REVIEW:

INFORMATION AND COMMUNICATION TECHNOLOGY USE IN PHILIPPINE PUBLIC AND PRIVATE SCHOOLS

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Abstract

The Philippines is one of many developing nations that have turned to information and communication technology (ICT) as a tool to improve teaching and learning. Unfortunately, implementation suffers from several shortcomings: the absence of information on how ICT is actually used; a lack of coordination between public and private sector efforts; and insufficient teacher preparation. This paper begins with a discussion of the pedagogical, social, and economic benefits that developing nations hope to gain by infusing schools with ICT. It cites national policies and programs to infuse schools with ICT, as well as parallel programs initiated by the private sector. The paper then discusses each of the mentioned shortcomings in turn.

Keyword: *information and communication technology; teacher preparation; developing nations; national policies; public and private sector*

Education in the developing world

Education in developing countries takes place under circumstances that are substantially different from those in developed countries. The poorest countries spend the least – absolutely and proportionately – on non-salary related educational expenditures (*1*). In the early 1980s, while African countries allocated only 3.6% of their education budgets to classroom materials, and developing countries in Asia spent 8.8%, industrialized countries spent 14.4% on books and learning aids (*1*). Lewin estimated that, while the richest countries spend as much as US$430 per child on non-salary educational expenditures, the poorest countries disburse approximately US$5 per child, of which US$1 or less goes to information and communication technology (ICT) (*2*). It is, therefore, no surprise that in developing countries, school buildings commonly do not have concrete flooring, furniture, electricity, and water, and there is virtually no equipment for science, art, and other practical subjects (*3*).

The Philippines is a developing country in Southeast Asia whose educational system shares many of the same problems and limitations as those of its fellow developing nations. Some provincial schools lack chairs and tables, blackboards, and laboratory equipment (*4*). Some do not have electricity and water (*5*). There is a scarcity of learning aids in general. In contrast, American students have 140 times more reading material available to them than their Filipino counterparts (*1*).

Pedagogical Benefits of ICT

Despite these conditions, the Philippines along with other developing countries in Asia, Africa, and South America are generally interested in educational technology, particularly in ICT, hoping that their educational systems reap the pedagogical benefits associated with it. Drill and practice or tutorial software, for example, individualizes instruction and provides students with immediate feedback (*6*). Students can proceed at their own pace (*7*). Internet connectivity enables students to access remote sources of information (*6*). It exposes them to diverse expert opinions and

makes them aware that they are part of a global community (*7*). There is evidence that multimedia learning environments, simulations, and computer-based laboratory analysis tools foster superior math, science, and language skills (*8*). Researchers characterize the ICT-infused classroom as highly interactive learning environments (*9*). Communication and collaboration between and among students, teachers, and outside experts occurs through formal presentations, cooperative learning activities, and informal dialogue in large groups, small groups, or on a one-on-one basis (*9*). Finally, some researchers believe that ICT fosters self-direction. Students learn to initiate their own learning by asking probing questions and seeking out answers using a variety of resources (*9*).

Social and Economic Rationales for Using ICT in Education

Aside from pedagogical benefits, there are social and economic factors that motivate technology infusion in schools. Volk noted that the ability to use modern technology is essential in preparing a people for competition in a global workplace (*10)*. Limiting technology may then limit freedom of choice and opportunities for advancement. Both developed and developing nations share these sentiments. In the United States, educators and policymakers recognize that skills and knowledge in ICT are key to maintaining national competitiveness in the global economy (*11*). Belgium, Denmark, and Singapore view ICT in education as a strategy for producing a workforce that can meet the technology challenges of the twenty-first century (*12*). The governments of China and Uganda regard computers in schools as a necessary step towards becoming industrialized nations (*3*). Malaysia's Ministry of Education believes that embracing high-technology industries is the key to elevating the country from developing nation status, and has tasked a consortium of 12 multinational ICT companies with designing systems and software for Malaysia's schools (*13*).

