was adopted and modified from Murphy, Coover, and Owen (1989). The CTS consisted of three parts. Part One contained the modified demographic items from the ACT. Part Two included attitude items from the ACT, and Part Three asked for responses to the items of computer self-efficacy and desirability of learning computing skills from the CDK.

To test the validity of the CTS, two successive pilot studies were conducted to make sure the same patterns were used as the criterion. A review panel, consisting of seven computer-using educators, examined the CTS to be used in this study. When more than 50% of the panel indicated that an item or description was not clear or appropriate, adjustments were made.

Within the CTS, Cronbach alpha (Cronbach, 1951) was used to evaluate the internal consistency reliability for The CDK, and the ACT, as well as for a newly created variable for this study--desirability of learning computing skills. An internal consistency reliability (alpha) estimate of .96 was obtained for the entire 35-item CDK. The reliability estimates for the subscales were .93 (self-efficacy of beginning computer skills), .91 (self-efficacy of advanced computer skills), and .91 (self-efficacy of telecomputing). An internal consistency reliability estimate of .86 was obtained for the entire 19-item ACT. The alpha reliabilities derived for subscales comfort/anxiety and usefulness were .86 and .82 respectively. A reliability alpha estimate of .98 was obtained for the entire 35 items of desirability of learning computing skills. The internal reliability coefficients were compatible with results with those in the Murphy et al. (1989) and Delcourt and Kinzie (1993) tests.

DESIGN AND DATA ANALYSIS: To test out hypothese, the Pearson product-moment was used to determine the correlations of selected variables in this study. Simultaneous multiple regression as a general linear model was conducted to detect the significantly predictive effect of attitudes toward computers on computer self-efficacy and the effect of attitudes toward computers and effect of computer self-efficacy on desirability of learning computing skills.

RESULTS: The following seven variables were examined in this study.

CONFISUM: sum scores of computer self-efficacy.

COMFANXI: attitude toward computers--comfort/anxiety.

USEFULNE: attitude toward computers--usefulness.

DESIRSUM: sum scores of desirability of learning computing skills.

CONFIDE1: confidence level of beginning computing skills.

CONFIDE2: confidence level of advanced level of computing skills.

CONFIDE3: confidence level of telecomputing.

Bivariate correlations among seven selected variables were calculated. Correlation coefficients among seven variables are shown in Table 1.

Correlation coefficients, as presented in Table 1, may assist with the interpretation of the following multiple regression analyses. Analysis of the subscales of attitudes toward computers in the multiple regressions (Table 2) revealed that the independent variable comfort/anxiety contributed significantly to the prediction of computer self-efficacy. Although the bivariate correlation between CONFISUM and USEFULNE was significant, the correlation coefficient was low.

Multiple regression was used to test predictive effects of two variables of computer attitudes--comfort/anxiety and usefulness--toward computers on computer self-efficacy. This analysis revealed that R for regression was significantly different from zero, $F(2, 217) = 80.56$, $p < .05$, with a determinant of coefficient of .43. Analysis of data showed that there was a significantly combined predictive effect of computer attitudes toward computers on computer self-efficacy. Therefore, Hypothesis 1 was rejected.

Hypothesis 2 stated that there would be no statistically significant predictive effect of attitudes toward computers on the desirability of learning computing skills. Analysis of the subscales of attitudes toward computers in the multiple regression (Table 3) revealed that the independent variable usefulness contributed significantly to the prediction of computer desirability of learning computing skills. The correlation coefficient between the variable desirability of learning computing skills and the variable Comfort/Anxiety was weak, as demonstrated in Table 1.

However, the result of multiple regression revealed that R for regression was significantly different from zero, $F(2, 217) = 19.41$ ($p < .05$). This indicates that attitudes toward computers had a significantly combined predictive effect on desirability of learning computing skills. Therefore, Hypothesis 2 was rejected.

Hypothesis 3 stated that there would be no statistically significant predictive effect of computer self-efficacy on the desirability of learning computing skills. Analysis of the subscales of computer self-efficacy in the multiple regression (Table 4) revealed that the independent variable advanced computer skills contributed significantly to the prediction of desirability of learning computing skills. This finding was consistent with the bivariate correlations shown in Table 2.

The result of overall multiple regression revealed that R for regression was significantly different from zero, $F(2, 216) = 3.15$, $p < .05$. This analysis showed that computer self-efficacy had a significantly combined predictive effect on desirability of learning computing skills. Therefore, Hypothesis 3 was rejected.

DISCUSSION: This study investigated the relationship between the desirability of learning computing skills and two predictive attributes--attitudes toward computers and computer self-efficacy. The hypotheses were tested at the .05 alpha level for statistical significance. The analysis of the data revealed findings that served as the basis for the following conclusions, which can be generalized only to subjects similar to the ones in the sample.

Multiple regression analysis revealed that computer comfort/anxiety was a significant predictor of computer self-efficacy in general. The analysis showed a significant combined predictive effect of scores both in comfort/anxiety and in usefulness on computer self-efficacy.

The result of simultaneous multiple regression revealed that usefulness exerted significantly predictive effects on desirability of learning computing skills. Another computer-attitude subscale--comfort/anxiety--failed to provide enough evidence to contribute successful prediction for desirability of learning computing skills.

Attitude toward computers--specifically, the students' self-perceived feelings of comfort or anxiety about computers--was correlated with computer self-efficacy as measured by both intercorrelations and multiple regression. Computer self-efficacy tended to increase as the score of comfort about computers increased. The relationship was significant; indicating that attitude toward computers was a predictor of students' confidence levels about computers.

Attitude about the usefulness of computers was a predictor of the desirability of learning computing skills. However, the combined predictive effect was not very strong. Students may be self-motivated to learn more about computers when they have personal goals and recognize that acquiring computer knowledge will be useful in their future careers. Volet and Styles' (1992) study of the relationships of goals of students' stable characteristics, student management, and performance in the first-year computer class indicated that personal goals were positively and dynamically associated with their achievements and interactions. Their finding was similar to that in the current study.

A significant predictor was found only for advanced computer skills. The combined multiple regression, however, revealed that computer self-efficacy was a significant predictor of desirability of learning computing skills, although the combined predictive effect was not very strong. A student's confidence about advanced computer skills may affect the willingness to learn about computer skills. The less confident a student feels about advanced computer skills, the more he or she desires to learn about computer technology.

Educational computing research has indicated that computer self-efficacy is a crucial factor in learning and using computers (e.g., Delcourt & Kinzie, 1993; Hill et al., 1987). The current study supports the finding from the study by Ertmer, Evenbeck, Cennamo, and Lehman (1994) that students' self-perceived confidence levels are related to their computer self-efficacy. Based on this finding, an instructor may enhance students' computer self-efficacy by creating a nonthreatening environment for students to reduce their anxiety about computers and to help them feel comfortable about using computers.

Usefulness of computers was a predictor of the desirability of learning computer skills. Computer education instructors should help students be aware of the functions of computer technology in the information age. Students may not feel a need to learn computing skills until they recognize that computer technology is necessary in their future careers. Computer educators may inculcate their students with the importance of computing skills pervasively required in the information society.

