2.At least 80 % of K12 schools will have connection to education and research network.

3.Establish the policies to encourage information sharing and exchange, and globally use electronic data interexchange (EDI) in educational administration.

4.Establish social education libraries and specific database, provide permanent learning environment, and link with cable TV to expand services to home.

5.Periodically or dynamically hold seminars and workshops on network applications to promote network applications in various fields and techniques.

5 Conclusion

In addition to the above functions of school computer center and the execution of project "E-mail to Secondary Schools", the distance learning pilot project is also very important. The Science & Technology Advisory Office and Computer Center of MOE are currently setting a plan on this project. At the beginning of this plan, the video conference and video classroom may be first targets to setup, and it is likely to use video server and VOD model to make a trial on distance learning and services. In order to provide a good information service to all teachers and students in the 21th century, what will be the information environment of campus networks like in the future? The conclusion as bellows are summarizing the ideas of how schools can provide services as mentioned above:

1.Provide a fundamental environment for fast access and information exchange to all teachers and students.

2.Provide a two way communication channel for campus, interscholastic and international information exchange.

3.Provide the access of global information about various teaching and research resources to establish a multifaceted self-learning environment for teachers and students.

4.Cultivate and utilize human resource and apply available information resources in teaching, research and administration, then establish the computerized civilization.

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Author Information

Shian-Shyong Tseng is the director of Ministry of Education Computer Center. He received the B.S., M.S., and Ph.D. degrees in Computer Engineer from National Chiao Tung University in 1979, 1981 and 1984. He is also a Professor in Department of Computer and Information Science at National Chiao Tung University.

Ai-Chin Lu is a senior analyst in the computer center at the Ministry of Education (MOE). She received M.S. in Computer Science from the University of Missouri-Rolla in 1987.

Ching-Hai Yin is working as senior analyst at Computer Center Ministry of Education Since 1985. He's responsibility is to push TANet development in Cooperate with regional network center.

Yu-Hsuan Chen is working as network engineer at Computer Center Ministry of Education since 1989. From 1990 ～ 1993 she was delegated to construct TANet backbone and Internet connection to JvNCnet. At that duration she also charged with TANet maintenance, services and management. The most important was to help and encourage schools to connect to TANet. Since 1994, She is involved in setting up TWNIC. She is one of TWNIC staffs and APNIC staffs for handle and control TWNIC services.

Each district education network center will be established by experienced TANet regional network centers with coordination of education bureau of each county, and install application systems such as BBS, Gopher and electronic mail etc. At the beginning, all teachers and students are encouraged to access those applications via dial-up system. District network centers will provide their experiences on building networks to other schools and encourage those schools to establish their own campus networks. All technical people in regional and district network centers should periodically take professional training programs from information industries to adequately handle networking operations.

2.Form management committee and technical committee.

MOE invited all administrative subordinations, experts and regional network centers to form a promoting committee and TANet management committee. Each regional network center should establish its management committee and technical committee based on their regional needs, and increase members of management committee including representatives from schools and libraries, meanwhile should setup a standard for relevant process and data transfer of among libraries; academic research and teaching activities; administrative services. Besides, the legality of each regional network center managing district education networks need to be authorized, so that they can handle illegal behaviors on networks to build network ethics and usage policies.

3.Establish various information applications.

Assist all levels of schools to establish various information applications such as educational resources database, test samples database, national library system etc. with a principle of overall plan and cooperative development. In the meantime, develop user friendly Chinese interfaces and make all application users connect to each other.

4.Provide training opportunities.

Each regional network center and district network center are responsible to provide short term and long term training to its region and district network users, and also to cultivate sufficient teachers in networking application. Regional network centers should periodically hold seminars or workshops on Education and Research Network to provide experts and scholars a good place to demonstrate their innovatory network systems and applications, thus to introduce up-to-date information technologies and share experiences.

5.Establish a national education and research database for providing educational decision makers systematic and digitized information in education.

The Database for Educational Research is established mainly for making all educational resources systematic and digitized thus to provide decision makers and researchers sufficient materials for experiment on educational problems, and to offer educational decision makers some basical educational information for better understanding the current situation in education. This database can consolidate all educators through Internet exchange with other countries and domestic teachers, educational administrators to provide good references.

6.Search funds for expanding the bandwidth of the network backbone to accelerate information exchange.

4.3 Mid-term Action Plan (1998-2000)

1.Upgrade the bandwidth of the link from universities and colleges campus networks to education and research network backbone, and well construct campus networks extending to all dormitories and laboratories.

2.Make possible for all junior colleges having 64Kbps link to each regional network center or district network center.