There is also a need to develop proficiency in ICT to supply internal demands for technology literate personnel. The knowledge economies of the Western world depend on knowledge workers who can find, acquire, manage, share, and apply new information (*14*). Exposing students to technology creates future employees who may be later expected to use ICT to increase productivity, reduce costs, and improve results (*6*). In poorer nations such as Uganda, business environments generally provide computer training as necessary (*3*). However, more and more corporations are requiring experience with ICT as a qualification for prospective employees (*3*). Because computerization of small companies is hindered by training costs and it is prohibitively expensive for the average Ugandan to seek training in a commercial ICT school, familiarization with computers is best provided through the educational system (*3*). In rich and poor nations alike, ICT-infused educational systems increase graduates' opportunities for employment and satisfy a demand for computer literate workers.

Finally, countries invest in ICT in education to decrease the social and intellectual inequalities among schools and their respective graduates. In developing countries, researchers have perceived a glaring disparity among schools. Lewin (*2*) observed that

> *…the prospects of the poorest developing countries benefiting from the potential of ICTs to transform opportunities and access to learning are severely constrained. For small minorities, concentrated in the professions and amongst the wealthy, …participation in global networks offers real advantages which can and will influence development and learning. However, for the majority easy and convenient access will remain unaffordable and/or unavailable.*

Indeed, some urban schools in Belize and Lithuania boast advanced computer resources and highly trained personnel, while rural schools have few to no ICT facilities (*10,12*). The unevenness causes differences in learning outcomes achieved by student populations and, in the long-term, differences in the types of employment opportunities open to graduates. Bagatsing noted that public school students, marginalized by their schools' lack of ICT facilities, are "in a predicament of competitive disadvantage. While private school students are on their way up the corporate ladder, their public school counterparts are continuously missing the bus" (*15*). In a February 2000 statement, Manuel

Villar, Jr., Speaker of the House of Representatives of the Philippines, underscored the need for ICT in public schools by saying that ICT is "not only for the rich but for the masses as well, who, by learning to use them will be given the opportunity to improve their quality of life" (*16*).

ICT in Philippine Schools

Philippine national policy has, therefore, been formulated to advance the use of ICT in education. In March 2001, the Senate Committee on Education in cooperation with the DECS launched Project CARES. Project CARES was designed to upgrade the use and application of ICT in public elementary and secondary schools nationwide (*17*). The project's primary concern is school administration and is a response to the need for accurate and timely data that administrators and teachers need to manage their classes. Rimando quotes former DECS Undersecretary for Administration Isagani R. Cruz as saying that CARES will provide public schools and district offices with "computer-based management and operations support tools…and eventually make elementary and high school principals…more efficient and productive in their work" (*17*).

To produce a critical mass of ICT professionals and ICT-literate manpower, both the Senate and the House of Representatives of the Philippine Legislature contemplated laws directing public and private institutions to incorporate ICT into the curriculum at all levels of education (*18-22*). Congressman Erico B. Aumentado proposed tax incentives to encourage private companies and individuals to donate computer equipment to schools or research institutions (*23*). One congressional bill would have mandated the installation of computer equipment in all public schools (*24*). Yet another proposed law would have a 7% tax on all cellular phone calls to fund the computerization of public schools and state universities and colleges (*25*). Although the Philippine Congress adjourned before passing any of these bills into law (*26,27*), these bills depict the legislature's determination to provide for ICT in education.

The executive arm of the Philippine government has also adopted extensive ICT in education policies. DOST, DECS, the Commission on Higher Education (CHED), the Technical Education and Skills Development Authority (TESDA), and the Department of Trade and Industry (DTI), in 1998, drafted an interagency Educational Technology Master Plan that would improve the accessibility and quality of education through the use of ICT (*28*). Among the objectives of the plan were to promote the use of ICT in education; to develop competence in the design, production, and use of ICT in education; to provide the physical infrastructure and technical services needed for educational technology programs; and to monitor and evaluate the outcomes of these programs (*28*).

