Survey of Information & Communication Technology Utilization in Philippine Public High Schools

Preliminary Findings

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I. Introduction

The world we live in today is very different from what it was a century, even a few decades ago. This transformation has been driven in part by rapid technological innovation. While the 19th century saw the rise of the Industrial Revolution, with steam-powered machines intensifying and expanding human productive power, the 20th century was characterized by the birth of machine-powered flight and the emergence of broadcasting and computer technologies that extended the reach of human creativity even more and made possible new ways by which humans could live and work together.

In the past fifty years, especially, technology has made information, once a scarce resource, abundant. With computers and Internet technologies in particular, more people can now have access to more information more quickly than ever before. Moreover, the exponential growth in access to information has led to a corresponding exponential growth in the production of new information, and this has forced us to rethink our notions of what we need to learn and how we should learn it.

Educational institutions acknowledge that they must move apace with the technology-driven changes in society and economy. In today's knowledge society, not only must schools ensure that learners possess the competencies to wield these new information and communication tools productively, they must equip learners with the critical and analytic tools necessary to live and flourish in an information-saturated environment. Mastery of facts has become less important than the ability to contextualize these facts and derive their meaning within specific contexts. Thus, learners must develop three foundational skills: "1) how to find information; 2) how to determine if what is found is relevant to the task at hand; 3) how to determine if the relevant information is accurate."[1]

Acquisition of these three foundational skills sets the parameters for the use of ICT in schools. The tools that in part created the demand for information literacy skills in the first place can, if used effectively, be the best tools to help learners meet these demands. The integration of ICT in the teaching and learning process is, potentially, one of the most viable interventions towards educational reform. The models of effective ICT use, however, cannot be constructed overnight. A variety of technological, curricular, pedagogical, institutional, cultural, and financial issues need to be addressed, and the complex interaction among these various factors means that constructing the best practice models would involve much "thought, experimentation, and a willingness to spend the time to develop and refine strategies until they are proven to be effective."[2]

Objectives. The general objective of this study is to determine the use of ICT in the Philippine public secondary education system. Specifically, school-beneficiaries of the 1996 Department of Education, Culture and Sports (DECS, later changed to Department of Education or DepEd) Computerization Program will be profiled to determine the following:

1) the history and goals of ICT use in the public high school system;
2) the level of ICT resources present in the system;

[1] Thornburg, David D. "Technology in K-12 education: Envisioning a Future", (http://www.air-dc.org/forum/abthornburg.htm) 1999, p.
[2] *Ibid*, p.1.

3) the types and extent of uses—administrative and educational—of ICT resources in the system;
4) the ICT-related competencies of teachers and the extent of staff development activities; and
5) barriers to the use of ICT in the system.

II. Context and Significance

In 2001, the then Department of Education, Culture and Sports, now the Department of Education (or DepEd), began a process of curriculum restructuring aimed at improving the quality of Filipino learners and providing them the necessary skills for lifelong learning. The resulting 2002 Basic Education Curriculum (BEC) is being implemented nationwide beginning June 2002. Among the new curriculum's notable features is the reorganization of subjects into five learning areas, namely: Filipino, English, Science, Mathematics, and Makabayan. The latter integrates previously separate subjects such as Social Studies, Physical Education, Health and Music, and Technology and Home Economics. Values Education, on the other hand, will be integrated in all learning areas. [3]

In elaborating the philosophy of education that informs it, the 2002 BEC enshrines information literacy as a prerequisite for social and economic development: "We have to educate our Filipino learners to filter information critically, seek credible sources of knowledge, and use data and facts creatively so that they can survive, overcome poverty, raise their personal and national esteem, and realize a gracious life in our risky new world."[4] In view of this goal, the new curriculum provides for the harnessing of the power of ICT as an instructional medium, specifying that ICT be "an integral part of all the learning areas, whenever hardware and software are available."[5]

Consistent with the goals of the new curriculum, the "Department of Education Information Technology Framework" lays down the action areas for ICT-integration in the basic education system from 2000 to 2005. These include school computerization, teacher training, IT curriculum development, multimedia content development, financing, and monitoring and evaluation.[6]

However, government's continued investment in ICT for education has provoked some criticism. DepEd has been accused of a failure to present clear-cut policies, plans and targets that would justify such investment, particularly as increased allocations for ICT reduces those for more traditional learning tools.[7] Related to this is the continuing debate over the differential efficacy of ICT intervention across subject areas, student characteristics, teacher roles, and levels of access to technology, among others.[8]

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[3] Department of Education, "2002 Basic Education Package", January 29, 2002, p. i.
[4] *Ibid*, p. 4.
[5] *Ibid*, p. 18.
[6] This is a preliminary and unofficial document submitted by DepEd to the Information Technology and E-Commerce Council (ITECC). There is also, according to a DepEd officer, an unofficial National ICT for Basic Education Strategic Plan but which is not for public circulation.
[7] Rodrigo, Maria Mercedes T. "Information Technology Usage in Metro Manila Public and Private Schools". PhD dissertation. School of Computer and Information Sciences, Nova Southeastern University, 2001, pp.22-23.
[8] *Ibid.*

But despite these criticisms, computerization and connectivity initiatives by both the public and the private sectors continue. The absence of a comprehensive database on ICT deployment in the public school system makes it impossible to determine the actual level of ICT resources and their instructional use, but data that are available provide some indication of the extent of ICT penetration, if not actual use, in schools.

DepEd estimates that around 80,000 units of personal computers (PCs) are required to provide every public high school with a computer laboratory (at 18 PCs per school for 4,209 high schools nationwide). As of schoolyear 2000-2001, 1,571 schools are estimated to have received computers through the various assistance programs of the government and the private sector: [9]

Program	Assistance Package	No. Of Schools
DECS Computerization Program (1)	7 PCs per school	661
DECS Computerization Program (2)	10 PCs, 1 server	280 (for Y2000)
DOST Science & Technology Oriented School	15 PCs per school	110
DOST Computer Literacy Program	10 PCs per school	70 (for Y2000)
Individual private sector donations		200 – 250

Such efforts still left over 60% of public high schools without access to computers. Currently government has a project dubbed "PCs for Public High Schools" involving the deployment of 20 PCs in 1,000 public high schools across the country. Delivery and installation of PCs are ongoing. Upon completion of the program, around 60% of public high schools would already have PCs.

Government assistance packages typically included office software and educational CDs as well as a teacher training component.

The extent of private sector contribution to ICT investment in education is likewise difficult to estimate. What *is* known about private sector activities in this area suggests though that its efforts either expand or build on the existing initiatives of government.

For instance, the loose consortium of corporate foundations, non-profit organizations, IT vendors, and private IT training providers called ConnectEd has identified 100 public schools for connectivity assistance, i.e., the provision of a local area network and free Internet access for one year. ConnectEd also solicits PC donations from private firms for distribution in the schools. Teacher training is also included in the consortium package.