3.After complete establishing district network center, promote all links of K12 schools in each county to its district network center.

4.Each district network center can apply for government funds to maintain network and develop networking applications depending on their loads of connectivity to schools, hence they will have interest in more connections to other schools.

5.Establish a T3 national backbone at least, correspond with the trial of ATM of Telecommunication Bureau to evaluate a possible ATM backbone for future; through network applications provide multimedia environment, distance learning and virtual museum.

6.Upgrade international link to T1 circuit.

4.4 Long-term Action Plan (after 2000)

1.Correspond with the network policy of Telecommunication Bureau to establish ATM national backbone, meanwhile, upgrade international link to T3 circuit; regional networks can establish their own regional backbone.

2)Plan on cultivation of information professionals and teachers

On account of most teachers and administrators not having computer background, the information professional training programs had to be designed for those teachers and administrators. Till 1993 there were totally 33,551 trainees; 8% of teachers in all senior high and vocational schools have taken training programs and it should meet the requirement of teaching basic computer courses; about only 1.15% teachers in compulsory education (1th to 9th grades) have taken programs, it was still not enough for teaching requirement. In addition, there were 14,640 teachers having taken information application training programs. Currently the quality of computer teachers is to be upgraded, and yet not many teachers have basic computer knowledge in all levels of schools, the current training programs for Seed- Teachers still cannot meet the requirement of information education in compulsory education in the future. Hence, in order to cultivate more sufficient computer teachers, not only the "Information Professional Training Programs" will be continuously held for those teachers taking information professionals related courses, but also MOE provides "Plan on Improving Information Teaching for All Levels of Schools" and the "Plan on Development and Promotion of CAI" to give teachers more opportunities to take computer applications courses. Till 1997 these plans can make 25% of teachers in all primary schools and 30% of teachers in all junior high schools trained by basic computer applications. In the meantime, the curricula of teaching information science will be enhanced for all normal universities and colleges to improve the quality of computer teachers in compulsory education. Moreover, we hope in accord with the above plans all teachers in various disciplines can eventually obtain basic computer background in the future.

In order to enhance training information professionals, MOE will help each university and college setup more equipments for computer teaching and practice, improve practice curricula, encourage schools to join the collaborative works with private enterprises, so that teaching and marketing needs can meet together. Besides, information applications should be focused in all curricula of various departments, so students can easily apply any computer information into their daily lives. Furthermore, the hardwares and softwares for the compulsory education should be increased, each school should have at least one computer classroom. Since 1997 all students in 8th and 9th grade should take computer courses as core courses, meanwhile, all students in primary schools should be encouraged to take at least five computer related courses before they enter junior high schools. We even open training programs to ordinary people so that the computer knowledge and technologies can prevail to all civilian.

2.Consolidate the design of curricula and make information teaching systematic and contiguous.

At present, all computer curricula lack of consolidation and so the curricular outlines and materials are having some repetitions and some are not connecting to each other; therefore, the entire teaching cannot go through from the most simplicity to the most complexity step by step with association. For this reason, the MOE will setup relevant plans to consolidate computer courses outlines from primary schools to senior high schools as well as reference guides of computer curricula for normal universities and colleges to make contents of all information teaching systematic and contiguous.

3.Apply multimedia in CAI and improve teaching environment.

In order to improve the traditional teaching model and system, the curricular materials, teaching methods and teaching media can be more interesting by using multimedia to assist teaching with voice, image, animation and text functions and to break the limitation of traditional materials by using different ways such as simulation, practice and tests while as to change teaching model and contents. By doing so, students can learn according to their own schedules, capabilities and interests, and the teaching model will not be repeating the course contents and turn to stimulate and assist students to learn. Therefore, since 1990 MOE started to plan on the development and promotion of CAI, there are so far thousands of curricular softwares developed for all subjects in all levels of schools, and MOE also brings out an assessment system for design of CAI curricular softwares to assure the best quality of all CAI curricular softwares in campuses. In the future, in accord with various subjects, the collaborative projects from all commercial industries, government, academics and research areas will develop various CAI softwares for every different subject and build a serial of whole set of instruction softwares, such as math, physics for primary schools, math, Chinese for junior high schools, Chinese course for deaf special education, and some CD softwares for beauty, hairdressing, baking and planting skills.

4.2.2 Construction of Networks and Promotion of Applications [6]

1.Establish district education network centers.

Moreover, we conduct project "E-mail to Secondary Schools" [5] to prevail the Internet access for K12 students, and to help all teachers and students to have capability of adapting themselves to the information society in the future.

