Bringing the Internet on Campus:
Lessons Learned from China and Taiwan (Chinese Taipei)

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Abstract: As one of the popular and promising instructional technologies, Internet is playing a more and more important role in educational field all over the world. Bringing Internet into classrooms is encouraged in many countries; however, their policy initiatives to achieve this vary.

The present paper is an empirical and exploratory study, trying to explore the policy initiatives taken by Mainland of China and Taiwan to enable school classrooms to have access to Internet. The educational system and policy initiatives for bringing Internet into classroom are firstly addressed. Then, educational philosophies for these policy initiatives are discussed and are compared with that of in the United States (the E-Rate program). Challenges and recommendations for improving the policy initiatives are finally presented.

1. Introduction

High technology has been playing a more and more important role in the education. Internet, among others, is crucial to students' daily learning activity. Internet has become an important part of the America's

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education practice. However, in many developing countries, schools are still struggling to purchase basic computer equipments, not to mention Internet access. Obviously, the American government has more money than most other countries, which gives it a great advantage in bringing Internet to education. However, public policy is also playing a crucial role. An effective policy will help to efficiently distribute limited resources to achieve the best available result, which is even more important to developing countries.

The present paper is an empirical and exploratory study, trying to provide a case of how China and Taiwan (Chinese Taipei)'s governments help to bring Internet into campus. Differences in policy initiatives of China and Taiwan (Chinese Taipei) and the United States of America are also compared and analyzed in historical, cultural and philosophical context.

The educational system and policy initiatives for bringing Internet into classroom in China and Taiwan (Chinese Taipei) are addressed in the first part., followed by the discussion of educational philosophies for these policy initiatives and the comparison with that of in the United States. Problems of the current polices are identified. Policy recommendations are discussed as well.

2. Methodology

Case study research methodology is used in the present paper. According to Yin (1984), case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident.

According to Eisenhardt (1989), case study has several advantages, which are all applicable for our research. First, it is flexible. Researchers are free to discover and address issues as they arise in their analysis. The flexibility also allows researchers to begin with relatively broad research questions and narrows down their focus during the process. This feature is especially suitable to policy research given the complexity of the social problem and unpredictability of the policy outcome. In our study, a lot of policy issues are involved. Second, case study emphasizes context. Qualitative research tradition generally believes that there is no universal law in the social study and context is the key to understand any social phenomena. Case study is well situated in this tradition by focusing on "deep data" or "thick description." In our study, we focus much on the social, cultural and historical contexts of the policy initiatives for bringing Internet into campus in China and Taiwan (Chinese Taiwan).

The reasons that we choose China and Taiwan (Chinese Taipei) in our case study are due to the similarities and difference between them. Both

being originated in Confucianism, China and Taiwan (Chinese Taipei) share a lot in common in history, culture and social values. However, for political reasons, currently, China and Taiwan (Chinese Taipei) are politically separated and have different economic development level. China is still a developing country while Taiwan (Chinese Taipei) has already been economically developed. Thus, the similarity and difference provoke our interests to study the policy initiatives in bringing Internet into campus in the two country and region.

3. Overview

Traditionally, America's universal service policy, including the E-Rate, focuses on access instead of service. The Telecommunications Act of 1996 mandated discounts for high-speed connectivity for schools, libraries, and rural health care centers as part of its Universal Service provision. E-Rate program was developed to implement the statute.

Despite E-Rate's several new features[1] compared to other universal service programs, it still focuses on access. Several researches[2] have shown that the E-Rate has been a great success in helping schools to get wired up. However, since the E-Rate does not include teacher training and software purchase, its effectiveness is questionable. E-Rate's focusing on access and lack of teacher education can be traced back to the famous educational philosophy in American schools—the Montessorism, which places more emphasis on hands-on experience from teaching materials than teachers themselves, who are only regarded as supporters and custodians in classroom teaching.

There is a saying in Confucianism that if people want to achieve better outcome from their work or study, they must first make their tools better. It is widely accepted that the Internet can play a very important role in helping to improve the quality of teaching. Realizing the importance of Internet in education, both the government of China and Taiwan (Chinese Taipei) have launched policy initiatives to bring the Internet into public education system. Compared to western culture, Asian cultures have a different view of education. Although Confucianism also regards tools as an important issue, it places more emphasis on the people who use the tools. Based on this philosophy, the American style of E-Rate program does not fit into China and Taiwan (Chinese Taipei)'s historical and cultural context since the E-Rate program does not support teacher education. In this paper, we will conduct an exploratory study of Mainland ChinaChina and Taiwan (Chinese Taipei)'s approaches in bringing the Internet into campus. We will go over the current status, analyze problems and challenges, and provide our recommendations.