Students may be self-motivated to learn more computer technologies if they feel confident about computer self-efficacy of beginning computer skills and telecomputing. However, students may not be self-motivated to learn more computer technologies if they feel too comfortable about their advanced computer skills. Computer education instructors should be aware of differences between current students who bring computer experience with them and previous students who had to learn computer literacy from the very beginning. For example, most subjects in this study appear to have already obtained a certain level of computer skills before entering the university. Computer technologies at different levels and various teaching strategies should be applied in the teaching process.

This study also supports Hunt and Bohlin's (1995) study of educational applications of microcomputers, which indicated that a hands-on approach in teaching computer technology could generate students' positive attitude toward computers and that successful completion of any assignments in the classroom was the most influential factor in changing attitudes. Results of computer attitudes of both comfort/anxiety and usefulness from this study imply the encouragement of hands-on activities in addition to demonstration and lecture.

CONCLUSION: To help college students learn basic computer skills more effectively, research has been conducted to test computer attitudes and their related attributes (e.g., Savenye, Davidson & Orr, 1992). This current study provides additional insights, documenting relationships between students' desirability of learning more computer skills, with computer self-efficacy and with attitudes toward computers.

The findings of this study confirmed the statement from previous studies (e.g., Delcourt & Kinzie, 1993; Hill et al., 1987) that students' attitudes toward computers affected their confidence levels about computers. Furthermore, this study suggests that students' desirability of learning computing skills can be predicted by their self-recognition of the usefulness of computers and their perception of advanced levels of computer technologies.

The study of the relationships between computer self-efficacy, attitudes, and desirability of learning computing skills is not a simple task. The analysis of this study does not include any demographic information, which may reveal different outcomes. Further research is recommended to analyze the relationships by cooperating demographics as independent variables, such as gender, age, current status at college (e.g., freshman, sophomore, etc.), and preference for computer platform, to provide more thorough information on computer self-efficacy, attitudes, and students' willingness to learn more computing skills.

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Table 1 Intercorrelations Between Subscales for All Students (N = 220).

(TABLE) 1 2 3 4 5 6 71 CONFISUM -- .65(FN*) .18(FN*) -.10 .90(FN*) .92(FN*) .78(FN*) 2 COMFANXI -- .38(FN*) .04 .65(FN*) .58(FN*) .41(FN*)3 USEFULNE -- .37(FN*) .24 (FN*) .10 .12(FN*)4 DESIRSUM -- -.03 -.16(FN*) -.095 CONFIDE1 -- .72(FN*) .52(FN*)6 CONFIDE2 -- .66(FN*)7 CONFIDE3 --

FOOTNOTE* $p < .05$.

Table 2: Summary of Simultaneous Regression Analysis for Variables Predicting Computer Self-Efficacy (N = 220).

(TABLE) Variable B SE B b Comfort/Anxiety 3.14 .26 .68(FN*) Usefulness -.29 .23 -.07.

FOOTNOTE: R = .65. * $p < .05$.

Table 3 Summary of Simultaneous Regression Analysis for Variables Predicting Desirability of Learning Computer Skills (N = 220).

(TABLE) Variable B SE B b Comfort/Anxiety -.55 .33 -.11Usefulness 1.80 .29 .42(FN*).

FOOTNOTE: R = .39. * p < .05.

Table 4 Summary of Simultaneous Regression Analysis for Variables Predicting Desirability of Learning Computer Skills (N = 220).

(TABLE) Variable B SE B b Beginning Computer Skills .42 .22 .19Advanced Computer Skills -.77 .28 -.30(FN*)Telecomputing .06 .34 .01.

FOOTNOTE: R = .20. * p < .05.

APPENDIX A: COMPUTER TECHNOLOGIES SURVEY Results from this survey will be used to help determine how university students perceive computer technologies. Your responses are an important contribution to the process.

Within this survey, the term computer technology is defined as the use of computers and related hardware and software to perform specific tasks. Computer technologies are most often used for word processing (e.g., WordPerfect, Word, Works), spreadsheets (accounting), databases (e.g., ERIC), telecomputing (e.g., logging onto the university computer system mainframe to read your electronic mail or bulletin boards). When responding to the following statements, please consider your use of all of these computer technologies.

There are three segments to this survey: background information, attitudes, and confidence and desired knowledge. It should take about 12 minutes to complete all sections. Your responses will be kept completely confidential.

Thank you in advance for your participation.

PART ONE: BACKGROUND INFORMATION Please respond to each of the following items.

- What class are you in? (Circle one).

C Sci126 Section 001 Section 002 Section 003 Section 004 ETec224 Section 001 Section 002 Section 003 Section 004 GBus128 Section 001 Section 002 Section 003 Section 004 Section 005 Section 006 PE144 Section 001 Section 002.

Are you currently taking more than one of these classes: (circle one) yes no.

Last four digits of your Social Security Number: __________.

- Age: _____.
- Sex: (circle one) male female.

Please indicate your racial/ethnic status. (circle one).

African-American Caucasian (non-Hispanic) Hispanic Native American Asian/Pacific Islander Other: __________.

How many computer course(s) have you taken (including the one in which you are presently enrolled)?

___ in High School ___ at ETSU ___ at Other Institution(s).

What is your current status at ETSU? (circle one).

Freshman Sophomore Junior Senior Other: __________.

Major (if one has been declared): ____________________.

Hours Completed in Current Major: ____________________.

Do you have a computer of your own? (circle one) yes no.

How often do you use a computer? (circle one) Never At least once/year At least once/month At least once/week Daily.

Where do you use a computer most often? (Circle one).

Computer Lab on Campus Dormitory or Resident Hall Job Setting Home Other: _____.

Which computer system do you prefer? (Circle one).

Macintosh Computer

IBM or IBM-Compatible Computer

University Computer System (Mainframe)

- No Preference.

PART TWO: ATTITUDES TOWARD COMPUTER TECHNOLOGIES (DELCOURT & KINZIE, 1993)This survey has 19 statements about computer technologies. After reading each statement, please indicate the extent to which you agree or disagree, by circling the number to the right of each statement. Please respond to all statements. There are no correct or incorrect responses.

(**TABLE**) Strongly Disagree / Disagree / Agree / Agree I don't have any use for computer technologies on a day-to-day basis.

Using computer technologies to communicate with others over a computer network can help me to be more effective in my job.

I am confident about my ability to do well in a task that requires me to use computer technologies.

Using computer technologies in my job will only mean more work for me.

I do not think that computer technologies will be useful to me in my profession.

I feel at ease learning about computer technologies. With the use of computer technologies,

I can create materials to enhance my performance on the job.

I am not the type to do well with computer technologies.

If I can use word processing software, I will be more productive.

Anything that computer technologies can be used for, I can do just as well some other way.

The thought of using computer technologies frightens me.

Computer technologies are confusing to me.

I could use computer technologies to access many types of information sources for my work.

I do not feel threatened by the impact of computer technologies.

I am anxious about computer technologies because I don't know what to do if something goes wrong.

Computer technologies can be used to assist me in organizing my work.

I don't see how I can use computer technologies to learn new skills.

I feel comfortable about my ability to work with computer technologies.

Knowing how to use computer technologies will not be helpful in my future work.