One significant project by the executive branch of government was the PhP375 million modernization program of the DECS, initiated in 1996 (*29*). Seventy-five percent of the funds was used on hardware and software procurement (*30*). The remaining 25% was spent on staff training (*30*). Administrators, teachers, and support staff had to undergo at least seven days of instruction in the development of computer-aided instruction, and the use of productivity tools and administrative support software (e.g. accounting software, library systems, and student information systems) (*31*). The modernization program also included the establishment of a Center for Education and Technology (CET) whose functions included the development and production of local multimedia instructional materials, training of DECS personnel, and showcasing of a "school of the future," with state-of-the art multimedia hardware and software (*32*). An additional PhP300 million was allocated in 1997 for a nationwide program to computerize 97 state universities and colleges (SUCs) and 168 private schools (*29*). Finally, the 1999-2000 DECS Computerization Program had a budget of PhP210 million to equip 325 schools with computers and train 4,000 teachers (*29*).

One of the success stories of the DECS modernization program was the Science and Technology Education Center in Lapu-Lapu City in Region 7, Central Visayas. District Superintendent Caridad C. Labe, Ph.D., described her current four-year ICT curriculum in which students learn basic computer literacy, use of productivity tools, troubleshooting of hardware and software, and multimedia authoring (*34*).

In recent years, DECS has partnered with other government agencies or the private sector to improve public school facilities. DECS's Adopt-a-School Program, initiated in 1998, enlists the help of private corporations in delivering educational goods and services, among these computer laboratories and equipment, to underserved areas (*29*).

DECS, in partnership with the Department of Trade and Industry and the private sector, has also embarked on the PCs for Public High Schools Project (*35*). The PhP600-million project began as a private sector initiative, but then became a flagship project of former Philippine President Joseph Ejercito Estrada. Its objective was to provide 1,000 public high schools nationwide with 20 computers each. The project also provides for the ICT training of one "master teacher" per high school. The project's implementation began in school year 2000-2001 and is scheduled for completion in school year 2001-2002 (*36*). DECS hopes that these efforts will enable high schools to produce a critical mass of ICT-literate graduates.

Finally, the private sector has established ICT in schools through a combination of outright purchases, leases, and grants (*37*). Philippine Business for Social Progress (PBSP) is one of many non-government organizations filling the need for ICT in education. From May to November of 1994, PBSP convened the Consensus Group on Business and Education. The group was composed of 18 chief executives, corporate officers, and university presidents. The group's purpose was to discuss the state of science and technology education in the Philippines. The group noted that, in terms of growth and development, the Philippines lags behind its Asian neighbors (*38*). This is caused, in part, by the lack of science and technology personnel, the educational system's incapacity to produce quality graduates, and the lack of investment in science and technology activities (*38*). The group, therefore, formulated a portfolio of project proposals to build schools' and training centers' capacity to produce quality technicians, as well as masters and doctoral graduates (*38*). Interested corporations reviewed this portfolio and selected projects they would like to fund. One of the projects, entitled "Computer Laboratories Program for Secondary Schools," aimed to establish computer laboratories in at least 50 public and private high schools nationwide (*38*). In February 1999, Citibank, N.A.-Philippines granted US$100,000 towards the computer laboratories program (*39*). By July 1999, Citibank and PBSP constructed computer laboratories in San Juan Municipal High School, Pedro E. Diaz High School, Jose Abad Santos High School, and Makati High School-San Antonio Annex, all within Metro Manila (*39*). The computer laboratories program established eight laboratories in all, 42 short of the intended 50 (*40*). However, PBSP still considers the program a success because school heads, computer education and non-computer education teachers, and students viewed the laboratories favorably (*40*).

The Foundation for Information and communication technology Education and Development (FIT-ED) is another non-government organization dedicated to the application of ICT in education and training. Together with the Ateneo Center for Education and Development (ACED) and Lucent Foundation, FIT-ED initiated an educator training program for public school teachers and instructors from social welfare institutions (*41*). The program began in the second semester of school year 1999-2000 and was open to teachers from Muntinlupa City, Quezon City, and Makati City, as well as social workers from the National Training School for Boys and the Marilac Hills Institute for Girls. In the second semester of school year 2000-2001, FIT-ED opened a second program at the Ateneo de Davao in Davao City, Mindanao. The program was open to public school teachers from the division of Davao City. Funding for both programs expires in 2001.