4. Public Education System of China and Taiwan (Chinese Taipei)

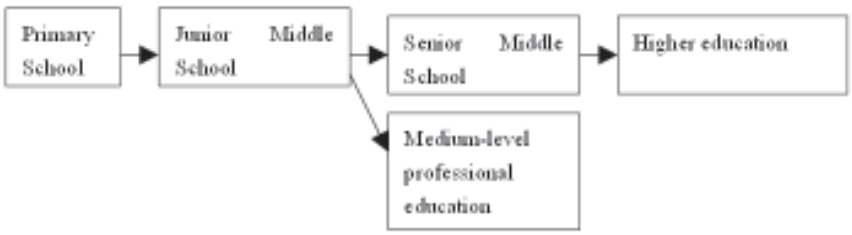
4.1. Structure of the Public Education System

Public education system of China and Taiwan (Chinese Taipei) is composed of 3 parts: basic education, higher education and vocational education. Basic education includes primary school, junior middle school and senior middle school.[3] Primary and junior middle school education is compulsory. Children at the age of 6 or 7 enter the 6 years of primary school. Primary school graduates will, without examinations, enter the junior middle school. After 3 years of junior school education, students may choose to continue on to senior middle school by passing the examination authorized by the local education authority or to enroll in the vocational school. Vocational school system includes polytechnic schools, occupational middle schools and various kinds of short-term occupational and technical training programs. Vocational school programs aim to train technicians, factory workers, entry level salesman, etc. for the mass job market. For those who choose to enter senior middle schools, they will take the National College Entrance Examination in order to be admitted by higher education institutes after 3 years of study. Higher education system comprises junior college,[4] bachelor, master and doctoral degree programs. Junior college usually takes 2-3 years. Junior college graduates are conferred vice-bachelor's degree. Bachelor's program generally takes 4 years to finish with the exception of some medical related programs which take up to 6 years. Master's program takes 2 to 3 years and doctoral program takes another 3 to 4 years. See Figure 1 for an overview of the public education system in China and Taiwan (Chinese Taipei).

4.2 Management and Administration System

The government is the major investor and administrator of the public

Figure1
Overview of Public Education System in China and Taiwan(Chinese Taipei)



Source: Compiled by Authors

education system. Local government is responsible for compulsory education. Senior middle schools are funded by the provincial government. Higher education is jointly funded by the national and provincial governments. In China, other institutions including for-profit companies and non-for-profit organizations are also encouraged to invest in the public education. In Taiwan (Chinese Taipei), there are even more private colleges and universities than the public funded ones (See Table 1). The Ministry of Education is the highest education administrative agency in the China. The MOE[5] is responsible for making related laws, regulations, guidelines and policies; drafting education development plan; coordinating nationwide initiatives and programs; directing and monitoring national education system reform. Since 1978, the Chinese government has published several statues concerning education such as Law of Compulsory Education of the People's Republic of China, Code of Teachers of the People's Republic of China, Protection of Children Act of the People's Republic of China, Education Law of the People's Republic of China, Teacher's Eligibility Act and Higher Education Act of the People's Republic of China. The MOE has issued more than 200 administrative orders concerning the public education. Each province has an Education Commission accordingly. Similar to China, public schools in Taiwan (Chinese Taipei) are also sponsored by the government. The Ministry of Education of Taiwan (Chinese Taipei) is the major government administrative agency in charge of the public education system.

Direct government funding is the major source for the public education system. Taking China as an example, currently, higher education institutions are jointly funded by the national and provincial government. Senior middle school and vocational school are jointly funded by provincial and local government. Compulsory education schools, including junior middle and elementary schools are solely funded by local governments. It is by law that the funding for the public education shall remain

Table1
Number of Schools in Taiwan(Chinese Taipei) at Selected Levels, 2003

	Senior high school		Junior high school		Elementary high school		Colleges and Universities	
	Public	Private	Public	Private	Public	Private	Public	Private
Num. of Schools	166	136	704	12	2597	30	50	89

Source: The Ministry of Education of Taiwan(Chinese Taipei)

at a fixed rate of 4 percent of national general budget. In the year of 2000, the total amount of funding for the public education had reached 380 billion Yuan.[6] See table 2 for the distribution of the funding.

5. Policy Initiatives

In middle 1990s, both governments of China and Taiwan (Chinese Taipei) began to draft policy initiatives to bring Internet into public education system. Given the different economic development level, China took an evolving hierarchical approach, giving higher education institutions first priority and then extending to K-12 schools later, while Taiwan (Chinese Taipei) focused on K-12 schools, since their higher education institutions were already well wired at that time.