Another private sector initiative is the Coca-Cola Company's ed.venture Program which in 2001 provided 14 public high schools in Metro Manila and the Visayas Internet laboratories with between 10 to 21 PCs. This program also includes a comprehensive training package for teachers, school administrators, and lab managers.

Recent research on ICT usage show that despite these efforts, however, access to and use of technology in public schools are still quite limited. In "Information Technology Usage in Metro Manila Public and Private Schools," Rodrigo suggests that there are

[9] Estimates were compiled by the Task Force on PCs for Public High Schools, Economic Coordinating Council of the Philippines in May 2000. Numbers have been updated by the researchers.

generally poor levels of access to computers, peripherals, software, and the Internet in Metro Manila public and private elementary and secondary schools. Gaps also existed between the goal of the school to use ICT to promote active, individualized instruction and to improve student achievement, on the one hand, and the actual use of ICT, which was limited to classes on computer literacy, productivity tools and programming, on the other.[10]

Another study being conducted by SEAMEO INNOTECH called Project CARES focuses on assessing the readiness of public schools to adopt ICT-based teaching and learning strategies through a universal survey of public primary and secondary schools. Findings from this research, however, are not yet available but would certainly go a long way in establishing benchmarks for ICT-integration in education.

The present study is another attempt to contribute to the limited body of knowledge on ICT use in the Philippine public school system, specifically at the secondary level. It adopts the same survey instrument used by Rodrigo, which was in turn based on an international computer use in education study conducted in 1998 and covering 27 countries and territories.[11] This study, however, has extended the scope of the survey nationwide in the hope of drawing some conclusions indicative of the national status of ICT in education that may help inform national ICT in education policy planning.

III. Methodology

Data for this study was drawn from a survey conducted from November 2001 to January 2002 of school-beneficiaries of the 1996 DECS Computerization Program.

Sample selection. The survey sample consisted of 100 schools nationwide randomly selected from the complete list of school-beneficiaries of the 1996 DECS Computerization Program provided by the DepEd Central Office. The sampling frame consisted of 661 public high schools that were selected by DepEd to be beneficiaries of its 1996 Computerization Program based on the following criteria: 1) must be a high-performing school (as indicated by overall performance in the National Secondary Achievement Test); 2) must have a full-fledged administrator; 3) must receive a share of the national government budget for education; 4) must offer "Business Technology (Computer Education)" as a specialization in the 3rd and 4th years; 5) must have electricity and an air-conditioned room to house the computer package; and 6) must be recommended by the Division and Regional Offices.[12]

Questionnaire. Face-to-face interviews were conducted using a structured questionnaire. The questionnaire used for this survey was adapted from the instrument developed in 1998 by the International Association for the Evaluation of Academic Achievement (IEA) for the Second Information Technology in Education Study (SITES).[13] The questionnaire focuses on six areas, namely: 1) background information on the

[10] See Rodrigo, "Information Technology Usage in Metro Manila Public and Private Schools".
[11] *Ibid*, p. 40.
[12] Department of Education, "Status Report on the 1996 DECS Computerization Program," prepared by Marivic Abcede, Adopt-a-School Program, DepEd, 2001.
[13] Used with permission from Dr. Willem J. Pelgrum.

respondents and the school; 2) history and objectives of ICT use; 3) ICT resources; 4) ICT use; 5) technical support and needs; and 6) staff development. Nine of the 113 items in the questionnaire were to be answered by the Principal or his/her equivalent, the Assistant Principal or the Officer-in-Charge. The rest of the items were to be answered by the Computer Coordinator or his/her equivalent, assisted when necessary by other staff knowledgeable on the matter.

Respondents. Two hundred fifty school staff from the 100 sampled schools were interviewed. In all but 14 sampled schools, there were multiple respondents ranging in number from two to seven (See Table 1.). Most (70%) had two to three respondents.

Table 1. Percentage of schools by number of respondents

One	14
Two	46
Three	24
Four	11
Five	3
Six	1
Seven	1

Of the 14 schools with single respondents, all were Principals or their equivalent. Other respondents included the Computer Coordinator or his/her equivalent; Department Heads, Master Teachers, and Head Teachers; other subject area teachers; and non-teaching and other support staff (See Table 2.)

Table 2. Percentage of respondents by position

Principal or equivalent	92
Assistant Principal or Officer-in-Charge	5
Computer Coordinator or equivalent	53
Computer Coordinator employed by a private firm	1
Department Head, Master Teacher or Head Teacher	22
Other subject area teacher	54
Non-teaching staff (administrative or support)	23
TOTAL	250

Efforts were made to reduce non-sampling errors (due to nonresponse, lapses during the conduct of the field interviews and recording of responses, and errors in data editing, coding, and entry.)

Pre-testing. Pre-testing of the questionnaire—to identify vague or ambiguous items and to pinpoint problems in the administration of the instrument—was conducted in three Metro Manila schools selected from the 1996 DECS Computerization Program list. Key issues that arouse during the pre-test included the respondents' difficulty in answering technical questions (e.g., processor types and operating systems of computers), the general lack of documentation of the history and use of ICT and thus the reliance on the respondents' reconstruction of events, the need for multiple respondents since

information on ICT is dispersed within the school structure as well as to cross-validate responses, and the need for a thorough inspection of existing resources and infrastructure.

Changes were made to the questionnaire based on the results of the pretest. In particular, several items which were found to be either ambiguous or too difficult to answer were modified or deleted altogether. Moreover, the sequence of items was changed and the format of response tables was modified to incorporate a verification procedure consisting of an ocular inspection of ICT resources.

Field interview team. The field interview team was composed of one Field Manager, two Group Supervisors and 11 Field Interviewers. A Group Supervisor, reporting directly to the Field Manager, was assigned to every two to three Field Interviewers.

All Group Supervisors and Field Interviewers received at least one week of training conducted in three locations—Metro Manila, Cebu and Davao. Training focused, among others, on mastery of the technical vocabulary, the conduct of the ocular inspection, and differentiation between different types of ICT uses and ICT-related tasks.

Initial interviews were conducted by Field Interviewers accompanied by a Group Supervisor. Field Interviewers were only permitted to conduct interviews on their own after they had conducted three successive interviews without committing any errors in the interview procedure or in the recording of responses. Throughout the data gathering period, Group Supervisors made surprise checks on the interview team and conducted follow-ups.

Field editing. Field Interviewers were asked to go over the questionnaire at the end of each interview to check for consistency of responses. Each completed questionnaire was then submitted to the assigned Group Supervisor for another round of checking. Telephone follow-ups were made to resolve logical inconsistencies in responses.