PART THREE: CONFIDENCE AND DESIRED KNOWLEDGE WITH COMPUTER TECHNOLOGIES (ADAPTED FROM MURPHY, COOVER, & OWEN, 1989) This survey has 35 statements about your confidence with and desirability to learn computer technologies. Each statement should be rated in two different ways using two sets of numbers. The first set of numbers on the left describes your present level of confidence with respect to the statement. The second set on the right describes the level of knowledge which you would like to learn. Please respond to all statements, even if you have not had a great amount of experience with a particular type of computer technology. For example:

Strongly Disagree = SD Disagree = D Agree = A Strongly Agree = SA.

(TABLE)I feel confident... I would like to learn formatting a computer diskette.
SD D A SA.

By circling the letter A on the left side, you indicate that you have some degree of confidence in formatting a diskette.

By circling the letters SA on the right side, you indicate that you have a strong degree of desirability of learning how to format a diskette. Remember there are no correct or incorrect responses.

Strongly Disagree = SD Disagree = D Agree = A Strongly Agree = SA.

(TABLE)I feel confident... I would like to learn...1. Working on a personal computer SD D A SA. Getting the software up and running Logging onto the university computer system.

Strongly Disagree = SD Disagree = D Agree = A Strongly Agree = SA.

(TABLE)I feel confident... I would like to learn...

Working on the university computer system

Using the user's guide when help is needed

Entering and saving data (numbers or words) into a file

Escaping/exiting from a program

Logging off the university computer system

Calling-up a data file to view on the monitor (screen)

Understanding terms/words relating to the computer hardware

Understanding terms/words relating to the computer software

Sending the same mail message to more than one person on e-mail

Learning to use a variety of programs (software)

Learning advanced skills within a specific program (software)

Making selections from an on-screen menu SD D A SA

Using the computer to analyze number data (e.g., spreadsheet, databases, & statistical software)

Using a printer to produce a copy of my work

Copying a disk

Copying an individual file SD D A SA

Adding or deleting information from a data file

Moving the cursor around the monitor screen SD D A SA

Writing simple programs for the computer SD D A SA

Using the computer to write a letter or essay

Describing the function of the computer hardware (e.g., keyboard, monitor, disk drives, and computer processing unit)

Understanding the three stages of data processing: input, processing, output

Getting help for problems in the computer system

Storing software disks correctly

Explaining why a program (software) will or will not run on a given computer

Using the computer to organize information.

(**TABLE**)I feel confident... I would like to learn...
Strongly Disagree = SD Disagree = D Agree = A Strongly Agree = SA.

Getting rid of files when they are no longer needed

Organizing and managing files (e.g., disk management, directories, sub-directories, & paths)

Reading mail messages on e-mail

Deleting messages received on e-mail

Troubleshooting computer problems

Responding privately to messages originally sent to more than one person on e-mail.

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Appendix 6

Educational Technology Standards

THE NATIONAL EDUCATIONAL TECHNOLOGY STANDARDS (NETS): A REVIEW OF DEFINITIONS, IMPLICATIONS, AND STRATEGIES FOR INTEGRATING NETS INTO K-12 CURRICULUM

Subject(s): EDUCATIONAL technology -- United States; NATIONAL Educational Technology Standards (Organization); CURRICULUM planning

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ABSTRACT

National educational technology standards (NETS) for PreK-12 students recently joined the array of other national curriculum standards which schools must address. However, integrating NETS into an already full curriculum presents several kinds of challenges many schools finddifficult to meet. This article provides a historical and current context for NETS, describes their implications for priorities such as school funding, and suggests curriculum-based strategies that may be used to meet these standards within content-area lessons.

Keywords: educational technology, curriculum standards, computer literacy, technological literacy.

INTRODUCTION

In the American education system of the 1990's, as accountability became a familiar and fixed part of the educational landscape, curriculum standards emerged as one of its most prominent features.

While it is helpful, most educational leaders agree, to have clear guidelines that define adequate performance in each content area and grade level, standards also have become a popular measuring stick for school quality and teacher performance (Darling-Hammond & Falk, 1997).

If some legislators are successful in their efforts, critical elements such as school funding and certification will be tied to compliance with standards (Quality counts, 1999, January 11). Schools and districts face varying difficulties in meeting these performance guidelines, and most look to an increasing reliance on them with mixed views. In addition to their significance as benchmark skills in preparing students for an Information Society, national technology standards represent an important development in the search for behaviors to define "computer/technological literacy." The historical significance and current impact of NETS will be described here, along with curriculum-based strategies for addressing them at all levels.

AN OVERVIEW OF NETS

Policymakers and educators alike are beginning to see technology skills as an important part of preparing citizens for tomorrow's world. The current U.S. Administration has made it clear it considers preparing students to use technology tools as high a priority as basic skills in reading and mathematics (Technology counts, 1997, November 10). Several states, most notably North Carolina, decided a few years ago to set their own standards for what students at each grade level should know and be able to do with technology (Atkins & Vasu, 1998).

Others like Florida integrated technology into their state curriculum standards. However, unlike content areas such as mathematics and social studies, there were no national standards developed by a respected content area professional organization.

In June, 1998, the National Educational Technology Standards (NETS) Project published such standards. NETS is an initiative of the International Society for Technology in Education (ISTE) and was funded by NASA in consultation with the U.S. Department of Education, the Milliken Exchange on Education Technology, and Apple Computer. Technology Foundation Standards for Students developed by the NETS Projects are shown in Figure 1. ISTE is the largest educational technology organization in the world, and its ties both to classroom teachers and national policymakers give its work in this area an aura of authority. (Copies of the standards are available from ISTE or at: http://cnets.iste.org.)

A Brief History of Technology Standards

NETS is not the first attempt at setting national standards for student performance with technology. Since Arthur Luehrmann first coined the term "computer literacy" in pre-microcomputer days (Roblyer, 1992), educators struggled to define it in terms of student performance. This effort was complicated by the lack of agreement on what constitutes adequate preparation in computer skills. In 1980, the National Science Foundation and the Human Resources Research

Organization cosponsored a conference of experts to agree on strategies for addressing issues related to instructional technology and to develop a definition and a set of skills through which educators could address "computer literacy." However, the meeting dispersed without accomplishing its mission; the experts simply could not agree.

Later, some states set their own computer literacy standards, and various national groups recommended that students should learn some computer skills at each grade level (Bitter, 1983, June 5). At that time, computer literacy skills focused on programming, as well as operation skills and using tools such as spreadsheets and databases.

States such as Oregon and Florida included computer literacy skills in their listing of statewide basic skills. However, none of these states ever required students to meet such standards in order to graduate; later, this "basic skills" approach to assessing computer literacy was dropped altogether.

The emergence of the Internet as a pervasive presence in education and society signaled a renewed national interest in student performance standards related to computer technology. This time, the search for performance standards has been successful, and their impact may be far-reaching. Also known as "technology literacy skills," standards for using computers and related technologies have been developed for teachers, as well as students. ISTE worked in conjunction with the National Council for the Accreditation of Teacher Education (NCATE) to generate standards and a vision statement for how teacher education programs should address technology.

IMPLICATIONS OF NETS FOR SCHOOLS

State and Federal Requirements

Technology standards for students are poised to make several new kinds of requirements on teachers and schools at all grade levels. State and federal governments view technology skills as such a critical part of student preparation, the new standards are likely to be seen in the same light as content area standards. Thus, they could become either a separate set of required skills, as they are in North Carolina, or integrated into other statewide skills, as they are in Florida.