5.1. China

5.1.1. China Education and Research Network (CERNET)

China's Education and Research Network (CERNET) project, modeled after the mid-1980s U.S. National Science Foundation's Internet backbone project, was launched by the Ministry of Education in 1993 (Tan, Foster & Goodman, 1999). The Ministry created a special task force, the CERNET Administration Committee, to direct the CERNET project. The CERNET Administration Committee comprised experts from the Ministry of Education and 10 major research universities. The CERNET Expert Committee, with members from 10 major research universities, was responsible for

Table 2
Management and Administration System of China's Public Education System

	Number of Institutes	Funding* (10,000 Yuan)	Source of Funding
Higher Education	1225	9133504	Central and Provincial Government
Senior Middle School	14901	2101586	Provincial and Local Government
Vocational School	11062	2536698	
Junior Middle School	65525	6135722	Local Government
Primary School	491273	10821233	

*Funding is based on 2000 data, 1$=8.3Yuan
Source: China Statistical Yearbook 2002, table 20-1 Basic Statistics on Education, table 20-36 Educational Funds in Various School (2000), compiled by the authors.

technical decisions. In early 1994, before any commercial startup, the MOE began to build CERNET backbone. The CERNET Pilot Project was finished in 1995 with 30,000 registered users, 108 connected universities and colleges, and 3 international transmission channels connecting USA, Germany and Canada respectively (CERNET, 2001).

In 1998, facing steady increase of user base and huge demand for bigger network capacity, the Chinese government approved the plan of upgrading the original 64Kbps backbone transmission channels to 4Mbps. National and regional CERNET computing centers were also upgraded accordingly. In order to reach those institutions in rural and hard-to-access areas, the Chinese government allowed CERNET to use the satellite communication system.[7] As a result of those efforts, higher education institutions in those less developed western regions such as Lanzhou, Yinchuan, Xining, Urumchi, Kunming, Guiyang and Chongqing were connected to CERNERT backbone.

Since 2000, with additional funding from the national government, the MOE launched the second run of upgrading CERNET backbone. Using optical fiber technology, the national backbone transmission capacity reached 2.5G by the end of year 2001. Ongoing projects include regional backbone upgrading, campus network upgrading, high-speed high-capacity database developing and integrating. Today, with more than 900 universities and research institutes connected, CERNET has one national supercomputing center, ten regional computing centers, and 30 provincial computing centers, composing a nationwide star-shaped network (Refer to Figure 2). Registered users have exceeded 8 million and registered computers have exceeded 1 million.

CERNET is a non-for-profit educational network. CERNET's national backbone infrastructure is funded directly by the Chinese government. Regional networks are funded jointly by local governments and universities. The universities are also responsible for building their own campus networks, as well as necessary facilities connecting campus networks to the nearest regional computing center. To recover part of the maintenance cost, most universities charge a small fee to students for using CERNET. Generally, CERNET is free for faculty and staff. CERNET also offers database service, search engine service for the general public for a fee. In many universities, there is also an additional charge for the international data traffic.

5.1.2. "Every Campus Wired" Project

In November 2000, the MOE issued "Special Order on the Every Campus Wired project." In the Order, the MOE outlined three major goals of the ECW[8] project. First, the ECW project would support more

Figure 2
China Education and Research Network Structure

Source: CERNET Retrieved at: http://www.edu.cn/20010101/ 21585.shtml

than 90 percent of public K-12 schools to build campus networks with Internet access; second, the ECW project would develop a platform for the delivery of continuing education to all K-12 teachers; third, the ECW project would develop various levels of database in order for the teachers and students to share education resources. The timetable was also outlined in this order:

- ◆ Before 2005, all K-12 schools in East China shall have access to the Internet;
- ◆ Before 2005, most of K-12 schools in the urban areas of West China shall have access to the Internet;
- ◆ Before 2005, for those schools located in the rural areas, satellite receivers shall be installed in order to receive education programs from the China Educational Satellite Network, other necessary facilities such as DVD players, over-head projectors and computers shall be equipped;
- ◆ Before 2010, more than 90 percent of all nationwide K-12 schools shall have access to the Internet. For those located in hard-to-reach areas, multimedia computers shall be equipped in order to provide basic computer literacy education.
- ◆ Develop online education database in order to share education resources. K-12 schools shall have access to those databases through the Internet, education television program or CD media.

◆ Training programs shall be provided to K-12 schools teachers and staff in order for them to learn basic techniques of operating and maintaining the ECW equipments.

The MOE created a special committee called "National K-12 Schools ECW Project Advisory Committee" to direct the progress of the ECW project. Each province shall have corresponding "Provincial K-12 Schools ECW Project Advisory Committee" set up to coordinate with the national government. Funding comprises four parts: the national government's appropriation, the provincial government's appropriation, school's self funds and fees charged to students. The MOE also encourages other entities to contribute to this project by donations, discounted equipments and through other appropriate ways. However, the MOE prohibits any kind of commercialization and strictly limits this project to non-for-profit educational purpose. The special funding is also appropriated by the national government to support those schools in poor and hard-to-reach communities.

In November 2001, the MOE issued "Guidelines for the ECW Projects," in which the MOE set seven guidelines for the ECW projects:

◆ Maturity: the ECW projects shall use mature and widely accepted technology in order to guarantee compatibility;

◆ Practicability: the ECW projects should make full use of currently available hardware and software resources. Considering most of the ECW's end users are K-12 school teachers and students, it shall use Chinese user-friendly interface wherever available;

◆ Openness: the ECW projects shall be built on open structure for future expansions;

◆ Flexibility: the network design shall take a module structure approach which allows smooth upgrading and restructuring if necessary;

◆ Reliability: the ECW hardware and software shall be reliable since most end users do not have much technical knowledge;

◆ Security: the ECW shall have the ability to protect essential database from hackers and computer virus;

◆ Economy: the ECW equipment shall be cost-efficient.