Data processing. Codes were built and whenever appropriate pre-codes modified based on the recorded responses. A final consistency check was done before coding. Additional telephone follow-ups were performed to address consistency issues. Finally, a data encoding program was used to check for logical consistency and for validation of encoded data before data tables were generated.

IV. Scope and Limitations

As this study is focused on ICT use in public high schools, it was decided by the researchers to focus only on schools that are known to have computers. Thus while it would have been ideal for purposes of establishing national estimates to use as sampling frame the entire universe of public high schools with existing ICT resources, consultations with DepEd Central Office revealed that no authoritative list of schools constituting that universe exists.

The lists that are available are for the 1996 DECS Computerization Program and a subsequent computerization initiative in 1999-2000. As the package for the latter program was delivered only in late 2000 and early 2001, the researchers decided to derive its sampling frame from the 1996 Program, which completed delivery by early 2000. This

meant that the ICT resources would have been present at the schools for at least one complete schoolyear at the time of the interview.

Furthermore, although efforts to minimize non-sampling errors (due to item nonresponse, measurement errors, recording errors, respondent errors, and data processing errors) were largely successful, some data from telephone/fax follow-ups have yet to be received as of the writing of this report.

For instance, in four of the 100 schools sampled, the Principal or his/her equivalent, Assistant Principal or Officer-in-Charge was unavailable for interview. Thus for these schools, seven questions pertaining to the history and goals of ICT use were not answered.

V. Findings

A. Profile of the Schools

General information. The one hundred public high schools included in this survey are located throughout the Philippines, with at least one school sampled from each region with the exception of ARMM. Half of the schools are located in Luzon—of which five are in Metro Manila—while the rest are in the Visayas (27%) and Mindanao (23%). The schools are also almost evenly divided in terms of locale, with urban and rural schools comprising 52% and 48% of the sample, respectively.

The schools vary widely in terms of total student population (See Table 3.). Twenty percent has less than 500 students, but an equal number has over 2,500. The smallest school in the sample has only 166 students. The largest school, on the other hand, has 11,848. The mean student size is 1,833, with a standard deviation of 1,886.

Table 3. Percentage of schools by size of student population (schoolyear 2001-2002)

Less than 500	20
500 to 1,000	21
1,001 to 2,500	39
2,501 to 5,000	12
More than 5,000	8
TOTAL	100

Similarly wide ranging is the student-teacher ratio in the schools, the lowest being 9:1 and the highest 95:1. The majority of the schools (55%) have a student-teacher ratio of between 30:1 to 40:1. An overwhelming majority of classes are overcrowded, however, with ninety-two percent of classes composed of over 40 students. Of these 31% are sections with over 60 students.

Electrification and telephony. A necessary condition for technology integration in the school system is the presence of basic infrastructure such as electricity and, for Internet access, telephony that can carry data. Thus, access of schools to such basic services has implications on the schools' capacity for ICT-integration.

All but one of the schools had power service at the time of the interview, with 89% having power 24 hours a day. The one exception had its electricity cut off in December

2001 but expects it to be reconnected within a month. Two schools have limited power service—one for only five hours per day and another, which relies solely on a generator, for only three hours. Two other schools have electricity 13 hours per day and the six remaining schools have power from between six to 12 hours per day.

In many of the schools, however, the regularity of power service remains an issue. One third of the schools experience brownouts at least once a month. Of these, half have brownouts once every two weeks. Extreme cases include a school that reports having brownouts ten times a month, and ten schools that say brownouts occur too frequently to count.

Over half (55%) of the schools have no fixed telephone lines, either because none is available in their area (41%) or they cannot afford it (10%) or both (2%). On the other hand, 20% of the schools have multiple landlines.

B. History and Goals of ICT Use

The majority of the schools claim to have used computers for educational purposes for at least two years (see Table 4.). First year to fourth year students in 68% of the schools have used computers for learning in some way for three to five years, and in 16% of the schools for even longer than that.

Table 4. Percentage of schools by the number of years ICT has been used for teaching and learning activities

2 years	11
3 to 5 years	68
6 to 10 years	16
No response	5
TOTAL	100

When asked about the goals that determine how computers are used in their schools, respondents considered preparing students to join the workforce, improving student achievement, and making the learning process more interesting their three most important goals (See Table 5.). Lower mean rankings for goals such as promoting active learning, individualizing the learning process, and encouraging cooperative learning suggest that these goals, although not considered unimportant, are less of a priority and that the prevailing notion of technology intervention is focused on the acquisition of basic technical skills and is still embedded in traditional pedagogy.

Table 5. Mean ranking of goals that determine how computers are used in the school

To prepare students for future jobs	2.54
To improve student achievement	2.85
To make learning more interesting	2.97
To develop student independence and responsibility for own learning	3.31
To promote active learning strategies	3.38
To encourage more cooperative and project-based learning	3.67
To individualize student learning experiences	3.68

To give students drill and practice exercises	3.73
To satisfy parents' and community expectations	3.87

This seems to be borne out by the responses to the question of the type of computer skills that, according to the school's goals, students should acquire by the end of their fourth year (See Table 6.). Almost all of the respondents cited basic skills such as "operating a computer" and "writing documents with a word processor". Fewer respondents claimed higher level skills such as "calculating with spreadsheets" or "writing simple programs" as part of the skill set they would like their students to acquire. Understandably since very few of the schools have Internet access, email- and Internet-related skills are given limited emphasis.

Table 6. Percentage of schools that identified the indicated computer skills as those which their students must acquire by the end of the fourth year

Operating a computer (saving files, printing, keyboarding)	99
Writing documents with a word processor (typing, editing, layout)	94
Making illustrations with graphical programs	77
Calculating with spreadsheet programs	70
Writing simple programs	63
Sending, searching for and using electronic forms of information	58
Communicating via e-mail with teachers and other students	41

ICT use in some of the schools has also not been formalized. Only 76% of the schools have a written policy or statement regarding the use of computers and/or the Internet. In most cases these written policies focus on present and future use of the computers, staff development, and the assignment of computer-related tasks, less so on hardware and software related issues or on the issue of "equity of access", i.e., ensuring equal access to all students and staff (See Table 7.)

Table 7. Percentage of schools whose written policy on the educational use of ICT has the indicated provisions

Use of computers in the current schoolyear	84.2
Plans for staff development with regard to ICT training	76.3
Use of computers in the forthcoming schoolyears	71.1
Specifications for computer-related tasks and persons-in-charge	63.2
Plans for hardware replacement or upgrade	59.2
Plans for software acquisition	51.3
Equity of access	48.7
Internet policy	22.4

C. ICT Resources and Use

Student-to-computer and teacher-to-computer ratios. The student-to-computer ratio is computed by dividing the total student population by the number of computers available for student use. Similarly, the teacher-to-computer ratio refers to the quotient of total

number of teaching staff by the number of computers that can be used by teachers. These statistics are a useful index of the level of ICT resources and use in a given school.