Also, just as participation in some federal funding programs (e.g., Technology Innovation Challenge Grants) requires a district or state technology plan, such funding programs could begin requiring that participants have a clear strategy for addressing technology standards in their technology plans. One indicator this may become important is the development of materials such as the STAR chart, a rubric for gauging a school's readiness for using technology meaningfully in curriculum and teaching. Developed in 1997 by a consortium of presidents of technology organizations, the rubric was updated in 1998 (CEO Forum on Education and Technology, 1998, October 29), and has received widespread attention from educators and legislators.

Barriers to Teaching with Technology

For most schools across the country, teaching with or about technology is a continuing challenge. The primary issues revolve around the most appropriate methods for using technology and how to obtain the required resources.

How to Integrate Technology?

Microcomputers have been in schools since 1978, but there have been continuing debates about the role technology should play in teaching and learning (Roblyer, 1997). Until the "Internet Explosion" of just a few years ago, many schools still viewed computers as an optional add-on, even a luxury. The result is that a minority of schools are in a position now to exploit the capabilities of today's technologies or define for themselves the ways in which technology tools can help them create enhanced learning environments. Educational technology experts see technology integration as a problem with many dimensions, but most agree that technology skills for students should not be goals in themselves. They should be a natural outgrowth of the role technology plays in teaching and learning.

How to Obtain Resources?

The most persistent, long-term problems schools face with technology are with resources: having sufficient technology equipment, software, and media in place, and teachers who are trained in their use. Without these resources and personnel, the question of technology skills for students is problematic. Every state and national survey of technology resources show the same distressing picture: schools vary widely in the numbers of computers they have, the software and media available, their online capabilities, and the budget allocated to keeping these resources updated (Quality Counts, 1999, January 11). As one might guess, schools with high percentages of students from white, high socioeconomic families have the most resources; those with populations of mostly minority and poor students have the least.

Most schools and districts have begun a technology acquisition program of their own, and many states, along with the U.S. Department of Education, have begun funding programs to help provide more equitable access to schools and students with unusual technology deficits. But it is clear that the vast majority of schools will be playing catch-up for many years to come. In the meantime, schools cannot teach what they don't have, and the technology skills students will be able to learn usually will be limited to the resources available at their schools.

Issues in Integrating Technology

As schools consider how they might incorporate NETS into content area curriculum and methods, they must first address several kinds of curriculum and pedagogical issues about the role technology should play in classrooms. Three kind of problems are described here: skill priorities, grade level issues, and materials/methodology decisions.

When to Teach Technology Skills?

The first set of problems teachers must confront is logistical. Although educational technology magazines have many articles-even whole issues-describing technology-based lesson plans, activities, and projects, many educators feel that learning to use technology takes time away from learning the more important basic skills. Introducing students to a multimedia software (e.g., HyperStudio) or a digital camera does take time. Once students learn these tools, they can use them to help build their reading, writing, and content area skills.

The problem is: how do schools fit technology skills in to an already full curriculum?

What Are Appropriate Technology Uses at Elementary Levels?

Elementary schools face special problems in identifying an appropriate role for technology. Even though there are a variety of software packages and applications available for elementary levels, this level typically reports the least number of available resources and technology applications in place (Technology counts, 1998, October 1).

The reason for this de-emphasis on technology is not difficult to discover. Both educators and parents view elementary schools as the place for children to acquire the basic skills in reading, mathematics, study, and organization that will help them be successfulstudents and life-long learners. Technology skills usually are not seen as an essential part of this basic preparation.

Other pedagogical reasons influence technology integration at PreK-5 levels. In the first place, computers still rely primarily on keyboard input; and children, especially at Grades PreK-2 lack the fine motor skills to become fast typists. Some schools pair small children with older students to help speed up input, but most teachers who use computers with young children must do most of the typing themselves or use volunteers or aides to assist. Also, it is more difficult to locate software designed for elementary levels whose benefits for developing reading, writing, and mathematics skills clearly offset the time required to implement them. Some of the most powerful instructional software available, e.g., simulations and problem solving software, provide an abstract environment for learning concepts which many educators feel young children should encounter first in a real-life, hands-on way. Science and social studies simulations, for example, sometimes are viewed as less helpful to young students than to older ones.

Which Strategies Are Most Appropriate?

Finally, an ongoing debate about whether schools should emphasize directed or constructivist methods tends to confuse and complicate educators' search for appropriate technology integration methods (Roblyer, Edwards, & Havriluk, 1997; Roblyer & Edwards, 2000). Some educational technology experts equate technology integration with curriculum reform (Gonzales & Roblyer, 1996); they say teachers should use technology resources and applications primarily to promote problem-solving, critical thinking, and collaboration (e.g., student development of multimedia, Internet-based research projects, problem solving with simulations). Other experts make a case for a mixture of these and more directed resources and applications (e.g., tutorial and drill activities, Integrated Learning Systems). Many educators find that the lack of consensus on what constitutes appropriate uses of technology makes it even more difficult to convince administrators that the costs and training involved in using a given resource is justified.

CURRICULUM STRATEGIES FOR MEETING NETS

In the end, school teachers and administrators must make difficult decisions about the role technology skills should play in preparing students for future learning and how these skills can best be integrated into other required activities. Clearly, as Roblyer and Edwards (1999, in press) put it "... the future of educational technology rests to a great degree on us (educators): how we view technology, how we respond to the challenge it presents, and how we see it helping us accomplish our own informed vision of what teaching and learning should be."

The NETS document offers curriculum examples and scenarios to illustrate each of the four skill levels. These kinds of grade-level examples are helpful to show teachers at each level how they can teach these skills in the context of other required content area activities with the aim of enhancing the learning of both technology and content area skills. The following by-grade technology-integrated lesson Ideas are summaries from a resource database of more detailed strategies for integrating technology across the curriculum at various grade levels (Roblyer, 1999). NETS Technology Foundation Standards (Figure 2) addressed with each lesson are shown in parentheses at the end of each summary.

Pre-K: Drawing to support language development (Wachob, 1993) --Students can practice learning their addresses by using a graphics package to draw their own houses. The teacher writes the child's name and address on the house. A bulletin board can be created to show everyone's house as part of the community, with connecting roads and surrounding landmarks (3).

Kindergarten: Video-assisted interviews (based on Wachob, 1993) -- Each child gets to be the interviewer and ask another child questions while looking through the camera set on a low tripod. The interviewer starts with simple questions, then gradually branches out. It is a good opportunity for language use and for focusing on someone other than themselves (2, 3, 4).

Grade 1: A Project with Teeth (based on Boehm, 1997) -- Teachers use e-mail to connect their K-3 students with "key pals" around the world in order to exchange information on how many teeth the children lose during the year. This activity is used as a springboard for learning geography (locations of the key pals), literature and culture (tooth-fairy traditions and other stories from their region), art (creating pictures or murals illustrating tooth fairy traditions), creative writing (e-mail messages to participants, poems and rhymes on teeth), and mathematics (graphing data on lost teeth) (3, 4).

***Grade 2**:* A Database Yearbook (based on Hollis, 1990) -- This project is introduced as a "getting to-know-each-other" activity at the beginning of the year with a curricular theme such as "Beginnings" of "Friendships." Students brainstorm the 10 most important things they would like to know about each other. The teacher creates a database template and students work in pairs to enter it into the database.