By the end of 2002, nationwide K-12 schools have been equipped with 5.84 million computers. The ratio of students per computer had decreased from 121 as of 1999 to 35. The number of campus networks with Internet access had exceeded 26000 nationwide. In the year of 2003, the national government appropriates 360 million Yuan to support schools located in less-developed western provinces. Most K-12 schools have begun to

offer basic computer literacy courses on regular basis. New course materials also have been developed using computer and network technology (MOE, 2003).

Similar to CERNET, the ECW is also a not-for-profit educational project. There are usually three finance models. For cities in rich urban areas such as Shanghai, Beijing, and Guangzhou, local municipal governments generally fully finance the ECW project, building city-wide backbone, purchasing computer facilities and providing free Internet access to K-12 schools. Rural townships and small cities in developed areas usually only construct regional backbone facilities and leave the burden of constructing the campus network to K-12 schools. In less developed western China, due to limited funding, most local governments choose to support K-12 schools by purchasing basic computer equipments and coordinating with telecommunication carriers to provide narrow-band Internet access to those schools at a relatively low price or free of charge. In those remote and hard-to-reach areas, small satellite receivers are installed to receive education television programs. In the extreme case where it is impractical or impossible to install any facilities,[9] television sets with VCR or DVD are equipped and multimedia course materials are delivered by postal service.

5.1.3. Characteristics

Gradual and hierarchical approach: The disparity between eastern and western provinces in China's in social and economic development is increasing according to a recent survey by the National Information Office (China Daily, 2003). In terms of Internet subscriber-ship, statistics showed that the number of Internet users in Guangdong, Beijing and Shanghai accounted for 10.4 percent, 9.8 percent and 9.2 percent respectively of the country's total, whereas that of Tibet, Qinghai and Ningxia in the western China was only 0.1 percent, 0.2 percent and 0.3 percent in the year of 2002 (China Daily, 2003). In some rural areas in the western provinces, even the basic telecommunication infrastructure is not available, not to mention the Internet. Facing the challenge of the east-west and urban-rural disparity, the Chinese government takes a gradual and hierarchical approach in wiring the national public education system. The priority is firstly given to higher education and research institutions. After most higher education and research institutions are wired, the Chinese government takes the second step to help K-12 schools to build network facilities. The Chinese government encourages those higher education and research institutions to donate their out-of-date computer equipments to K-12 schools when they upgrade their own networks. This strategy is proved to be very efficient and economically.

Furthermore, those higher education and research universities also help local K-12 schools to design and build their campus networks and provide technical support at a very low price. Some of K-12 schools are connected to CERNET directly instead of leasing commercial lines from the telecommunications carriers. The Chinese government also sets different goals for different regions. In those developed eastern provinces, focus is put on constructing campus networks and high speed backbones. While in those less developed western provinces, the education authorities emphasize on equipping basic computer facilities and narrowband internet connections. The Chinese government also encourages K-12 schools in eastern provinces' to donate or sell their used computer equipments to the western K-12 schools. In terms of funding, most of the central government's appropriation is allocated to western provinces. In eastern provinces, local education authorities are the major source of funding for the ECW project. This gradual and hierarchical approach is proved to be cost-efficient and doable. The Chinese government also expects this project will be helpful for narrowing regional digital divide.

An Incentive-Based Approach: Another important characteristic of the ECW project of China is that it is designed to be incentive-based. Funding is not equally distributed to each university and K-12 school. Although there are various models adopted by the local education authorities, generally the public schools that are interested in getting national or provincial financial support must first file applications along with their designs, budgets and future expansion plans. In most cases, local education authorities will hold open bids periodically to purchase necessary equipments and distribute them to the schools whose plans have been approved. For those schools whose proposed budgets are lower than that of education authorities' pre-set limits, portion of the difference will be awarded to them. This approach creates no incentives for the schools to overbuild. Education authorities set ceiling budget limit and minimal technical requirement. Schools can not take advantage of overbuilding because no governmental funding will be available above the ceiling. Rather, schools have strong incentives to adopt the most cost-efficient design to meet the minimal technical requirement. Thus, limited funding will be used efficiently.

5.2. Taiwan (Chinese Taipei)

5.2.1. Overview of the Information Education Development Project

In order to help K-12 schools access Internet, the Ministry of Education of Taiwan (Chinese Taipei) conducted "The Information Education Development Project," which is in the charge of the Computer and Calculating Promotion Center of the Ministry of Education of Taiwan

(Chinese Taipei). This project was divided into two stages, which started in July 1997 and will end in June 2007. Specifically, the first stage began in July 1997 and ended in June 2001, while the second stage started in July 2001 and will end in July 2007. The short-term goals were: (1) to integrate all current plans about information education, (2) to expand the education resource of all schools, and (3) to develop and promote the computer-aid teaching software. The long-term goal is to enhance current information education system, to build up the full-functioned information teaching environment, and to develop new information education methods (Ministry of Education of Taiwan (Chinese Taipei), 1996).