Findings from the survey indicate that there is an urgent need to improve student-to-computer ratios if the country is to successfully integrate ICT in the public secondary school system.

Two of the 100 schools surveyed no longer have computers currently in use whether for administrative or educational purposes.[14] Of the 98 schools with working computers, two dedicate their units to administrative (i.e., non-instructional) use. Thus, only 96% of the sample have computers used for educational purposes either by teachers, by students or by both. Furthermore, only 95 schools have computers that can be used by teachers. The same number of schools has computers for student use.

Among those schools with student access to computers, the student-to-computer ratio ranges widely from 12:1 to 1,098:1. The mean ratio is 267:1 (std = 209) and the modal ratio is 209:1.

Teacher-to-computer ratios appear slightly better, with almost a quarter (24.2%) of the schools that allow teacher access to computers having one computer for four or less teachers. Nonetheless, the mean ratio is still a poor 9:1 (std=8). The modal ratio is 8:1.

Processor types and operating systems. The technical specifications of computers are also a good indicator of the extent to which these devices can be used as an instructional tool, particularly its efficiency in running multimedia applications. In general, the computers currently in use in the schools surveyed have fast processors and fairly recent operating systems. 96.4 percent of all the working computers in the sampled schools have Pentium processors. The rest have either 486 (3.1%) or 8-bit processors (.5). The majority of the computers in the schools also run on Windows 95 or 98 (96%). Only a small number use Windows 3.1 (3.8%) or MS DOS (.2%).

Multimedia computers. Multimedia computers are defined as those with a CD-ROM drive and a sound card. Many educational software are multimedia in form, thus the number of multimedia computers available to teachers and students in a school is indicative also of the usefulness of a school's ICT resources for teaching and learning.

The computers available for educational purposes in the schools surveyed are predominantly able to support multimedia applications. Eighty-six percent of the computers available to students and 87% of those available to teachers have CD-ROM drives and sound cards.

Software. The number and variety of software applications available in a school also indicates the extent of use of computers and related tools.

[14] One of these schools was able to offer computer education classes for five years, until schoolyear 2000-2001, by virtue of an arrangement with a private computer training firm. The school stopped offering these classes after the students' parents said that they were no longer willing to pay the PhP50 monthly fee. Moreover, the private firm only offered the same basic courses every year and so student interest had already flagged. The second school which reported zero computers currently in use, on the other hand, only used the seven computers they received from DEPED in 1998 and in 2000 very briefly for teacher training. Teachers from that school report that the principal took two of the units home for personal use for one year and refused to let the teachers use the other units, which eventually became unusable because of improper storage.

Table 8 below shows that the types of applications that are present in the schools are predominantly "office software" or "productivity tools", i.e., word processing, spreadsheets, database management, etc. There is relatively less variety in the available software in terms of the different types of curricular and pedagogical tools (e.g., simulations, drill and practice, tutorials, etc.).

Table 8. Percentage of schools by the types of software for teaching and learning available

Word processing	100
Spreadsheet	99
Presentation software	99
Graphics	88.5
Database	88.4
Encyclopedia/References on CD-ROM	83.3
Recreational games	82.3
Desktop publishing	70.8
Tutorials	61.5
Internet browser	58.3
Educational games	57.3
Drill and practice programs	54.2
E-mail software	53.1
Video/Audio/Authorware	44.8
Programming languages	30.2
Music composition	18.8
Statistical / mathematical programs	16.7
Simulations	7.3

Of the subject areas in the secondary school curriculum, Science and Technology, English and Mathematics are typically those for which educational software is available for use by students (See Table 9.). On the other hand, there seems to be a relative dearth of educational software for music and arts classes, and particularly for subject areas that require local content in the local language such as Araling Panlipunan (Social Studies) and Filipino (National Language and Literature).

Table 9. Percentage of schools that have educational software available for use by students in the indicated subject areas

Mathematics	77
Science and Technology	76
English	76
Technology and Home Economics	50
Social Studies	17
Multidisciplinary projects or activities	9
Filipino	4
PE, Health and Music	4
Values Education	2

RHGP	1
NONE	7

Peripherals. Hardware peripherals such as printers, scanners, digital cameras, etc. also expand the functionality of computers, and the presence of such devices in the school suggests the extent of use of computers for educational purposes.

Printers predominate as far as peripherals available at respondent schools are concerned, both for instructional and non-instructional use. All 100 of the schools received two printers as part of the 1996 DECS Computerization Program. In each of the 96 schools that have computers for educational use, both printers from DepEd are still functional. Aside from printers, however, the availability of other types of peripherals are quite limited (See Table 10). For instance, only 21.9 percent of the schools have scanners and a miniscule 3.1 percent (3 schools) have digital imaging devices. Less than 10% of the schools have projection devices that would be useful during class presentations.

Table 10. Percentage of schools that have the indicated types of peripherals

Color printer	90.6
Dot matrix printer	53.1
Scanner	21.9
Inkjet printer	18.8
Laser printer	9.4
TV and decoder (projection device)	6.3
Video/LCD projector	4.2
CD writer	3.1
Devices for digital imaging and video processing	3.1
Graphical tablet	1.0
NONE	4.2

Local area networks (LANs). The presence of networked computers may also indicate a higher level of efficiency in the management of educational resources (e.g., the caching and sharing of files, distribution of Internet connection, etc.).

Only nine out of the 100 respondent schools have a local area network, with only seven of these with computers that can be used for educational purposes connected to the LAN. The number of networked computers for teaching and learning in these seven schools range from one to 176. The majority of the LANs use a single server (55%) while the rest have between 3 to 10 servers. All servers run on Windows NT, one of the most commonly used server operating systems wordlwide.

Instructional use of computers. Given the student-to-computer ratios and the types of software and hardware peripherals described above, it is not surprising that the instructional use of computers in the respondent schools is predominantly for basic computer skills training (typically under Technology and Home Economics or THE).

Respondents were asked to identify the subject areas where computers have been used for teaching and learning activities. Almost all of the schools that have computers for educational use (96.9%) cited THE (See Table 11.). In fact, 93.7% percent offer a full computer skills course under THE.

Table 11. Percentage of schools that use computers for teaching and learning activities in the indicated subject areas

Technology and Home Economics	96.9
Science and Technology	77.1
Mathematics	67.7
English	62.5
Multidisciplinary projects or activities	43.8
Social Studies	30.2
PE, Health and Music	27.1
Filipino	25
Values Education	25
RHGP	17.7
Literacy Program	1
Journalism	1
Citizen Army Training	1

Respondents also reported the use of computers in some way in the subject areas Science (77.1%), Math (67.7%) and English (62.5%). These responses are consistent with the claims regarding the availability of educational software discussed previously.[15] The lack of curriculum-relevant digital resources in the local languages would explain the relative infrequency of use of computers for Filipino, Social Studies, and Values Education.