On 13 July 2000, FIT-ED entered into a joint project with the Ayala Foundation, the philanthropic arm of the Ayala group of companies whose holdings include Ayala Land (real-estate), Ayala Systems Technology (software development), EDINet (e-commerce) and Globe Telecom (telecommunications). The project was Pilipinas SchoolNet, a network of Philippine schools that will use information and communication technology to interact and collaborate (*42*). When fully operational, the Pilipinas SchoolNet will be connected to a regional network called the Asean SchoolNet and then eventually to the World Links for Development Program (WorLD), a network that links schools in 35 developing countries.

The Ayala Foundation further manifested its commitment to ICT in education through its Youth Tech program. The objective of the program is to provide junior and senior students of public high schools with access to ICT and the necessary training to use the technology (*43*). In partnership with the Ayala group of companies and DECS's PCs for Public High Schools project, the Ayala Foundation will provide computer laboratories, Internet access, and teacher training to selected schools.

Another private firm, Procter & Gamble (P&G) Asia, with the cooperation of IBM Philippines, promoted the use of technology in education through Project Sagip-Isip (*44*). Under the program, schools were asked to accumulate points by collecting wrappers from P & G products. The schools could then exchange these points for IBM personal computers. P & G targeted 5,000 schools nationwide.

The League of Corporate Foundations[1] recently initiated Project Jumpstart (*45*). The project's purpose was to equip 100 public schools with computer laboratories, network peripherals, and Internet connectivity. Telecommunications partners committed to providing these schools Internet connectivity for one year while member organizations promised to supply the necessary hardware and software.

Other private institutions, such as the University of St. La Salle in Bacolod City, Visayas, are making smaller but still meaningful contributions to promoting ICT in education. Lily C. Go, chairperson of the Department of Management Information Systems, described her university's ICT training program for public school teachers (*46*). For four consecutive Saturdays, volunteer teachers from St. La Salle train the teachers from one public school in the use of word processors, spreadsheets, presentation software, and the Internet. The training is free of charge. At the end of the four sessions, the training is made available to another public school. Note that this initiative is supported solely by volunteers and survives with virtually no funding.

Shortcomings of ICT Implementations in Philippine Education

Despite enthusiasm from all sectors, the implementation of ICTs in Philippine Education suffers from a number of shortcomings. Among them are the absence of documentation, a lack of coordination between public and private sector efforts, and insufficient teacher training. The remainder of this paper shall discuss each of these limitations in turn.

Surveys Regarding ICT Use

ICT adoption in the Philippines, as in other developing nations, is relatively recent and has limited coverage. It is, therefore, understandable that examinations of the extent of use are limited as well.

A presentation by Labe of DECS cited some broad national statistics on the pervasion of computer technology (*34*). She said that 71% of private elementary schools and 70% of private secondary schools have computers for administration and teaching. On the other hand, only 7% of public elementary schools and 45% of public secondary schools have ICT resources. Six percent of public elementary schools use their computers solely for administrative purposes, while the remaining 1% use theirs for both administration and education. Unfortunately, Labe did not elaborate further.

In line with the Southeast Asian Ministers of Education's (SEAMEO) Regional Center for Education in Science and Mathematics (RECSAM), Roxas and Marinas gathered information about the availability of computer technology in Filipino schools, computer technology's current and intended uses, the status of computer technology in the curriculum, and the attitudes of principals

[1] The League of Corporate Foundations is a non-stock, non-profit organization consisting of 44 member foundations. Its mission is to harness the resources of corporate foundations in pursuit of national development goals through greater corporate social responsibility.

and teachers (*47*). The researchers began the study in December 1986 and completed it in February 1988 (*47*). The survey included 80 out of 3,357 schools nationwide (*47*). It was not possible to sample representative schools from all regions because few public schools had computers at the time (*47*). In their report, Roxas and Marinas cited another study that the Curriculum Division of the Bureau of Secondary Education conducted in 1986 (*47*). The 1986 study surveyed high schools within the National Capital Region (NCR) and nearby areas. The study revealed that 46% of schools surveyed had fewer than five computer units, while 33% had more than ten (*47*). Seventy-one percent of respondents opened computer classes after 1984 (*47*). In 67% of schools these courses were electives, while in 44% they were open to high school seniors only (*47*).