5.2.2. Goals and Policy Initiatives

The Ministry of Education of Taiwan (Chinese Taipei) outlined seven goals. As illustrated in table 3, those policy goals could be categorized into four types: educational and pedagogical resources, training, computer facility and access.

Table 3
Policy Goals

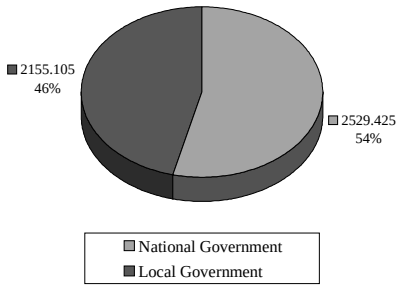
Goals		Policy Initiatives
Educational and Pedagogical Resources	Develop and Integrate Educational Resources	Establish the National Center for Educational Software Development and Integration
	Pedagogy Research	Fund research in using high technology in K-12 teaching
	Curriculum Restructure	Computer related courses shall be required in all K-12 schools after 1998
	School Administration Restructure	Adjust the reward and promotion mechanism in order to encourage teachers to learn and use high technology in classroom
Teacher Training		Offer training programs, including basic computer operating, computer-aided teaching design, and basic networ operating skills, for all K-12 teachers,
Computer Facility		Subsidize K-12 schools to purchase and upgrade necessary computer hardware and software.
Access		Provide access to TANet for all K-12 schools

Source: Compiled by authors.

According to the policy outlined by the Ministry of Education of Taiwan (Chinese Taipei), the program has several characteristics. First, it particularly emphasizes the development and integration of educational and pedagogical resources. The National Center for Educational Software Development and Integration is established in order to direct this program. Special funding is specifically appropriated to support research in using high technology in daily classroom teaching. In the short term, computers and other high technology are used as tools to enhance traditional teaching methods. In the long term, computer-related courses will be added to the required curriculum for all K-12 schools. Furthermore, current reward and promotion mechanisms will be adjusted in order to encourage K-12 teachers to learn and implement high technology more effectively. Second, it also focuses on teacher training. In the short term, teachers are trained to use computers and networks proficiently. In the long term, it is expected that K-12 teachers will be able to design their own pedagogical applications by using computer technology. Third, in terms of computer facility, in the short term, every K-12 school shall be equipped with one computer lab with Internet accessibility. In the long term, computers will be installed in every classroom. Forth, in regard to access, the government will subsidize K-12 schools to connect to the TANet.[10] It is planned that, before 2007, all of K-12 schools shall have some forms of access to the TANet and more than 40% of K-12 schools shall have access to the TANet in every classroom.

Figure 3

National and Local Government Funding from 1997 to 2001(in thousand NT Dollars)



Source: Ministry of Education of Taiwan(Chinese Taipei), available at http://www.edu.tw/moecc/information/itstatus/articles/-N\x[YeslU\g.ppt, compiled by the authors.

5.3. Funding Source

Most of the budget is financed by national and local governments. As we can see in Figure 3, national and local government agencies contribute almost equally. Moreover, the Education Administration of Taiwan (Chinese Taipei) Province, the Education Administration of Taipei, and the Education Administration of Kuoshoung are required to contribute additional funding to this project. Furthermore, many of the research

Table 4
Total Budget from 1998 to 2001 (in million NT Dollars)

Items		1998	1999	2000	2001	Total
Teacher Education	Education Software Development	9	9	9	9	36
	Education Software Maintenance and Upgrade	2	2	2	2	8
	Pedagogy Research	18	18	18	18	72
	Center for Education Software	33	18	18	18	87
	Miscellaneous	8.28	8.28	8.28	8.28	33.12
	In-service Teacher Training	155				155
	Subtotal					391
Computer Hardware and Software	Junior Middle School	162				3079
	Senior Middle School	214				
	Elementary School	2702				
Network Access Fee						1148
Total Budget						4618

Source: Ministry of Education of Taiwan(Chinese Taipei), available at http://www.edu.tw/moecc/information/itstatus/articles/-N\x[YeslU\g.ppt

projects are coordinated and funded by the National Science Organization. Chuanhua Telecom, the biggest state-owned telecommunication carrier, is required to provide discounted broadband service to K-12 schools, especially those in rural and poor areas.

5.4. The Operating Outcome of the First Stage

There are five major achievements after the first stage. First, it was reported that 142 middle schools and 1009 elementary schools had built up their computer networks. Second, ChuanHua Telecom provided the discounted price of ADSL service to K-12 schools. The network connection fee is 2050 NT dollars per month in urban areas. In order to narrow the disparity between rural and urban areas, ChuanHua Telecom provided free service to 1032 rural K-12 schools for one year. Third, this project subsidized nineteen special education schools to enhance and replace the computer network facilities. Fourth, it subsidized twenty-four cities to provide training program for in-service teachers. From 1993 to 2000, more than 722,305 K-12 instructors received some forms of training. Fifth, the transmission capacity of education network backbone had increased dramatically (See Table 5).