4 The Promotion of Project "E-mail to Secondary Schools"

The project "E-mail to Secondary Schools" is one of many vital projects of NII in our country. Its main purpose is to help all teachers and students cultivate the information literacy and habits of applying information by using network in their daily life; meanwhile, it will urge all schools to build up their own campus networks to accommodate to the information society in future.

After constructing campus networks for all universities and research institutes, MOE is planning to construct campus networks for all junior colleges to connect to TANet, and meanwhile to make all K12 students can use the resources on TANet, and with some campus networks of normal universities acting as the regional education information centers to build a national education information network system.

Having built the above computing environment, we can help students, teachers and all civilian through E-mail and distance education on networks to access various permanent study databases, library information, test samples database and CAI softwares, additionally, to discuss with each other and accept instructions to make interactive learning, and establish a permanent study environment fitting various peoples' need. Furthermore, in order to make mutual communication easier between Taiwan and mainland China we are studying approaches to integrate Chinese text files to consolidate the different Chinese characters patterns [4].

4.1 The Goal of "E-mail to Secondary Schools" [5]

4.1.1 Initial Goal (Before 1998)

1.To complete construction of campus networks for all junior colleges and connection to TANet.

2.To establish district education network center by city or county.

3.To provide dial-up services to access the resources on district education network center locally.

4.To make 30% of students in secondary schools to use e-mail and network resources.

4.1.2 Mid-term Goal (1998 to 2000)

1.To establish information services system for secondary and primary schools to change the traditional teaching model.

2.To be accordant with the constructing schedule of telecommunication networks to apply multimedia information exchanges.

3.To make 60% of students in secondary, primary schools to use e-mail and network resources.

4.1.3 Long-term Goal (After 2000)

1.To establish service center prevailingly, there will be one education network center for each circuit area.

2.To make 80% of students in secondary, primary schools to use e-mail and network resources.

3.To promote applications of network information and build an information society.

For reaching the above goals, the MOE has setup strategic action plans to fulfill goals in ten years.

4.2 Short-term Action Plan

4.2.1 Enhancement of information education and computer courses [4]

1.Enhance the cultivation of computer teachers and information education professionals.

1)The status of information education in all levels of schools

The MOE has planned and promoted since 1984 the goal of information education for all levels of schools, courses, teaching environment, hardwares and softwares and training programs. Till 1994, there were 583 computer related departments, 258,885 graduated students; in each vocational school there are three computer courses in average; in senior high schools students take two hours "Basic Computer Concepts" course in the second or third year depending on the policy of each school; in the ninth year of compulsory education, students take "Introduction of Micro Computer" and "Information Industry" courses as elective courses; in primary schools students can take computer courses as outside class activities. It shows that most secondary schools and above levels are applying computers to assist teaching or practicing, that forms a good foundation for constructing our national information infrastructure.

educational administrators a comprehensive network to access resources they need and to exchange all kinds information with each other. Now MOE plans to expand TANet to be an education & research network having functions on teaching, research, and services for all teachers, students and educational administrators.

According to the statistics, the average utilization rate of leased line on TANet has been over 50% and even up to 80% sometimes, and the transmission volume is reaching top ten in the world and the second in Asia, meaning that the era for TANet mutually communicating with Internet has come [7].

3 The Impacts of Computerization Trtoraditional Campus

The information technologies not only stimulate the information education for civilian but also affect the current education system. While the reformation of education system is encountering various dead-ends, information technologies may break the limitation of traditional teaching environment which always regards the teacher as the main role in teaching-learning group, by multimedia computer assist instruction (CAI), computer network and by distance learning with self-learning databases, through which students can learn by themselves according to their own interests and abilities and teachers can be counselors or assistants to help them study, thus the idea of permanent study and different education for different people can be fulfilled. In addition, the educational administrators can fully understand the learning situation of students and offer their helps to students accordingly from the educational administration databases, quit-school students records and counselors network of all levels of schools.

As mentioned above, we realize that the current campus might have encountered the following impacts during the process of computerization [7]:

1. The interrelationship between teachers and students might be changed.

The speedy circulation, handy accessibility and diversity of information have changed the ways of applying information in education and research, and hence have affected the interrelationship between teachers and students.

2.The current education, research and administrative procedures need to be reexamined and reengineered.

Under the positive pressure of computerization, for example, the opening of information will bring about a striking effect on pointing out defects, so the current education, research and administrative procedures need to be reexamined and amended.

3.Multimedia applications will bring revolutionary influences on education and research activities.

The computerized applications, especially multimedia applications, will bring revolutionary influences on education and research activities, especially on creativity and cognitive learning environments.

4.Decision making procedure for campus democracy and campus problems will be established.