These and similar surveys were valuable because they documented how schools used limited ICT resources. As of 1989, elementary schoolchildren gained exposure to ICT by creating programs using Logo[2] (*47*). These computer awareness courses are normally sponsored by private computer education centers during the summer break (*47*). An earlier survey by Capalad (*47*) gathered data from primary and secondary schools throughout the country. Of the 63% of schools with computers, other findings by Capalad (*47*) were as follows:

- 70% were private schools
- 31% integrated ICT into math, science, and other courses
- 89% offered a separate computer literacy subject
- 30% used computers as teaching aids
- 20% used computers in co-curricular activities

A national survey conducted by the New Educational Technologies (NET) Foundation in 1996 showed increases in ICT diffusion and changes in utilization. At the elementary level, about one-third of public and private schools surveyed offered computer education as a separate course (*37*). Fifty percent (50%) of public schools and 21% of private schools used computers as an instructional "component" of an existing subject area (*37*). The term "component" was not qualified. Among high schools, about one-half of the schools surveyed offered computer education as a separate subject, while 47% of public schools and 13% of private schools used ICT as part of another subject (*37*).

A study of computer use in a premier elementary school further emphasized the recent and limited introduction of ICT in Philippine education. The school introduced computers to grade 6 and 7 students in 1983 and only opened the classes to grades 4 and 5 in 1996 (*48*). Over the course of one semester, each computer class met once a week for 80 minutes (*48*). The curriculum was limited to Logo programming (*48*). Students suggested that the curriculum be expanded to include the use of productivity tools and the Internet (*48*). They also suggested that computer classes be conducted throughout the school year and that the classes meet twice a week for a total of 120 minutes (*48*).

As of this writing, another nationwide survey is ongoing. Project CARES of the Senate Committee on Education in cooperation with the DECS began a survey to determine the present use and curricular inclusion of ICT in all public elementary and secondary schools (*17*). The results of the survey will be the basis of legislative actions towards the modernization of basic education.

Lack of Documentation in the Philippines

These studies notwithstanding, the extent to which ICT is being used in Philippine public and private schools is still largely unknown. The Secretary and Undersecretary of DECS as well as members of the private sector lament the general lack of documentation regarding the status of ICT

[2] Logo is a programming language designed for use by learners, including children. Its most popular form involved a turtle that could be directed to move using simple commands.

in education projects (*49,50,30*). More specifically, there is uncertainty whether computers in schools are, in fact, being fully utilized for educational computing (*30*). Some congressmen have even aired concerns that computers meant for students were instead being used only by teachers for preparing lesson plans or playing games (*51*).

Updates regarding the DECS modernization program have been difficult to obtain, even for Congress. The congressional Committee on Education complained that they received copies of DECS orders regarding the modernization program, but DECS has not submitted a report on the actual implementation (*52*). The Senate Committee on Finance also asked for a status report, displeased that it had received criticism for appropriating such a large budget for a modernization project that had no apparent results (*53*).

In a meeting with DECS officials on 17 July 2001, private sector representatives asked DECS for baseline statistics on schools' uses of ICT. They said it was important for them to know exactly how their donations were being used (*54*). DECS Undersecretary Ramon C. Bacani acknowledged that DECS had no data regarding ICT use (*55*). However, Marivic Abcede of DECS assured the private sector representatives that current ICT initiatives, such as the PCs for Public Schools Program, have provisions for documentation and feedback to donors (*33*).

The lack of documentation regarding ICT use is a problem that exists in many countries. In developing countries in particular, data that could help determine how scarce educational resources should be distributed or how effectively they are being used are simply not available (*56*). Educational researchers in these countries tend to collect data on inputs such as teachers, students, classrooms, and expenditures (*56*). Researchers tend to ignore substantive issues regarding IT implementation and its effect on people and work processes (*57*). Without adequate documentation, decision makers tend to base educational policy on imprecise data or purely political considerations, rather than rigorous, empirical analysis and evaluation of educational outcomes (*56*).

Lack of Coordination Between Public and Private Sector Efforts

Anecdotal evidence further suggests that public and private sector programs lack coordination within and between themselves. During the implementation of the 1996 DECS modernization program, teachers were trained to use Macintosh computers but were supplied with IBMs (*50*). There was also a one-year time lag between the training sessions and the equipment delivery (*30*).