6. Eastern Education Philosophy in Making Public Policy

It is interesting to find that both China and Taiwan (Chinese Taipei) clearly state in their policies that teacher training is one of the most important goals. Compared to E-Rate, which focuses more on access, this eastern style of policy approach can be explained in two ways.

First, the Chinese people's tolerance to public education system gives policy makers more flexibility. Compared to public education system, private schools, both in China and Taiwan (Chinese Taipei), are better equipped with those high technology facilities. In a typical private middle school in China, almost every classroom is equipped with computers with

Table 5
Education Network Backbone Transmission Capacity

Year	Number of 64k Dedicated Line	Number of T1 Dedicated Line
1998	25	0
1999	31	12
2000	37	22
2001	43	29

Source: Ministry of Education, available at http://www.edu.tw/moecc/information/itstatus/articles/-N/\x[ÇŒ“ŠYe² þsÁl¨,U\ g!.ppt

Internet access. However, the Chinese parents are still reluctant to send their children to those private schools even when the teaching quality there is comparable to those public schools. This phenomenon reveals a very interesting cultural tradition. Historically, the Chinese people regard education as the responsibility of the government. Confucianism believes that the goal of education is to serve the society by working for the emperor, or in a more general sense, the ruling class, rather than self-cultivation. That said, the Chinese people believe that only government-supported public education is official and orthodox.[11] Thus, the Chinese people have strong tolerance to the relatively worse equipped public education system. In terms of Internet access, rather than sending their children to private school, the Chinese parents will buy computers and Internet access for their children at home in case that those public schools do not have enough facilities. This tradition actually gives the Chinese education authority great flexibility in making policies. They are not, to a large extent, limited to those figure-type of goals, such as the number of computers per 100 students etc. Compared to the western culture, it is easier, in the Chinese culture context, for the Chinese education authority to justify their policy approach of appropriating a relatively large portion of money to teacher training program which is very difficult to be quantified.

Second, at the pedagogical philosophy level, the Chinese culture values "arts of teaching." Teachers, in the Chinese culture context, are

Table 6
Comparison of Major Internet Backbone in China as of 2003/6/30

Network	Owner	Bandwidth of Leased International Connections	Bandwidth of Interconnection with CERNET	Number of Subscribers
CHINANET	China Telecom	10959M	1465M	53 million
UNINET	China Unicom	1435M	1000M	
CNCNET	China Netcom	3155M	774M	
CERNET	MOE	324M	n/a	8 million personal users and 900 universities

Source: CNNIC14, MII15, 2003, Compiled by the author

usually regarded by the society as moral models. Teachers are the center of education, not powerful pedagogies, technologies or tools. The old saying "Teacher's job is to introduce students to the subject. It is students' responsibilities to explore the subject matter" reveals that the Chinese people do not value teacher's pedagogical skills. To some extent, the Chinese people depreciate the value of powerful pedagogies. Influenced by this traditional value, teachers are reluctant to accept high technology, such as computer and Internet, in their daily practice. Even at the college level institutions, where teachers are familiar with those new technologies, they still feel more comfortable with the old blackboard-chalk style. At K-12 level, many teachers think that using high technology will only distract students' attentions from the course subject. If the government only made all those computer and Internet available on campus, it would be very possible that those equipments would not be adequately used by the teachers. With this tradition, teacher training is of great importance. Appropriate teacher education does not only provide teachers with knowledge and skills of using high technology, but also play an important role in changing teacher's teaching philosophy.

7. Problems and Challenges

Limited Funding

Although the national and local governments have appropriated special funding to support CERNET and the ECW projects, due to the large population base, government funding is extremely limited. In some western provinces of China provinces, where provincial government can not raise enough funding, schools have great difficulties in building computer networks and purchasing Internet access. For example, in Xinjiang, a geographically large rural western province, the average budget for each K-12 school located in small townships is only 6000Yuan,[12] which is barely enough to buy one computer. Although schools are allowed to charge students a fee to recover some of the costs, education authority sets very stringent policy on how much should be charged. Generally speaking, the money collected from the students' fee even can not cover operating and maintenance cost, not to mention future expansion. Public schools can not take loans from banks either. Some well-known "famous" schools managed to get funding from donations and other external resources. However, for most of the "ordinary" schools, they can only depend on government appropriations. It is ironic that one of the purposes of those projects is to promote sharing of education resources and thus to help narrow down the gap between "good" and "bad" schools, however, in reality, the disparity between those "elite" schools and "ordinary' ones is

getting even wider (Liu, 2002). For example, in the case of CERNET, while those famous universities have wired each dormitory, some small community-type colleges only have several networked computer labs. Although compared to China, Taiwan (Chinese Taipei), as a developed region, has almost wired every campus and constructed a relatively integrated network environment, the Department of Education of Taiwan (Chinese Taipei) still faces great difficulty in raising money for future expansions. Without a steady source of funding, it is very difficult, if possible, to keep those public schools up with rapidly developing technologies.