When the database is complete, students look for interesting relationships and ask and answer questions such as "How many students are still seven years old?" and "What is the most favorite color in the class?" They use a graphing program to produce graphs of class data. They create the yearbook for an individual class or across all the classes in a given grade by printing out each student's record, adding a picture to it, and producing a booklet with a graphic cover (2, 3, 4, 5).

Grade 3: Estimating with Eye Droppers and Spreadsheets (based on Harriss, 1994) -- The teacher begins this activity with a discussion of what is meant by predicting and estimating, and explains that the students will be using these processes to predict the number of drops of water that can fit on a coin. After making their predictions, students begin the experiment, keeping accurate count of the drops.

Then they record them on a form. They do this twice, noting any factors that would allow them to get more drops of water on the coin. The students repeat the same process with the tail side of a penny, then enter the data into a spreadsheet and complete Totals and Averages. When all students have entered their water drop records, the teacher discusses the results of their prediction and the actual drops. Discussion focuses on factors that allow them to get more drops on the coin. The experiment can be repeated by varying these factors (3, 5, 6).

Grade 4: State History Bites on the Morning News (based on Holifield, 1992) -- This activity is designed to keep student interest high while developing skills in research, social studies, and communication. Students use an electronic encyclopedia to research a topic in state history; then they plan and develop "video history bites" designed to be shown on the school's closed circuit television "morning news program." (4, 5)

Grade 5: Watching the Weather (based on itschek, 1993) -- Teachers identify schools who wish to participate in a "weather data exchange," which may be done via e-mail or on a location on the school's website set up for the project. Each school or classroom involved must record the minimum and maximum temperature and rainfall for the past 24 hours. They should take these readings at about the same time every day and e-mail their data to the school partners. Each partner school or classroom has an opportunity to collect all the data called in, summarize it in a chart, and present it to the other classes. Students can compile and plot the data over time, comparing information on and talking about the different areas involved, or talking directly to the schools about their weather conditions (2, 3, 4, 5,).

Grade 6: Visualizing Colonial America (based on Sherwood, 1994) --Students can make history come alive by using a using the Colonial America 1760's videodisc in conjunction with role-playing. They create buttons to allow other students to look at various occupations of colonists. After viewing and discussing the segments, the students act out the roles of colonists, the Royal governor, colonial assembly

Grade 7: Analyze Our Eating Habits (based on Justice, 1996) --Students use spreadsheets to do a combined study of nutrition, weights, and measurements. They enter data on a spreadsheet on how much they eat in each food category and how many calories and grams of fat they consume each day. They use these data to design their own daily balanced eating plan with the right number of servings from each food group and the correct calories and fat requirements for their age and activity levels (3, 4, and 6).

Grade 8: Multimedia Yearbooks (Based on Kwajewski, 1997) -- The development of multimedia yearbooks is a highly motivational activity in which all students can participate, regardless of ability. It is an opportunity for students to exercise their writing skills, try out their creativity, and reflect on themselves as members of the school community. Although this project was tried out in an eighth-grade class graduating from middle school, it could be a profitable pre-graduation activity at any grade level. Some items they may choose the include are: original backgrounds with their own artwork, tributes to special teachers, friends, or relatives who helped them in their middle school careers; contributions they made to the school or accomplishments in sports, academics, or other activities; and personal photos of themselves and/or friends (3, 4).

Grade 9: Exploring Real-world Problem with Spreadsheets (based on Walsh, 1997) -- Difference equations calculate values of items that change over time, such as a population that grows at a certain percent or money in an interest-bearing account. A spreadsheet makes it easy to do these calculations and show students graphically the concept behind the equations. Topic areas for such equation activities include Population Growth and Simple/Compound Interest (3, 4, 5, and 6).

Grade 10: Critics Corner via E-mail (based on Daniels and Bryan, 1992) -- If students are still functioning several reading levels below normal by the time they are sophomores in high school, something unique and different is necessary to capture their interest and convince them to continue trying to improve their communication skills. This activity uses collaboration with other students on literary critiques via e-mail to provide that extra interest. Another way to increase motivation in conjunction with this e-mail activity is to have students write critiques on topics connected with special events (e.g., mystery stories or Gothic tales during October; love and romance during February, sports during the Olympics broadcasts) (4, 5).

Grade 11: Exploring Distant Ecosystems Up Close (based on Hunnicutt, 1993) -- This lesson uses e-mail to expose high school students to first-hand experience with widely varying ecosystems. Students learn how to gather data, communicate it to others, and use it to draw comparisons among systems. This project was done at Grades 11-12, but modified versions could be carried out at many grade levels. After an initial getting-acquainted period, students do actual research, observation, field work, and interpretations, and share information among sites (3, 4, 5, 6).

Grade 12: Developing Computer-Aided Study Skills (based on Sales and Goodlander, 1987) -- Most parents and teachers agree it is difficult to get students to study for tests, or at least to use their study time efficiently. Students will retain more of what they study if they themselves generate questions, definitions, or problems related to the content. Each student in the class generates several test items over the content to be studied. They word process these items, then work in pairs or small groups to cut and paste them into a test generator. Or students may work in groups to develop exercises or crossword puzzles based on the content using a package such as Mindscape's Crossword Magic (3).

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FIGURE 1. NETS PROJECT TECHNOLOGY FOUNDATION STANDARDS FOR STUDENTS

(FROM ISTE, 1998: HTTP://CNETS. ISTE. ORG)

1. Basic operations and concepts

* Students demonstrate a sound understanding of the nature and operation of technology systems.

* Students are proficient in the use of technology.

2. Social, ethical, and human issues

* Students understand the ethical, cultural, and societal issues related to technology.

* Students practice responsible use of technology systems, information and software.

* Students develop positive attitudes toward technology uses that support lifelong learning, collaboration, personal pursuits, and productivity.

3. Technology productivity tools
* Students use technology tools to enhance learning, increase productivity, and promote creativity.

* Students use productivity tools to collaborate in constructing technology-enhanced models, preparing publications, and producing other creative works.

4. Technology communications tools
* Students use telecommunications to collaborate, publish, and interact with peers, experts, and other audiences.

* Students use a variety of media and formats to communicate information and ideas effectively to multiple audiences.

5. Technology research tools
* Students use technology to locate, evaluate, and collect information from a variety of sources.

* Students use technology tools to process data and report results.

* Students evaluate and select new information resources and technological innovations based on the appropriateness to specific tasks.

6. Technology problem-solving and decision-making tools
* Students use technology resources for solving problems and making informed decisions.

* Students employ technology in the development of strategies for solving problems in the real world.

FIGURE 2. NETS PERFORMANCE INDICATORS FOR FOUNDATION TECHNOLOGY STANDARDS FOR STUDENTS: GRADES PREK-2,3-5,6-8, AND 9-12 (FROM ISTE, 1998: HTTP://CNETS.ISTE.ORG)

Prior to completion of Grade 2 students will:

1. Use input devices (e.g., mouse, keyboard, remote control) and output devices (e.g., monitor, printer) to successfully operate computers, VCRs, audio tapes, and other technologies.

2. Use a variety of media and technology resources for directed and independent learning activities.

3. Communicate about technology using developmentally appropriate andaccurate terminology.

4. Use developmentally appropriate multimedia resources (e.g., interactive books, educational software, elementary multimedia encyclopedias) to support learning.