Victoria Tinio of FIT-ED and Pilipinas SchoolNet narrated that in mid-2001, two public schools in Cebu province received computer and network equipment (*58*). Unfortunately, neither school had rooms that could accommodate the machines. The schools were not expecting the computers, and were therefore unprepared to receive them, because the machines had been promised to them two years earlier, as part of the 1999-2000 DECS Computerization Program. Ultimately, one public school set up its network, but in a room without air conditioning. The other had to store the computers unopened in another school until school officials could determine how to accommodate them.

In May 2001, Pilipinas SchoolNet sent a group of public school teachers to Singapore for one week of training on telecollaboration. The teachers in the group were selected because they were computer literate. In some cases, their schools had computer laboratories and Internet connections. Upon returning to Manila, at least two of the teachers from schools with ICT were transferred to campuses without computers (*59,60*). Others were not allowed to use their school's computer facilities because their principals had no knowledge of the Pilipinas SchoolNet project (*61*). Others still expected either Pilipinas SchoolNet or the PCs for Public Schools Program to supply computers and Internet connectivity (*62,63*).

Insufficient Teacher Preparation

Finally, teacher preparation is insufficient. Some teacher training programs emphasize use of specific software packages but overlook the integration of ICT in curriculum (30). Others provide teachers with training in integration, but not in computer literacy. One public school teacher noted that she was asked to teach a mathematics class using mathematics software, after only one day of training. Prior to that one-day session, she had no previous exposure to ICT.

If teachers venture to use ICT without adequate training, they are likely to do so erroneously. A Physics teacher of a private secondary school in Metro Manila attempted to demonstrate the Doppler Effect using the Microsoft's Sound Recorder tool. A microphone was attached to her computer. She asked one of her students to produce a sound about 10 feet away from the microphone. She then asked the student to move directly in front of the microphone and then produce the sound again. In both instances, the teacher recorded the sounds. She then instructed her class to examine the sound files and relate their observations to the Doppler Effect.

There were several flaws in the way the experiment was conducted. First, the Doppler Effect refers to the shifting of a sound's frequency depending on the relative motion of the sound's source. As a sound source moves closer to the observer, the frequency of the sound is higher. As the sound source moves farther away, the frequency becomes lower. It is essential, therefore, for the source of the sound to be in motion for frequency to change. In the case of this demonstration, the sound's source was stationary; therefore, there was no Doppler Effect.

Second, the choice of tools was inappropriate. The Sound Recorder of Microsoft is not the correct tool to show differences in frequency. The sound waves are too small and too compressed for the observer to see distinctions.

Conclusion

Developing countries such as the Philippines are committed to infusing schools with ICT. There is great faith that these technologies will improve teaching and learning, and consequently afford these countries a greater stake in today's knowledge society. Consequently, the Philippine government and the private sector have initiated programs to provide schools with computer hardware and software, Internet connectivity, and teacher training. However, considerable gaps still exist in ICT program implementations. There is a lack of data on schools' use of ICT. Hence, there is little basis for policy formulation. There is a lack of coordination between public and private sector efforts, and within ICT programs themselves. This leads to wasted time, money, and human resources. Finally, there is a need for further teacher training in both computer literacy and ICT integration in the curriculum. These gaps must be sufficiently addressed before ICT can have a significant impact on teaching and learning in Philippine schools.

References

1. W. T. S. Gould, "Global patterns of education" in *People and Education in the Third World* (Longman Scientific and Technical, England, 1993), pp. 31-59.
2. K. M. Lewin, *Compare: A Journal of Comparative Education* [Online] **30** (3), 313-321 (2000), [accessed 13 June 2001].
3. Beauchamp, A. P., "Uganda's schools: Do these need computers?" in *World Conference on Computers in Education VI: WCCE 95 Liberating the Learner: Proceedings of the Sixth IFIP World Conference on Computers in Education,* J. D. Tinsey & T. J. Van Weert, Eds., (Chapman & Hall, London, 1995) pp. 193-201.
4. Committee on Appropriations, Subcommittee H., Transcript of committee meeting, House of Representatives of the Philippines, Quezon City, 4 September 1995, pp. 123-124.