Lack of Cooperation

Both in China and Taiwan (Chinese Taipei), the Ministry of Education is the only government agency that guides, monitors and invests in those policy initiatives. Due to security and administrative concerns, the MOE is not allowed to construct its own Internet backbone. The MOE has to lease transmission capacity from commercial telecommunication carriers. In the case of China, at the national level, even with the coordination of the State Council, it is still very difficult for the MOE to get enough bandwidth from telecommunication carriers. As we can see from table 6, CERNET only has 324M international transmission capacity. The interconnection backbone between CERNER and other commercial Internet service providers is only slightly above 2000M. However, CERNET serves almost all the universities and 8 million personal users, approximately one forth of those served by the commercial companies. Concerning about the ECW project, K-12 schools must negociate with local telecommunication carriers to get Internet access. Generally, K-12 schools can not afford the price for the dedicated line. Most of them use ADSL or Cable Modem service. Without clear guideline from the government, it is very difficult for K-12 schools to get the discounted price. In most cases, they have to pay business service price. In Taiwan (Chinese Taipei), situation is better than China because the government designated Chuanhua Telecom, a common carrier, to provide discounted service to K-12 schools. However, given the low profit margin of providing services to public schools, telecommunication carriers obviously lack of interests of investing in this field. It is very important to establish a cross-departmental committee to solve this problem. Telecommunication carriers subsidization system, such as America's E-rate program, should be considered for future policy making.

Are Teachers Ready?

Generally speaking, most of the teachers are not well prepared for using high technologies in daily teaching. First, some in-service teachers

do not have enough computer skills to fully take advantage of the new technology in their daily teaching. Survey shows that only 20 percent of all public school teachers older than 40 use Internet regularly. Second, there is no incentive for teachers to learn high technology. The main criterion of evaluating the quality of a school is the grade its students can achieve in national or regional examinations. Thus, teachers face great pressure both from the school administrator and students' family. Given the relatively heavy course load, teachers are reluctant to spend the already-limited time on learning high technology. Furthermore, currently in most public schools, especially in K-12 schools, people who teach computer-related courses are categorized as staff instead of teacher. Their salary is relatively lower and there are no favorable policies in rewarding and promoting them. Third, traditionally, the Chinese pedagogical philosophy focuses on "the art of teaching." Computer technology and Internet are regarded by many as the complementary tools. Teachers using technologies in the classroom are sometimes regarded as superficial. For example, from my observation, the Chinese people would prefer knowledgeable but somewhat boring instructors than those who are enthusiastic about high technologies.

In teacher training programs, there is a popular misunderstanding. Teachers are expected to develop their own computer-based course materials. Often, teachers get so frustrated in learning new software. In the case of Taiwan (Chinese Taipei), teachers are required to learn making power-point slides, designing course websites, etc. It is necessary for teachers to grasp basic computer skills. However, it is problematic if teachers spend most of their time struggling with the unfamiliar technologies. The key point of training is to reshape teacher's view of E-learning rather than to fill their heads with complicated and frustrating technologies (Chu, 2002).

Access: Is That Enough?

Providing technology does not guarantee that it will be used effectively. Other conditions must also be met, such as content designed for curricula and appropriate for various age groups and learners (Hudson, 2001). Content development is one of the keys to meet these conditions. Both CERNET and the ECW project mandate that part of the funding must be reserved for education resource development and integration. Particularly in the ECW project, K-12 schools are required to allocate more than half of the funding in content development. In Taiwan (Chinese Taipei), nearly 400 million NT Dollars are appropriated to teacher education and content development. However, in reality, since

infrastructure construction is more easy-to-see than content development, most schools do not follow the above government guideline. Furthermore, even if schools do reserve money for purchasing software, developing course materials and building education, they find that they do not have the expertise to do it by themselves. Commercial products are very expensive to purchase and they are not necessarily well tailored to fit into the current curriculum. In many schools, newly equipped computer labs are mostly used for teaching some basic computer techniques such as typing, Internet browsing etc. During the SARS[13] crisis this summer, the Beijing municipal government closed all the public schools in late April in order to stem the spreading of the SARS virus. Students were required to keep busy with their course work at their homes through the Internet (Rosenthal, 2003). However, both the quality and the quantity of the online education resources are very limited. Thousands of teachers and computer software engineers were called by the government to develop online education resources in a very short time. However, the qualities of those products were criticized by both students and their parents. Most teachers have to communicate with and instruct their students through regular telephone calls. The crisis of the SARS revealed that content development did not keep up with the rapid construction of the infrastructure.