5. Work cooperatively and collaboratively with peers, family members, and others when using technology in the classroom.

6. Demonstrate positive social and ethical behaviors when using technology.

7. Practice responsible use of technology systems and software.

8. Create developmentally appropriate multimedia products with support from teachers, family members, or student partners.

9. Use technology resources (e.g., puzzles, logical thinking programs, writing tools, digital cameras, drawing tools) for problem solving, communication and illustration of thoughts, ideas, and stories.

10. Gather information and communicate with others using telecommunications, with support from teachers, family members, or student partners.

Prior to completion of Grade 5 students will:

1. Use keyboards and other common input and output devices (including adaptive devices when necessary) efficiently and effectively.

2. Discuss common uses of technology in daily life and the advantages and disadvantages those uses provide.

3. Discuss basic issues related to responsible use of technology and information and describe personal consequences of inappropriate use.

4. Use general purpose productivity tools and peripherals to support personal productivity, remediate skill deficits, and facilitate learning throughout the curriculum.

5. Use technology tools (e.g., multimedia authoring, presentation, Web tools, digital cameras, scanners) for individual and collaborative writing, communication, and publishing activities to create knowledge products for audiences inside and outside the classroom.

6. Use telecommunications efficiently and effectively to access remote information, communicate with others in support of direct and independent learning, and pursue personal interests.

7. Use telecommunications and online resources

(e.g., e-mail, online discussions, Web environments) to participate in collaborative problem-solving activities for the purpose of developing solutions or products for audiences inside and outside the classroom.

8. Use technology resources (e.g., calculators, data collection probes, videos, educational software) for problem-solving, self-directed learning, and extended learning activities.

9. Determine when technology is useful and select the appropriate tool(s) and technology resources to address a variety of tasks and problems.

10. Evaluate the accuracy, relevance, appropriateness, comprehensiveness and bias of electronic information sources.

Prior to completion of Grade 8 students will:

1. Apply strategies for identifying and solving routine hardware and software problems that occur during everyday use. (1)

2. Demonstrate knowledge of current changes in information technologies and the effect those changes have on the workplace and society. (2)

3. Exhibit legal and ethical behaviors when using information and technology, and discuss consequences of misuse. (2)

4. Use content-specific tools, software, and simulations (e.g., environmental probes, graphing calculators, exploratory environments, Web tools) to support learning and research. (3, 5)

5. Apply productivity/multimedia tools and peripherals to support personal productivity, group collaboration, and learning throughout the curriculum. (3, 6)

6. Design, develop, publish, and present products (e.g., Web pages, videotapes) using technology resources that demonstrate and communicate curriculum concepts to audiences inside and outside the classroom. (4, 5, 6)

7. Collaborate with peers, experts, and others using telecommunications and collaborative tools to investigate curriculum-related problems, issues, and information, and to develop solutions or products for audiences inside and outside the classroom. (4, 5)

8. Select and use appropriate tools and technology resources to accomplish a variety of tasks and solve problems. (5, 6)

9. Demonstrate an understanding of concepts underlying hardware, software, and connectivity, and of practical applications to learning and problem solving. (1, 6) 10. Research and evaluate the accuracy, relevance, appropriateness, comprehensiveness, and bias of electronic information sources concerning real-world problems. (2, 5, 6)

Prior to completion of Grade 12 students will:

1. Identify capabilities and limitations of contemporary and emerging technology resources and assess the potential of these systems and services to address personal, lifelong learning and workplace needs. (2)
2. Make informed choices among technology systems, resources, and services. (1,2)

3. Analyze advantages and disadvantages of widespread use and reliance of technology in the workplace and in society as a whole. (2)

4. Demonstrate and advocate for legal and ethical behaviors among peers, family, and community regarding the use of technology and information. (2)

5. Use technology tools and resources for managing and communicating personal/professional information (e.g., finances, schedules, addresses, purchases, correspondences. (3, 4)

6. Evaluate technology-based options, including distance and distributed education, for lifelong learning. (5)

7. Routinely and efficiently use online information resources to meet needs for collaboration, research, publications, communications, and productivity. (4, 5, 6)

8. Select and apply technology tools for research, information analysis, problem-solving, and decision-making in content learning. (4, 5)

9. Investigate and apply expert systems, intelligent agents, and simulations in real-world situations. (3, 5, 6)

10. Collaborate with peers, experts, and others to contribute to a content-related knowledge base by using technology to compile, synthesize, produce, and disseminate information, models, and other creative works. (4, 5, 6)

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Appendix 7
Interview Schedule
John H. Stamper, Ph.D.

Date	Organization	Interview/Activity
Nov. 12, 2001	Wat Tein Tawai School Pre-primary – Primary, ONPEC	Singto Kaewkanlaya, School Director
	Pluppla-Siri School Pre-primary – Primary, Private	Dr. Sirichai Yokota, School Director
Nov. 15, 2001	Assumption University Private University	Dr. P. Martin Komolmas, Rector
Nov. 21, 2001	Center for Educational Innovation and Technology	Mr. Suntorn Promratanapong
Dec. 7-8, 2001	- Som-tha-wil School - Wichien Wattanajit, School Director - Distance Learning Foundation - Chair of the Executive Board and others - Distance Learning Television Station	
Dec. 1, 2001	- Non Formal Education Service Center, Amphor Muang Chieng Rai Province - CCF Foundation, Chieng Rai Province	
Dec. 18, 2001	- ICT learning and teaching activity at Non Formal Education Service Centers - Community Learning Center, Srisuwannaram Temple, Chieng Rai Province	
Dec. 19, 2001	- Community Centers, Chieng Mai Province	
Dec. 20, 2001	- Lampang Kindergarten, Lampang Province - Use of ICT for community “Three-Legged Village”, Lampang Province - Non Formal Education Service Center, Amphor Muang , Lampang Province	
Dec. 26, 2001.	Sukhothai Thammathirat Open University	Dr. Thongin Wongsothorn, President
Jan. 11, 2002	Sukhothai Thammathirat Open University	Assoc. Prof. Dr. Pranee Sungkatavat, Assistance to the President Assoc. Prof. Dr. Somkid Promjouy, Dean of School of Educational Studies Assoc. Prof. Dr. Kanjana
Jan. 17, 2002	Kenan Institute Asia	Prof. Dr. Montri Chulavatanatol, Director
Jan. 18, 2002	The Office of Private Education Commission	Ms. Songsri Wanasen, Deputy Secretary-General Mr. Amorn Chaiprasongsuk, Supervisor Ms. Panidda Thepsithitraporn, Acting for Chief, International Relations & Cooperation Cntr