By the new information and communication media (computers and networks), teachers and students communicate with each other very easily, it will be an important issue to establish and practise a reasonable decision making procedure for campus democracy and problem-solving.

Some schools have foreseen the trends of computerization, prepared well-conceived plans, and well adjusted their organizations and paces for the above impacts. So they can shift these impacts into positive pressure for school growth. On the contrary, some schools lack of the necessary sensitiveness, they just computerized their campus for the purpose of computerization, regarding buying hardware and software as the final goal. By doing so, cost increased, but lacking of positive effects. We will introduce the way by which schools can prepare themselves for the coming of the computerizing era in the following paragraph.

According to the impacts mentioned above, our strategy is to establish promoting organizations and enlarge the functions of computer center on campus. A Computer Committee can be established on campus to setup strategies of computerization for campus.

Under the Committee some task groups can be formed to promote computerization for campus administration or to construct campus network. A computer center can be the executive unit for the above committee or task groups. Its function should be defined as being able to plan, construct and manage the campus network, to promote computerization for campus administration, to support teachers and students in research, teaching and practice, to develop information related systems and provide application services, information education training for people in/out of campus, and necessary technical service to library.

2 Taiwan Academic Network(TANet)

In 1987, Ministry of Education Computer Center(MOECC) first introduced BITNET to Taiwan and then promoted connections among universities. TANet was built by MOECC and some national universities in July of 1990 to establish a common national academic network infrastructure and to support research and academic institutes in Taiwan. Because of its open strategy using TCP/IP as the networking protocol, the number of networking users among campuses are swollen rapidly. The topology of TANet is basically a ring/mesh by using intelligent routers to interconnect high speed leased circuits/LANs where high speed T1 (1.544 Mbps) link installed among regional network centers. At present, there are 11 regional network service ters which are run by 11 national universities (Figure 2). A 512 Kbps international link bandwidth between the MOECC and JvNCnet (Princeton University in U.S.) replaced the original 64 Kbps link in November of 1991, which couples TANet with JvNCnet, NFSnet, and international Internet connection [1]. Although TANet backbone is basically using TCP/IP protocol, all regional networks may support multi-protocols and additional facilities including X.25 transport or dial-up services, on a local basis, in accordance with regional requirements [3].

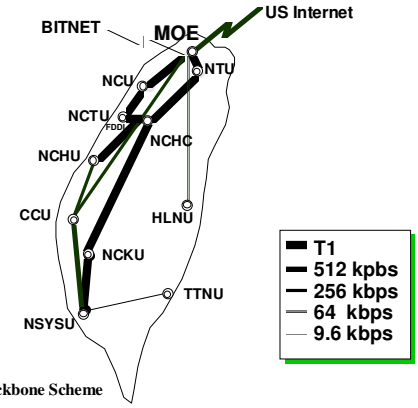

Figure 2 :TANet Backbone Scheme

Currently, TANet applications focus on Internet-based applications and their localization. Many Chinese information applications are introduced and developed on TANet, such as BBS, NetNews, WAIS, IRC, FTP, E-mail, Archie, WWW and Gopher, etc. (Figure 3) On campus networks there are public hot-lines, public domains, newsgroups, on-line discussions, on-line library catalogs, electronic databases, electronic magazines, etc.[7] for students and teachers to share their researches and experiences; in the meantime TANet has become a public media helping to improve problem- solving in education. Especially the BBS on campus networks are built by each school itself, they are very popular and welcomed by students; on BBS students can on-line talk, make friends, share experiences, discuss schools' policies, look for help, etc. Take the BBS in National Sun Yat-Sen University for example, in average there are about 300,000 users on line every month and several thousands users every day, and at any time there are hundreds users on line on that BBS.

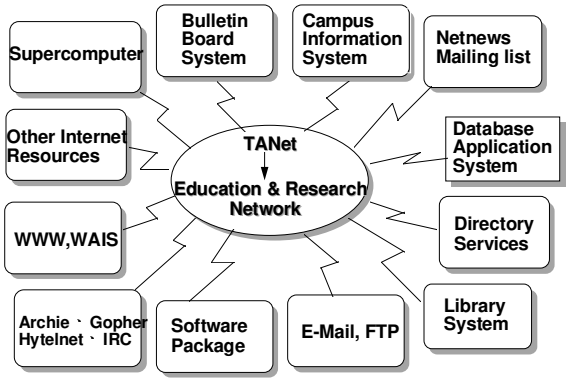

Figure 3 :Network Resources Sharing

Now TANet is the largest computer network in R.O.C. and its infrastructure is outstanding in Asia. TANet connects more than 190 sites, including all universities and some colleges, research organizations, and few senior high schools and vocational schools (Figure 4). As to junior high schools and primary schools, now the Provincial Education Department, Hsinchu City, Taichung County, Tainan City, and Kaohsiung City are establishing District Education Computer Network, and installing the systems such as BBS, Gopher, provincial assistant information network on it. Besides, Kaohsiung County government also plans to establish educational administration network which connects many primary schools to TANet, aiming to promote information education.