8. Conclusion and Policy Recommendations

Although there are disparities between China and Taiwan (Chinese Taipei) in the economic development level, as well as ideology, interesting enough, both of them take similar policy initiatives to bring the Internet into campus. The government-centered, non-commercialized and teacher-centered approach has certain advantages and is also facing great challenges. In concluding this exploratory paper, we would suggest several policy recommendations.

First, the government should continue to support teacher education. More efforts should be made to help in-service teachers to integrate new technology into daily curriculum. Awarding and promotion system should be adjusted in order to encourage in-service teachers to learn new technologies more actively. Furthermore, teacher education should be extended to pre-service teachers. Innovative programs and curriculums should be designed to help all pre-service teachers to build up a sound theoretical background and provide them opportunities to practice ICT-based instruction.

Second, the government should invest more resources in content development. Lack of content is the major obstacle in utilizing high

technology in education. Fortunately, some initiatives have been launched. For example, in China, a Teacher Quality Education Project initiated by the Ministry of Education and coordinated by seven national key normal universities, is launched to build a national database system for the sharing of education resources among K-12 schools. A national center is proposed to provide technical support for all in-service teachers nationwide. In Taiwan (Chinese Taipei), the National Center for Educational Software Development and Integration is playing an important role in developing and sharing education resources.

Third, other government agencies should participate more actively. Department of Education is the only government agency in charge of campus Internet project both in China and Taiwan (Chinese Taipei). Telecommunications industry is regulated by other government agencies. The interests of those commercial Internet service providers may conflict with that of non-for-profit education networks. Thus, commercial Internet service providers may set obstacles to the education networks, technically or economically. To solve this problem, coordination among different government agencies is necessary. A formal mechanism, similar to the US's E-rate system, should be established to ensure the continuous development of the education network.

The last and maybe the most drastic recommendation is commercialization. The biggest problem for both China and Taiwan (Chinese Taipei) is the lack of funding. It is extremely difficult, if possible, to raise more government funding. Given the rapid development of new technologies, government funding can never keep up with up-to-date technologies. The government should encourage commercial companies to participate. We have already seen a case in China. China Telecom, a commercial telecommunication carrier, contracted with Beijing University of Posts and Telecommunications to build its campus network. China Telecom is allowed to charge the students for using the campus network and to advertise its brand and products on the campus network. The outcome is somewhat encouraging. The University has its network built up fairly quickly with the up-to-date technology. However, put in the Chinese culture context, commercialization of any aspect of public education system will inevitably counter tremendous resistance from both the academy and society.

Notes

[1] Compared to other universal service program, E-Rate has several new features as Hudson pointed out in her paper "Universal Access: What have we learned from the E-Rate" (2002). Unlike other programs, the E-Rate funding is

not directly awarded to the carriers any longer. Schools and libraries are responsible to formulate their requests and file applications. It is a major transition from the traditional model of universal service with a focus on subsidizing the carrier directly to install facilities or provide services at a reduced price.

[2] Two research reports, *Great Expectations: Leveraging America s Investment in Educational Technology* and *E-Rate in America: A Tale of Four Cities,* base their research in urban areas. Dr. Heather Hudson presented her research finding, a project conducted in the typical rural State of Alaska, in the 2002 s Telecommunication Research Conference.

[3] The China and Taiwan (Chinese Taipei) basic education systems are approximately corresponding to the US K-12 system. Hereafter, we may use K-12 education and basic education interchangeably.

[4] Junior College can be understood as advanced vocational education.

[5] MOE: Ministry of Education

[6] 1 US Dollar=8.27 Yuan

[7] Satellite communication system was only for military use at that time.

[8] ECW is the abbreviation for Every Campus Wired

[9] Usually in those area, local education authorities can not afford to buy any computers either, not to mention network equipment.

[10] TANet (Taiwan (Chinese Taipei) Academic Network). TANet is the earliest Internet backbone developed in Taiwan (Chinese Taipei).

[11] The root of China s education system can be traced back as far as the 16th century B.C. later Shang Dynasty (1523-1027 B.C.)(Surowski, 2000).Throughout this period, education was solely supported by the government. Government officials were the teachers at the same time. The curriculum centered on the Six Arts: Rites, Music, Archery, Chairot-Riding, History, and Mathematics (Du Ruiqing, 1992). Later on, during the Spring and Autumn and Warring States periods (770-221 B.C.), the public education system was almost destroyed due to the continuous war. This period was called by many ancient philosophers, including Confucius, as Li Beng Yue Huai, meaning the tragedy of education and ethic. After Han Dynasty unified China in 206 B.C., public education system was restored by the government .From the beginning level of basic literacy learning to the upper level of Tai Xue, the government constructed school facilities, recruited teachers and thus provided free education to the people. Since then, the public education system was established and steadfastly maintained. In China s history, when one dynasty took over the other, restoring public education system was usually on their top priorities.

[12] 6000Yuan equals approximately to 800$,

[13] SARS: Severe acute respiratory syndrome

[14] CNNIC: China Internet Network Information Center

[15] MII: Ministry of Information Industry

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