Jan. 25, 2002	Training Center	Mr. Somporn Saewkwo
	Surat Thani School	
Jan. 29, 2002	The World Bank	Dr. Tanaporn Poshyananda, Education Project Manager
Jan. 30, 2002	NECTEC School Net Project	Dr. Chadamas Dhuwasethakul
Feb. 1, 2002	Speaker, National Seminar on "Using ICT for Quality Teaching, Learning and Professional Development" Rama Gardens Hotel	
Feb. 4, 2002	Office of National Economic and Social Development Board	Prof. Dr. Sippanondha Ketudat
Feb. 6, 2002	Sukhothai Thammathirat Open University	Dr. Thongin Wongsothorn, President
Feb. 12, 2002	Faculty of Education Chulalongkorn University	Dr. Tissana Kaemanee
Feb. 12, 2002	Faculty of Education Chulalongkorn University	Dr. Amornwich Nakorntup
Feb. 12, 2002	Office of National Primary Education Commission	Dr. Benjalak Num-Far
Feb. 14-15, 2002	World Bank Workshop on "Alternative Way for Effective Science Teaching through Computer-based Multimedia" Chulalongkorn University	
Feb. 15, 2002	Office of the Permanent Secretary, Ministry of Education	Dr. Derek Pornsima, Senior Advisor
Feb. 28, 2002	Sukhothai Thammathirat Open University	Dr. Thongin Wongsothorn, President

Appendix 8

National ICT Education Centers

ICT Education Centers

The National ICT Education Centers at Sukhothai Thammathirat Open University and Ramkhamhaeng University will provide project support through three (3) basic functions:

1. Develop <u>television programming and CAI software</u> in association with other projects such as NECTEC, ONEC, Chulalongkorn University, Chang Mai University and a consortium of public and private development groups within Thailand and the GMS region;

2. Provide <u>technical support</u> for uplinking the television signal from the studio facilities; and,

3. Provide <u>testing and teacher support</u> at STOU and RU centers for certification and credit programs for teachers who may wish to obtain university credit for participating in selected courses.

Appendix 9

Visit to Wat Tianthawai School
12 November 2001

Introduction: Wat Tianthawai School is located near the edge of a planned city development in the northern outskirts of Bangkok. 579 students from the surrounding area attend this pre-primary to primary school. The school's teaching staff consists of 21 full-time teachers. The principal and the abbot of the adjacent Tianthawai Temple share administrative and advisory duties for the school. A tour of the following areas of the school was provided:

Library: The library has a collection of approximately 300 books. Students are encouraged to check out books for home use, and the library provides carrying bags for book transport to and from home. The library room is often used for small group projects involving language and reading. The projects usually involve written worksheets. A group listening station provides access to cassette recordings, and is used for activities such as transcribing song lyrics as a way to learn writing skills. A stand-alone computer provides access to approximately 20 CD-ROMs.

Audio Lab: A 40-carrel audio lab with headsets equipped with microphones provides access to recorded materials for class use. A teacher's station provides playback control to all listening stations and the ability to audit individual student performances.

Cooperative Program: An experience-based cooperative program provides student groups with experiences in creating, producing, and selling useful products, such as decorative silk flower arrangements. Students work in teams to plan and operate a small business enterprise. Students also run a school bank in which students have individual accounts and a store for school supplies.

Lunch Project: A government subsidized lunch project provides twenty baht for each child, a yearly budget of approximately 80,000 baht. Three cooks prepare meals with the assistance of student helpers, who mainly perform services such as delivery of trays and utensils. Student assignments are considered a practical educational experience in preparation for work and homemaking. Groups from different classes are rotated by a daily schedule.

Technology Usage in the School: The role of technology within the educational process can be viewed as a continuum. At the simplest level, ICT within the school can be used for maintenance of school records; at the highest, to directly deliver instruction. Wat Tianthawai School has begun to use word processing capabilities in some classes, often in connection in student preparation of portfolios.

Recommendations for expanding ICT use include:

1. Add interactive simulations and role playing. The successful cooperative program at Wat Tianthawai School provides an opportunity to introduce ICT approaches using interactive multimedia software. Interactive simulations can be used to train for skills needed for students to effectively interact with customers and clients. This would provide an extension of the aims of existing cooperative programs to give students practice in the human aspects of business. An example of an outcome would be for students to describe the benefits of their new product, and to answer customer questions related to its use.

This kind of experience is currently difficult to include in the cooperative program experience, but would be an excellent opportunity to develop simulation-based interactive computer programs. Such simulations are often used in preparation for medical students to practice interaction with patient assessment in clinical assessment of emergency patients.

2. Add "spiral curriculum" teaching techniques. Spiral curriculum techniques refer to introducing basic principles early in curricular experiences and providing additional content and elaboration as a student's knowledge about a subject grows. The "learn by doing" approach, an effective strategy represented by the Wat Tianthawai School cooperative program, can be enhanced by simplified "advance organizers" to provide enhanced learning experiences and prepare the student to learn advanced concepts.

Introducing big concepts in a simplified fashion can provide a conceptual framework that can be built upon in further study. The authentic experiences that are part of the cooperative program could be used to teach simplified economics and business principles useful in later schooling and life experience. One such principle might be the supply-and-demand theory. Through the sale of their own products children are likely to learn that when supply is high, prices are low; when supply is low, prices are high.

The challenge in using a spiral curriculum approach is in presenting broad concepts in a simple manner. Using presentation graphics software such as PowerPoint, which is already available at Wat Tianthawai School, a teacher would be able to produce or use existing animated graphics to illustrate concepts. Animated graphics that would show, for example, that the money needed to purchase a product increases as supplies dwindle, or in subsequent grade levels - as the opposing rise and fall of two lines on a chart, illustrate concepts in a much more understandable and precise way than print or chalk illustrations.

3.Use interactive software to develop cooperative program business plans. A step-by-step approach to developing a simplified business plan would be helpful in the cooperative program. Creative Planner series software has been used in Australia at the high school level to help students to create professional business plans. Other recommendations for software to support this program involves "idea generating" software to help students identify new products and solutions to problems they identify using the program.

An example of this suggestion in practice is from Bendigo Senior Secondary School, a Navigator program school in Victoria, Australia. Navigator schools serve as a model for incorporation of ICT approaches in the classroom in Australia. The school's Small Business Enterprise course requires students to document each project with an electronic camera and publish descriptions and product information on a website developed by students. Advertising materials is also scanned into reports. Reports are posted on the Intranet for peer group appraisal, and then on the Internet for a wider audience.

Appendix 10

Combined Pilot and Dissemination Budget

Thailand & GMS	Total	Thailand	GMS
aenRECEIVE			
Receive Equipment Package:			
$87 x 12,000 sites upgrade (Pilot)	1,044,000	1,044,000	
$374 x 3000 new sites (GMS)	1,122,000		1,122,000
aenSERVE			
School/Site Server Package:			
$5,200 x 1,500 sites (Thailand Pilot)	7,800,000	7,800,000	
$5,200 x 3,000 sites (GMS)	15,600,000		15,600,000
EasiLAB (student lab)			
Computer Laboratory Package:			
$23,200 x 1,500 sites (Thailand pilot)	27,900,000	46,500,000	
$23,200 x 3,000 sites (GMS)	69,600,000		69,600,000
EasiLAB Software			
Virtual Science Lab Kits	123,000	61,500	61,500
English Language (Upper Secondary)	140,000	70,000	70,000
English Teacher Training	90,000	45,000	45,000
School Budgeting	110,000	55,000	55,000
Software Adaptation and Translatiin	175,000	77,500	77,500
Learning Objects Project - Buddhism	145,000	72,500	72,500
Learning Objects Project - Math	75,000	37,500	37,500
Learning Objects Project - Science	75,000	37,499	37,500
ICT Learning series	150,000	75,000	75,000
Targeted Software Development	25,000,000	12,500,000	12,500,000
EasiLAN (site network)			
Wireless Networking Package:			
$2,600 x 1,500 sites (Thai pilot)	3,450,000	3,450,000	
$2,600 x3,000 sites (GMS)	7,800,000		7,800,000
aen National Centers			
Lead Content Development:			
$225,000 x 2 lead sites (Thailand pilot)	450,000	450,000	
$225,000 x 6 sites (GMS)	1,350,000		1,350,000
aen Regional Centers			
Multimedia and Traning Support:			
$36,000 x 100 (Thailand pilot)	3,600,000	3,600,000	
$36,000 x 300 (GMS)	10,800,000		10,800,000
aenMITS (mobile support)			
Site Support Vehicles (Outfitted):			
$223,000 x 2 RV Lab vehicles (Pilot)	446,000	446,000	
$53,000 x 12 Van vehicles (Pilot)	636,000	636,000	
$223,000 x 6 RV Lab vehicles GMS)	1,338,000		1,338,000
$53,000 x 72 Van vehicles (GMS)	3,816,000		3,816,000
Total	**182,835,000**	**76,957,499**	**124,457,500**