5. R. A. Fernandez, "Only 1% of RP high schools have computers" in *Philippine Star,* 32 (23 February 1996).
6. Chief Executive Officers' Forum on Education & Technology), *Year 1 Report: From Pillars to Progress* (1997) [Online: http://www.ceoforum.org/reports.cfm?RID=1], pp.3, 33, [accessed 14 January 2000].
7. J. M. Peha, in *Educational Leadership* [Online] **53** (2), 18 (October 1995), Available: Expanded Academic ASAP in Infotrac. Record No. A17473008, [accessed 14 January 1999].
8. E. R. Bialo, G. Solomon, in *Technology & Learning* [Online], **18** (2), 70 (1997), [accessed 16 June 2001].
9. V. Hancock, *Educational Leadership,* **55** (3), 60-63 (November 1997).
10. M. Brandenburg, K. P. Dudt, *International Education* [Online], **28** (1), 42-57 (1998). Available: WilsonSelect in FirstSearch. Item: BEDI98029772 [accessed 4 October 1999].
11. F.L. Scheffler, J. P. Logan, *Journal of Research on Computing in Education* [Online], **31** (3), 305-326 (1999), [accessed 4 October 1999].
12. W. J. Pelgrum, R. E. Anderson, Eds., *ICT and the Emerging Paradigm for Life Long Learning: A Worldwide Educational Assessment of Infrastructure, Goals, and Practices,* (International Association for the Evaluation of Educational Achievement, Amsterdam, 1999), pp. 22, 38, 77, 65.
13. M. Pennington, "Asia takes a crash course in educational reform", in *UNESCO Courier* [Online], 5, 17-20 (July-August1999), [accessed 14 January 1999].
14. Abell, A., *Information Management Journal* [Online], **34** (3), 33-41 (2000), [accessed 29 June 2001].
15. R. Bagatsing, Speech in transcript of session proceedings, House of Representatives of the Philippines, Quezon City, 17 December 1996, pp. 6-16.
16. "IT education bill passed", in *Manila Standard,* 3 (2000, February 2).
17. T. P. Rimando, "Senate, DECS set computer project for public schools", in *Manila Bulletin*, 13 (6 March 2001).
18. R. G. Biazon, Senate bill no. 1081, Senate of the Philippines, Manila, 1998-1999.
19. R. A. Briones, House bill no. 2328, House of Representatives of the Philippines, Quezon City, 1998-1999.
20. D. V. Liban, House bill no. 361, House of Representatives of the Philippines, Quezon City, 1998.
21. J. R. Magsaysay, Senate bill no. 614, Senate of the Philippines, Manila, 1998.
22. D. E. Suarez, House bill no. 659, House of Representatives of the Philippines, Quezon City, 1998-1999.
23. E. B. Aumentado, House bill no. 6287, House of Representatives of the Philippines, Quezon City, 1999.
24. A. C. V. Badelles, House bill no. 2068, House of Representatives of the Philippines, Quezon City, 1998-1999.
25. D. E. Suarez, *et al.*, House bill no. 8278, House of Representatives of the Philippines, Quezon City, 1999.
26. N. Alvis, personal communication, 11 June 2001.
27. E. Lomeda, personal communication, 13 June 2001.
28. Department of Science and Technology (DOST), Department of Education, Culture, and Sports (DECS), Commission on Higher Education (CHED), Technical Education and Skills Development Authority (TESDA), and Department of Trade and Industry (DTI), *Education Technology Master Plan*, (New Educational Technologies Foundation, DAP Building, Gold Loop, Pasig City, 1998), p. 7.
29. *IT21 Philippines Asia's Knowledge Center: IT Action Agenda for the 21st Century*, National Information Technology Council, Manila, October 1997, p. 39.
30. N. L. Rosas, report presented at the Congress on the Educational Technology Master Plan, Makati City, 30 October 1998, pp.2, 30, 4, 6.