The number of teachers and students who are actually able to use the computers also suggests the extent of ICT use in the school. The majority of the schools claim that only half or less of their teachers (63.2%) and students (66.3%) has been able to use the computer as an educational tool. Furthermore, a large majority of these student users are either seniors or juniors since the Computer Education classes are most commonly offered, following DepEd guidelines, at these year levels (See Table 12.). Such distribution of access appears tied to the primary ICT-related goal of most schools to prepare their graduates to join a workforce that demands basic proficiency in the use of productivity tools.

Table 12. Percentage of schools by year level at which Computer Education classes are offered

First year	32.6
Second Year	29.2
Third Year	76.4
Fourth Year	97.8

Internet access and use. Connectivity adds great value to a school's computer resources. With email and the Internet, teachers and students can, among other things, communicate

[15] It should be noted, however, that upon further probing it was revealed that in some instances the subject-specific use referred to involved simply using a word processor for typing up a report or using "PowerPoint" to make a presentation.

and collaborate with peers, colleagues, and experts anytime, anywhere and can access a wealth of learning resources online. Whether or not a school has Internet access therefore is another indicator of how much technology is being used to enrich the learning process.

Only 13 out of the 100 respondent schools can access the Internet and even then only for a limited time and not exclusively for educational purposes. Of these schools, only nine and eight allow teachers and students, respectively, access to computers that can go online. Three schools dedicate Internet time to administrative tasks while another has Internet access only for the personal use of one of its staff. Only one school uses its Internet time exclusively for educational purposes. In most cases, Internet access is shared between administrative and educational use.

For purposes of classroom instruction, moreover, the number of computers with simultaneous access to the Internet is key. As Table 13 shows the number of computers that can go online and are available for educational use are, in most cases, quite limited. Almost half of the schools have only one computer that can access the Internet. The mean student-to-computer with Internet ratio is 1,763: 1 (std=2,190).

Table 13. Percentage of schools by the number of computers that can access the Internet which can be used for educational purposes.

One	44.5
Two	11.1
Ten	11.1
Fourteen	11.1
Twenty	11.1
Thirty five	11.1

Time online is also in general fairly limited, ranging from 1.5 hours to 160 hours on the average per month. The mean access time (for educational and non-educational purposes combined) per month is 32 hours (std=42.5). A little over half of the schools access the Internet for an average of less than an hour per day (See Table 14.). Bandwidth (or the speed by which data can be transmitted through the network) is also a limiting factor. All but one of the schools have a dial-up connection of 56kbps.

Table 14. Percentage of schools by Internet access time per month

1.5 hours	9.1
4 hours	18.2
12 hours	9.1
16 hours	9.1
17 hours	9.1
20 hours	9.1
25 hours	9.1
35 hours	9.1
60 hours	9.1
160 hours	9.1

Given these limitations, it is not surprising that 75% of the schools claim that not more than 10% of their teachers are actually able to use the Internet for teaching-related

activities (See Table 15.). Slightly better percentages were found with respect to student use of the Internet for learning tasks (See Tables 16.)

Table 15. Percentage of schools by the percentage of teachers who have used the Internet for educational purposes

1% to 10%	75
26% to 50%	12.5
Over 75%	12.5

Table 16. Percentage of schools by the percentage of students who have used the Internet for educational purposes

1% to 10%	57.1
11% to 25%	14.3
26% to 50%	14.3
51% to 75%	14.3

When asked what educational activities teachers and students performed using the Internet, doing research was the most common response. Using email and bulletin boards for communication and collaboration were less frequently practiced, even less so designing and maintaining web sites (See Table 17.). In fact, only one of the schools surveyed reported having a web presence.

Table 17. Percentage of schools whose teachers and students performed the indicated teaching and learning activities using the Internet

Teaching-related activities	
Doing research: using external databases to retrieve and extract information from different sites across the Internet	100
Using e-mail or bulletin boards to exchange ideas with peers/subject matter experts	62.5
Disseminating information via the Internet	62.5
Using e-mail or bulletin boards for group projects/collaboration within the school and/or with other schools	50
Designing and maintaining Web sites	12.5
Student learning activities	
Doing research: using external databases to retrieve and extract information from different sites across the Internet	85.7
Communicating via e-mail with teachers/experts/peers within and/or outside the school for learning purposes	57.1
Communicating via e-mail with teachers peers/ experts from other schools within and/or outside the country	42.9
Using e-mail or bulletin boards for group projects/collaboration within the school and/or with other schools	42.9
Disseminating information via the Internet	42.9
Designing and maintaining Web sites	28.6

When asked, on the other hand, in what subject areas teachers and/or students have used the Internet in some way, all the respondents claimed that the Internet has been used

in Technology and Home Economics (See Table 18.). Science and Technology (75%), Math (62%) and English (62%) were the next most common subject-specific use of the Internet. These findings seem to suggest that in terms of both computer-aided and Internet-enhanced instruction, there is a tendency to favor the four subject areas mentioned above.

Table 18. Percentage of schools by the subject areas for which the Internet has been used by teachers and students

Technology and Home Economics	100
Science and Technology	75
Mathematics	62.5
English	62.5
Social Studies	50
Filipino	37.5
Multidisciplinary projects or activities	25
PE, Health and Music	25
Values Education	12.5
RHGP	12.5

Non-instructional use of computers. Computers in the schools are also being used for administrative and management tasks, both at the school-level (by administrators and non-teaching and support staff) and at the class level (by teachers).

Table 19 indicates how often computers are used for different non-instructional activities. Administrators and non-teaching personnel from the majority of the schools use computers "often" for preparing and updating class schedules, staff administration, financial administration, and for communicating with persons outside of the school. Almost half of the schools, however, have not computerized their library database, assuming that they have one in the first place. On the part of teachers, computers are used for preparing instructional materials such as lesson plans, exams and teaching aids as well as for keeping track of students' progress. Spreadsheet programs, however, are less frequently used for computing grades.

Table 19. Percentage of schools by the frequency of use of computers by non-teaching and teaching staff for the indicated administrative/management tasks

School administrative activities	Never	Sometimes	Often
Creating and updating of class schedules	3.0	34.8	62.1
Staff administration	3.0	25.8	25.8
Financial administration	10.6	19.7	69.7
Communication with DepEd, parents and others outside the school	4.5	15.2	80.3
Updating the library database	4.5	31.8	19.7
Class administration activities			
Creating and updating lesson plans, exams and other teaching aids	9.1	28.8	62.1
Computing grades	16.7	40.9	42.4
Keeping track of students' learning progress	15.2	33.3	51.5

D. Staff Development

Teachers are critical to the success of technology integration in the classroom. A school's capacity to use technology to enhance the learning process depends not only on its level of development in terms of ICT infrastructure and resources but equally on the level of teacher ICT-competencies, both technical and curricular/pedagogical.