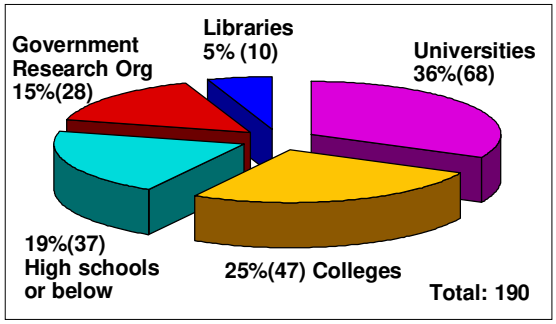

Figure 4 :TANet Linked Organizations Distribution

It estimates that there are at least 100,000 nodes on the TANet, and more than 100,000 users per day. All these efforts are to provide all teachers, students,

Construct Computerized Campus to Lay the NII Foundation

Tseng, Shian-Shyong < sstseng@cis.nctu.edu.tw >
Lu, Ai-Chin < lu@moers2.edu.tw >
Yin, Ching-Hai < yin@moers2.edu.tw >
Chen, Yu-Shuan < candy@moers2.edu.tw >

Abstract

To thoroughly develop NII in Taiwan, R.O.C., we regard the network infrastructure and computer application for teaching, research and development as our first priority including information technology in schools, to elevate the quality of teaching and research, to enhance the computer literacy of all civilian and to pave the fundamental way for the spread of information education.

This article addresses the impacts of computerization on current campus, proposes some reasonable solutions: based on the existing network TANet to expand a network for education and research and promote project "Email to Secondary Schools" to prevail Internet access for K12 students and teachers and hence to make all teachers and students cultivate the information literacy and information applications by using network in their daily life; meanwhile, to urge all schools to buildup their own campus networks for adaptation to the information society in future.

1 Introduction

After the U.S. President Clinton announced to develop an ideal information society based on "National Information Infrastructure" (NII), using information technologies to upgrade national capabilities in competition has become a common goal for all advanced countries [4]. Today all countries are striving to develop national information infrastructure, so do we in Taiwan R.O.C. with the cooperation of all areas to enthusiastically develop our national information infrastructure in order to strengthen our country, to expedite the development of the R.O.C. Regional Operation Center in Asia Pacific, to enhance the efficiency of administrative services and better living quality and to lead us to become one of the most advanced information countries over the world in the 21th century [4].

In June of 1994 Executive Yuan established an organization in charge of NII, its duty is to set up "National Computer & Communication Infrastructure Plan" and to establish task forces to build a national information super highway and to integrate the effort of government and investment from private enterprises for developing all applications related to computer and high-speed network, meanwhile to train professionals for research and development, design and applications [5].

Along with daily changes of information technology, every business applies more information technologies today and interacts with each other more frequently and broadly, so the structure of whole society has been changing greatly [4]. We found that most countries set goal to upgrade the development of economy and society through the usage of NII and regard the network infrastructure and computer applications for teaching and research & development as their first priority during their development of computer infrastructure. To develop NII in our country, we first need promote information education, upgrade the quality of teaching & research in all schools, and pave the fundamental way for the spread of information education. Hence, how to upgrade the information literacy and quality of civilian by education becomes a significant and urgent issue at this moment. Ministry of Education (MOE) will refer to the experience of the Internet-based NII developed by other countries to establish a network for education and research based on three existing networks TANet, Seednet, and HiNet, and to enhance the computer knowledge of all civilian and form a firm foundation for NII (Figure 1) [2].

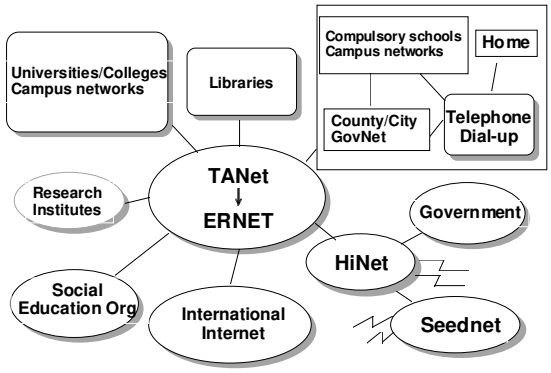

Figure 1 : Education & Research Network Scheme (ERNET)