Appendix 11

Thailand Pilot Budget, Years 1-3

Thailand Pilot	Total
aenRECEIVE	
Receive Equipment Package:	
$87 x 12,000 sites upgrade	1,044,000
aenSERVE	
School/Site Server Package:	
$5,200 x 1,500 sites	7,800,000
EasiLAB (student lab)	
Computer Laboratory Package:	
$23,200 x 1,500 sites	46,500,000
EasiLAB Software	
Virtual Science Lab Kits	61,500
English Language (Upper Secondary)	70,000
English Teacher Training	45,000
School Budgeting	55,000
Software Adaptation and Translation	77,500
Learning Objects Project - Buddhism	72,500
Learning Objects Project - Math	37,500
Learning Objects Project - Science	37,499
ICT Learning series	75,000
Regionally Targeted Development	12,500,000
LAN Networking (site)	
Wireless Networking Package:	
$2,600 x 1,500 sites	3,450,000
National Centers	
Lead Content Development:	
$225,000 x 2 lead sites	450,000
Regional Centers	
Multimedia and Traning Support:	
$36,000 x 100	3,600,000
Mobile IT Support	
Site Support Vehicles (Outfitted):	
$223,000 x 2 RV Lab vehicles	446,000
$53,000 x 12 Van vehicles	636,000
Total	**76,957,499**

Appendix 12

SE Asia Dissemination Budget

GMS Dissemination	Total
aenRECEIVE	
Receive Equipment Package:	
$374 x 3000 new sites	1,122,000
aenSERVE	
School/Site Server Package:	
$5,200 x 3,000 sites	15,600,000
EasiLAB (student lab)	
Computer Laboratory Package:	
$23,200 x 3,000 sites (GMS)	69,600,000
EasiLAB Software	
Virtual Science Lab Kits	61,500
English Language (Upper Secondary)	70,000
English Teacher Training	45,000
School Budgeting	55,000
Software Adaptation and Translation	77,500
Learning Objects Project - Buddhism	72,500
Learning Objects Project - Math	37,500
Learning Objects Project - Science	37,500
ICT Learning series	75,000
Regionally Targeted Development	12,500,000
EasiLAN (site network)	
Wireless Networking Package:	
$2,600 x3,000 sites	7,800,000
aen National Centers	
$225,000 x 6 sites (GMS)	1,350,000
aen Regional Centers	
$36,000 x 299	10,800,000
aenMITS (mobile support)	
Site Support Vehicles (Outfitted):	
$223,000 x 6 RV Lab vehicles GMS)	1,338,000
$53,000 x 72 Van vehicles (GMS)	3,816,000
Total	**124,457,500**

Appendix 13

School/Site Satellite Equipment Budget

Satellite	Total	Thailand	GMS
aenRECEIVE			
Receive Equipment Package:			
$87 x 12,000 sites upgrade (Pilot)	1,044,000	1,044,000	
$374 x 3000 new sites (GMS)	1,122,000		1,122,000
Total	**2,166,000**	**1,044,000**	**1,122,000**

Appendix 14

Central Network Server Budget

Site Server	Total	Thailand	GMS
aenSERVE			
School/Site Server Package:			
$5,200 x 1,500 sites (Thailand Pilot)	7,800,000	7,800,000	
$5,200 x 3,000 sites (GMS)	15,600,000		15,600,000
Total	**23,400,000**	**7,800,000**	**15,600,000**

Appendix 15

Computer Laboratory Budget

Activity	Total	Thailand	GMS
EasiLAB (student lab)	97,500,000	46,500,000	69,600,000
Computer Laboratory Package:			
$23,200 x 1,500 sites (Thailand pilot)	27,900,000	46,500,000	
$23,200 x 3,000 sites (GMS)	69,600,000		69,600,000
EasiLAB Software	26,083,000	13,031,499	13,031,500
Virtual Science Lab Kits	123,000	61,500	61,500
English Language (Upper Secondary)	140,000	70,000	70,000
English Teacher Training	90,000	45,000	45,000
School Budgeting	110,000	55,000	55,000
Software Adaptation and Translation	175,000	77,500	77,500
Learning Objects Project - Buddhism	145,000	72,500	72,500
Learning Objects Project - Math	75,000	37,500	37,500
Learning Objects Project - Science	75,000	37,499	37,500
ICT Learning series	150,000	75,000	75,000
Regionally Targeted Development	25,000,000	12,500,000	12,500,000
Total	**123,583,000**	**59,531,499**	**82,631,500**

Appendix 16

Local Area Network (LAN) Budget

Activity	Total	Thailand	GMS
EasiLAN (site network)			
Wireless Networking Package:			
$2,600 x 1,500 sites (Thai pilot)	3,450,000	3,450,000	
$2,600 x3,000 sites (GMS)	7,800,000		7,800,000
Total	**11,250,000**	**3,450,000**	**7,800,000**

Appendix 17

Regional Support to Local Sites Budget

Regional Support	Total	Thailand	GMS
aen Regional Centers	14,400,000	3,600,000	10,800,000
Multimedia and Traning Support:			
$36,000 x 100 (Thailand pilot)	3,600,000	3,600,000	
$36,000 x 300 (GMS)	10,800,000		10,800,000
aenMITS (mobile support)	6,236,000	1,082,000	5,154,000
Site Support Vehicles (Outfitted):			
$223,000 x 2 RV Lab vehicles (Pilot)	446,000	446,000	
$53,000 x 12 Van vehicles (Pilot)	636,000	636,000	
$223,000 x 6 RV Lab vehicles GMS)	1,338,000		1,338,000
$53,000 x 72 Van vehicles (GMS)	3,816,000		3,816,000
Total	**26,872,000**	**4,682,000**	**21,108,000**

Appendix 18

Mobile Support Vehicles (Extended Regional Center) Budget

Mobile Support	Total	Thailand	GMS
aenMITS (mobile support)			
Site Support Vehicles (Outfitted):			
$223,000 x 2 RV Lab vehicles (Pilot)	446,000	446,000	
$53,000 x 12 Van vehicles (Pilot)	636,000	636,000	
$223,000 x 6 RV Lab vehicles GMS)	1,338,000		1,338,000
$53,000 x 72 Van vehicles (GMS)	3,816,000		3,816,000
Total	**6,236,000**	**1,082,000**	**5,154,000**