Respondents were asked to estimate the proportion of their teachers who have basic computing (i.e., operating a computer, using word processing, spreadsheet, graphical, and presentation programs) and Internet-related (i.e., using email, researching online) skills. They were also asked how many teachers in their schools know how to use software applications designed for their respective subject areas.

Over half of the respondents (52%) claim that at most only half of their teachers have some knowledge of computer fundamentals and can use productivity tools (See Table 20.). In fact, in 13% of the schools, 10% or less of the teachers have basic computing skills. It is somewhat encouraging, however, that in almost a third of the schools (29%) at least 75% of the teaching staff is computer literate.

Table 20. Percentage of schools by the percentage of teachers with basic computing skills

1% to 10%	13
11% to 25%	8
26% to 50%	31
51% to 75%	19
More than 75%	29

Internet skills are less prevalent in the schools surveyed (See Table 21.). In twenty percent of the schools, not a single teacher has basic Internet skills, and in over half of the schools (54%) only 10% or less can email or do online research.

Table 21. Percentage of schools by the percentage of teachers with Internet skills

None	20
1% to 10%	54
11% to 25%	9
26% to 50%	12
51% to 75%	3
More than 75%	2

This is not surprising considering that only 13% of the schools have Internet access. What is remarkable is that in schools that do have Internet access the percentages are only somewhat better (See Table 22.). In only 15.4% of the schools are the majority of teachers Internet savvy. In a large majority (89%) of the schools not more than half of the teacher population know how to use the Internet, with over a third (38.5%) of the respondents reporting that only between 1% and 10% of their teachers can email or do online research.

Table 22. Percentage of schools with Internet access by the percentage of teachers with Internet skills

None	7.7
1% to 10%	38.5
11% to 25%	15.4
26% to 50%	23.1
51% to 75%	7.7
More than 75%	7.7

Considering also the general lack of educational software available in the schools, it is not surprising that most teachers lack the skills to use such digital learning resources for instruction in the different subject areas (See Table 23.). In over a third of the schools (36%), only a small minority of the teachers can use subject-specific applications. Eight percent of the schools have no teacher who has this competency. In a few cases (6%), however, at least 75% of the teachers know how to use software for teaching in specific subject areas.

Table 23. Percentage of schools by the percentage of teachers who can use subject-specific applications

None	8
1% to 10%	36
11% to 25%	19
26% to 50%	23
51% to 75%	8
More than 75%	6

Training opportunities for teachers are generally limited (See Table 24.). Consistent with the estimates of the number of teachers who have ICT skills, 50% or less of the teaching staff in the majority of the schools (58%) have had computer-related training since the schools received the DepEd computer package, while in 12% of the schools teachers have had no computer-related training at all. There is a significant minority of schools (20%), however, where more than 75% of the teachers have undergone some sort of ICT training, although what exactly this training involved and how effective it was are undetermined.

Table 24. Percentage of schools by the percentage of teachers who have undergone ICT-related training (in-house or external) since the schools received the DepEd computer package

None	12
1% to 10%	23
11% to 25%	15
26% to 50%	20
51% to 75%	9
More than 75%	21

E. Technical Support and Needs

Aside from teacher ICT literacy skills and competencies related to the instructional use of ICT in the different subject areas, another factor affecting the use of ICT is the ability of the school to 1) coordinate ICT-enabled learning activities and provide user support, both technical and curricular; and 2) manage and maintain computers and computer systems. Put another way, does the school have the capacity to coordinate learning activities that involve ICT? Does it have the skilled personnel who can assist teachers and students in using ICT for curriculum-relevant purposes? Finally, is there anyone in the school who has the technical competencies to maintain computers and administer computer systems?

All but one of the schools have a "computer coordinator", whether formally or informally designated. In nine of these schools, there is more than one person put in charge of the school's ICT resources. But in a majority of the cases (75.5%) the "computer coordinator" is a member of the faculty with a heavy teaching load who only performs his/her coordination duties part-time (See Table 25.). A handful of schools (6.1%) rely on an individual who is either an employee of a private firm to which the school outsources the computer training of its their students or is a local computer technician.

Table 25. Percentage of schools that have the indicated person/s as "computer coordinator/s"

A part-time coordinator with a heavy teaching load	75.5
A full-time computer coordinator (may have a small teaching load)	24.5
The school principal or non-teaching administrator	7.1
A person from a private computer training firm	6.1
A person from the division or region	4.1
A librarian	1.0
A committee for the coordination of technology	1.0
A clerk	1.0
None	1.0

Schools with Internet access rarely employ a full-time information specialist who can provide support to teachers and students for online research (See Table 26.). Either a member of the teaching staff, the principal or non-teaching administrator, or the computer coordinator performs this function for the school. Two schools provide no research support to their teachers and students at all.

Table 26. Percentage of schools with Internet access for educational use that have the indicated persons to provide support for online research

A member of the teaching staff	40
The school principal or non-teaching administrator	30
Computer coordinator	20
A full-time information specialist/librarian	10
A part-time information specialist from a private firm	10
None	20

Only about a third (32%) of the schools surveyed have at least one member of its staff who can install, maintain and repair computers and software. In some of these schools (40.7%), these "technicians" have been at the school for two years or less, with some only recently being employed (See Table 27.). In others (59.4%), these persons have been employed by the school for three years or longer.

Table 27. Percentage of schools with a person employed to install, maintain and repair computers and software by the number of years person has been employed by the school

Less than one year	21.9
1 to 2 years	18.8
3 to 5 years	46.9
More than 5 years	12.5

The schools that reported having local area networks (LANs) are almost evenly divided in terms of employing a person competent to operate and maintain LANs and those who do not (55.6% and 44.4%, respectively). The majority of those who do employ a LAN administrator have done so for at least three years (See Table 28.).

Table 28. Percentage of schools with a person employed to operate and maintain local area networks by the number of years person has been employed by the school

Less than one year	21.9
1 to 2 years	18.8
3 to 5 years	46.9
More than 5 years	12.5

The difficulty schools experience in meeting the technical demands of having technology in the classroom is made apparent by the respondents responses to the questions related to hardware breakdown. As these machines are fairly fragile and may malfunction if not handled properly, it is not surprising that 87% of the schools have had problems with their hardware at least once or twice within a one-year period (See Table 29.) Thirteen percent have had hardware problems more than once every two months. A few schools (13.3%), however, have managed their ICT equipment well and have never experienced problems with their hardware.

Table 29. Percentage of schools by frequency of hardware breakdown within a one-year period

1 to2 times	54.1
3 to 4 times	15.3
5 to 6 times	3.1
More than 6 times	13.3
Can't estimate	2
Never	13.3

Getting broken computers repaired is, in turn, not a simple matter for many of the schools (See Table 30.). When asked to recall the last time a computer in their school

broke down and to estimate the amount of time it took for the computer to be repaired, respondents in 42% of the schools said that it took a month or more. Nineteen percent claimed that the computer has never been repaired. On the other extreme, respondents in 30% of the schools report that the computer was repaired within a week.