31. R. T. Gloria, DECS Memorandum 90, s. 1997, Department of Education, Culture, and Sports, Pasig City, 18 March 1997.
32. R. T. Gloria, DECS Order No. 59, s. 1996, Department of Education, Culture, and Sports, Pasig City, 30 August 1996.
33. M. Abcede, personal communication, 17 July 2001.
34. C. C. Labe, paper presented at the Etrends 2000, Quezon City, 6 January 2000.
35. V. Manhit, personal communication, 19 September 2000.
36. Secretariat of the PCs for the Public High Schools Project, Department of Education, Culture, and Sports, Pasig City, 2000.
37. *The 1996 National Survey on Computer Education*, New Educational Technologies (NET) Foundation, Pasig City, 1996.
38. *Final Report of the Consensus Group on Business and Education, 1994, Center for Corporate Citizenship, A project of Philippine Business for Social Progress,* Consensus Group on Business and Education, Manila, January 1995, pp.5, 9, 28.
39. Philippine Business for Social Progress, Center for Corporate Citizenship, Manila, 1999, p. 3.
40. E. B. Barsaga, *et al., Rapid Appraisal of the Education Program of PBSP's Center for Corporate Citizenship*, Philippine Business for Social Progress, Manila, 2000.
41. *Priming the Philippines for the Information Age,* Foundation for Information and communication technology Education and Development, Makati, 1999.
42. T. R. Salazar, "RP classrooms to be wired with Asean counterparts", *Philippine Daily Inquirer*, H2 (17 July 2000).
43. M. Deriquito, personal communication, 26 September 2000.
44. *IBM Philippines to Donate IBM PCs to Qualified Schools* [Online], at http://www.ph.ibm.com. [accessed 23 January 2000].
45. T. Cabalia, personal communication, 17 July 2001.
46. Lily C. Go, personal communication, 6 January 2000.
47. P. S. Roxas, B. O. Marinas, *SEAMEO-RECSAM Computers in education Project: Country Report Philippines*, SEAMEO Regional Centre for Education in Science and Mathematics, Malaysia, 1989, pp.2, 24-25, 7, 13, 11, 12.
48. G. J. D. V. Solis, thesis, St. Joseph's College, Quezon City, September 1997, pp. 82, 9, 81.
49. A. I. Felipe, "I.T. solutions for school and classroom use in the Philippines", in *I.T. Education in the Philippines: Preparing for the 21st century: Messages and Selected Papers of the 1997 Information and communication technology and Telecommunications Education Congress*, L. G. Casilan, Ed., (NET Foundation, Pasig City, 1997), pp. 51-63.
50. A. Gonzales, keynote address in the Conference on the Education Technology Master Plan, Makati City, 30 October 1998, p. 3.
51. Committee on Education, Transcript of committee meeting, House of Representatives of the Philippines, Quezon City, 5 May 1997, p.65.
52. Committee on Education, Transcript of committee meeting, House of Representatives of the Philippines, Quezon City, 5 February 1997, pp. 37-93.
53. Committee on Finance, Transcript of committee meeting, Senate of the Philippines, Manila, 22 October 1997, pp. 23-33.
54. T. Cabalia, personal communication, 17 July 2001.
55. R. C. Bacani, personal communication, 17 July 2001
56. J. M. Puryear, *International Journal of Educational Development*, **15** (1), 79-91 (1995), pp. 86, 84.
57. R. Montealegre, "A case for more case study research in the implementation of information technology in less-developed countries", *Information Technology for Development* [Online], **8** (4), 199-207 (1999), [accessed 13 June 2001].
58. V. Tinio, personal communication, 20 July 2001.
59. A. Marcelino, personal communication, 29 June 2001.
60. S. Saet, personal communication, 29 June 2001.

61. R. Lacanlale, personal communication, 10 July 2001.
62. E. Mangubat, personal communication, 13 July 2001.
63. J. Piñero, personal communication, 23 June 2001
64. E. J. Angara, "Legislative initiatives in promoting the use of I.T. in education", in *I.T. Education in the Philippines: Preparing for the 21st century: Messages and Selected Papers of the 1997 Information and communication technology and Telecommunications Education Congress*, L. G. Casilan, Ed., (NET Foundation, Pasig City, 1997), pp. 7-17.
65. W. J. Pelgrum, T. Plomp, *The IEA Study of Computers in Education: Implementation of an Innovation in 21 Educational Systems (International Studies in Educational Achievement)*, (Pergamon Press, Great Britain, 1993).