Table 30. Percentage of schools by the length of time it took for a broken computer in the school to be repaired

Within a week	30
Within 2 to 3 weeks	9
A month or more	42
Never	19

The two most common problems encountered by schools when computers or any hardware break down is first, the lack of funds to pay for the repairs and second, the absence of anyone in or near the school who has the know-how to diagnose and fix the problem (See Table 31.).

Table 31. Percentage of schools by difficulties experienced when computers break down

The school has no funds to pay for repairs and/or replacement parts	38.7
No one (in the school/nearby) knows how to repair computers	33
Parts that need to be replaced are not readily available	9.7
Hardware is beyond repair	7.3
Hardware damaged en route to school after being repaired elsewhere	.8
None	10.5

In the absence of computer technicians employed in the school, especially if the school is in a relatively remote area and/or has limited funds, technical support will be a key issue in sustaining ICT use in the classroom. One stark example is the case of two rural schools located far from the city that found out soon after the delivery of the computers under the DECS Computerization Program—in 1998 in one school and in 1999 in the other—that a number of the units were not working properly. These computers were never replaced or repaired.

The issue of maintenance is also tied to the lack of space in the school premises to locate computers properly. Table 32 indicates how schools with a computer laboratory consisting of at least five computers (53 of the 100 schools sampled) fare in terms of meeting some structural requisites for a room to be adequate to ensure that computers will be operated and maintained properly, i.e., clean and dust-free, dry, adequately lighted, air-conditioned, secure, and with its own circuit breaker.

Table 32. Percentage of schools by the indicated features of computer laboratories with five or more computers

Dry (e.g. no ceiling leaks, no flooding)	93.5
Clean and dust-free	67.7
Adequately lighted	88.7
Air-conditioned	50
Secure (e.g., double locks on door(s) or door grills, grilled windows,	85.5

and/or 24-hr security guard in school)	

Although the majority of the schools comply with these specifications, a fairly large percentage does not and this would explain in part the difficulties these schools experience in keeping their computers in good running order. In particular, it is remarkable that only half of the schools have air-conditioned computer laboratories, and that almost a third does not keep their laboratories free of dirt and dust.

These factors can adversely affect the performance of these machines, and in a situation where there are no trained staff to troubleshoot and repair, as is the case in most of the schools, prevention is the better part of maintenance.

Security can also be a concern. Two of the schools surveyed report that each had five of the seven computers provided by DepEd stolen, despite the fact that their respective computer rooms had grilled doors and windows as well as double locks.

In cases where no classroom is available at all to be turned into the school's computer room, computers are housed in the principal's office or other administrative rooms. Respondents from two schools reported their principal's decision to put all the computers they received from DepEd in his/her office as an interim measure, while they waited for a proper computer room to be secured. Both schools claim to make these computers available for student use although clearly this is not the ideal set-up and may have a limiting effect on student access.

Provision of the proper structure to house computers and other hardware requires some degree of capital investment on the part of the school. The same is true for technical support and maintenance (This is especially so for the DepEd program beneficiaries which were expected to provide a counterpart contribution in the form of preparation of an air-conditioned computer room and the monthly cost of operations.). To defray the cost of operations some schools (28%) have resorted to charging user fees, mostly from students who take Computer Education classes. Of these, three schools have taken a more radical approach, that is, partnering with a private computer training school that will then set-up a computer laboratory on the school premises and assume all technical support functions in exchange for delivering computer-related training to the student population for a fee. User fees range from three pesos to three hundred pesos a month.

F. Major Obstacles to ICT Use

Respondents were asked to rank what they perceived to be the five biggest obstacles to their schools use of ICT for teaching and learning. Rankings were consolidated and mean ranks were computed (See Table 33.). Lack of enough computers is the single biggest obstacle according to the respondents, with a mean ranking of 2.35. All other issues have mean rankings considerably lower than this. Lack of enough technical support for operating and maintaining ICT resources (4.29) and the lack of teacher training opportunities (4.63) are considered barriers to change as well. So too are the lack of space for computers (5.01) and the general lack of funds for operations (5.03), including maintenance of equipment, purchase of supplies, and electricity.

Table 33. Mean rankings of what respondents consider to be major obstacles to the use of ICT for teaching and learning in their schools

Insufficient number of computers	2.35
Not enough technical assistance for operating and maintaining computers and/or insufficient help for solving technical problems with ICT	4.29
Not enough training opportunities for teachers	4.63
Not enough space to locate computers appropriately	5.01
Lack of funds	5.03
Insufficient peripherals (printers, scanners, etc.)	5.14
Teachers lack knowledge/skills in using computers/the Internet for instructional purposes	5.14
Not enough staff for supervising computer-/Internet-using students	5.37
No time in teachers' schedules to explore opportunities for using computers/Internet	5.46
Not enough copies of software for educational use	5.51
Insufficient time for teachers to prepare lessons in which computers/ the Internet are used	5.59
Weak infrastructure (telecommunications, electricity, etc.)	5.59
Problems in scheduling enough computer/Internet time for different classes	5.61
Lack of interest/willingness of teachers to use computers/ the Internet	5.73
Inadequate administrative support or initiative at the school/division/regional level	5.73
Insufficient plans and/or resources to prevent theft and vandalism of computers	5.76
Absence of or outdated school network/LAN	5.77
Difficulty integrating computers/ the Internet in classroom instruction practices	5.79
Not enough types (variety) of software	5.89
Lack of knowledge on what hardware/software to buy	5.92
Imported educational software not compatible with DepEd curriculum	5.93
Lack of skills/knowledge of students in handling computers	5.96
Insufficient number of teachers	5.96
Indifference of parents	5.96
Software too complicated for teachers and/or students to use	5.98
Teachers feel uncomfortable because some students are more competent with ICT than they are	5.99

Respondents were also asked in what areas of ICT use the schools needed more information and support. Responses reinforce the general sense that schools recognize gaps in their knowledge and preparedness for adopting technology-based instructional practices, and require additional guidance in optimizing whatever ICT resources they may have. All of the respondents indicated that there is a need for more information on how to use ICT to support the curriculum, and almost all require more advice on the use

of ICT for administrative work (92%) and on developing the information-handling skills of students and teachers (96%). There seems also to be some uncertainty over what ICT capabilities are prescribed at the national, regional, and divisional levels, with 87% of the schools needing more guidance on this matter. More information is also needed by the majority of the schools on how to use ICT with both underachieving and gifted pupils (87% and 79% respectively), as well as pupils with sensorial or physical disabilities (57%).

VI. Conclusion and Recommendations

Less is not more. Although it is true that it is not how much technology you have but how you use it that matters, certain minimums must be reached for instructional use of ICT to be viable. This is particularly true in public high schools where classes are typically overcrowded. The critical issue of equity of access hangs, in the first instance, on the presence in the schools of a sufficient number of computers to accommodate the needs of the largest possible number of students. Thus, the limited quantity of ICT resources present in the schools is, as suggested by the respondents themselves, the most obvious and pressing constraint to large-scale ICT use in schools. Student-to-computer ratios and teacher-to-computer ratios must be improved to double digit levels initially, and eventually to single digit levels, if technology is to become an effective form of intervention in the public secondary school system.

Increased investment in computers should be accompanied by a corresponding investment in hardware peripherals—especially those that deepen the educational functionality of computers (i.e., scanners, projection devices, imaging and audio tools, etc)—and in creating local area networks that allow for the more efficient management and sharing of learning tools and content. LANs will also allow for simultaneous access to the Internet. As the findings of the survey indicate, the majority of public high schools in the Philippines do not have nearly enough hardware, peripherals, network technologies, and simultaneous Internet access for technology use to begin to have an impact on the quality of instruction.

Software is as important as hardware. The number and variety of available applications in a school help define the scope of instructional use. And if, as the survey findings show, what applications that are available are predominantly office programs or productivity tools, then schools will be limited to teaching the tools rather than using the tools to teach. Without a variety of subject-specific application types (drill and practice software, tutorials, simulations, composition programs, educational CDs, etc.), as is the case in most public high schools, the curricular usefulness of the technology will not be realized fully. In a sense, computers will merely become glorified typewriters, and the only thing that computerization will accomplish is to raise the school's electricity bill. Furthermore, what little software there are in the schools is mainly for the Sciences, Math and English. The dearth of digital resources on local issues and concerns in the local language must be addressed as well if technology is to enable instruction in the learning area Filipino and in Social Studies which is a component of the Makabayan learning area. Technology-based learning materials for Values Education, which the new curriculum specifies should be integrated in all learning areas, should also be developed.

Quality of use. Deciding on what hardware or software to buy—or more broadly designing the ICT architecture and engineering of the public secondary school system—is contingent on what that technology is intended to be used for. Heartening though it may be that most of the computers in public high schools are fast, powerful and relatively versatile, if these machines are to be used predominantly for computer literacy training, as is suggested by survey findings, then it is a sad waste of a lot of technology muscle. If, on the other hand, technology use is envisioned as a strategy to effect positive changes in pedagogy towards better student achievement across all subject areas then the benefits reaped from the use of the technology will outweigh its considerable cost. Thus, it is imperative that prescribed technology solutions are matched with curricular goals, whatever these may be.

At the same time, attention should also be given to instances when gaps exist between stated goals and actual ICT use, and the factors that contribute to such gaps. For instance, results of the survey show that aside from providing students with the requisite technical skills to become productive members of the workforce, schools also aim to use ICT to improve student achievement. Directly related to this but given less priority is how technology can help transform the learning process and promote the acquisition of lifelong learning skills. This seeming disjunction may be explained in part by the general lack of guidance and support on how to use ICT to support the curriculum noted by all the schools, as well as the need for greater clarity on national, regional and divisional prescribed ICT capabilities.

These, in turn, can be partly explained by the fact that a nationally prescribed technology-enhanced curriculum remains a work-in-progress and has been such for a number of years. While the 2002 Basic Education Curriculum acknowledges the value of technology as an education reform tool and provides for the infusion of technology in all subject areas whenever appropriate, specific guidelines for how this can be done have not yet been formalized. What is available is an IT curriculum that covers basic computer and Internet literacy skills and some basic programming.

Thus, one possible contributing factor to the gap between goals and actual use is the incomplete institutionalization of the process of technology integration in the curriculum. Without this, the mechanism by which school administrators, teachers and students can obtain the range of technical, curricular, pedagogical and financial support required to sustain technology use cannot flourish.

Back to basics. Findings from this survey highlight a number of other interacting issues that inform the complex process of technology integration in the public secondary education system in the Philippines. First is the issue of basic school infrastructure. This includes stability of power supply, the scope of available telecommunications service and Internet access, and the availability of space in the school to accommodate the deployment of technology resources.

As revealed in the survey of public high schools nationwide, while electrical power is widely available the frequency of power interruptions in some schools can cause breakdowns in the ICT equipment and interruptions to instructional use. The relatively limited scope of fixed wire telephone networks, on the other hand, precludes the cost-effective use of the Internet in many schools, as the cost of wireless access remains prohibitive. Last mile solutions should therefore be explored in partnership with the

private sector to ensure that even the more remote schools are able to reap the educational benefits of new advances in technology. Clearly in a country like the Philippines where topography poses challenges to infrastructure development, there can be no cookie-cutter solution. Prescriptions on ICT architecture and engineering should take into account the diversity of school settings and match cost-effective technology solutions to realizable types and levels of ICT use.

The lack of space in which to properly maintain computers and other ICT equipment is another barrier to the widespread use of ICT in schools. In addition, there are costs attendant to adequately preparing a room to house ICT equipment, both one-time and recurring, which some schools may not be able to assume. Such costs include air-conditioning, electrical rewiring, and security, among others.

Another focus of concern which findings from the survey indicate have implications on the type and extent of ICT use in a school is that of the need for capacity building among teachers, administrators and other school staff. In general, ICT-related skill levels in the schools surveyed were less than ideal. Too few teachers have the know-how to apply ICT in the teaching of specific subject areas. Although computer literacy levels are somewhat higher, Internet-related skills levels are relatively depressed as well.

There exists also a dearth of technical and information specialists in the schools who can operate and maintain computers and computer networks as well as provide user support for Internet-related activities. And while most of the schools have a designated computer coordinator, in most cases it is a teacher with heavy teaching responsibilities and who performs coordination functions only part-time.

Bringing technology into the school setting demands that teachers and administrators acquire new skill sets, and this cannot be done overnight. The lack of training opportunities decried by survey respondents focuses attention on the need to develop a comprehensive and sustained in-service training program for teachers and administrators. Moreover, pre-service training institutions must also incorporate into their curricula the knowledge and skills that characterize the technology-enabled teacher.

Finally, retooling the Philippine secondary school system through technology can only be accomplished at enormous financial cost. As survey findings suggest, financing is, at this initial stage, possibly the single biggest barrier to ICT use in the classroom. Billions of pesos will be required to improve student-to-computer ratios alone. Aside from this, considerable investment must be made on peripherals, networks, software, and software development. The task of upgrading the skills of hundreds of thousands of teachers and school administrators will also be capital intensive. Funds must also be available to defray the recurring costs of operations (including electricity, supplies, telephone time, Internet access) as well as the cost of maintenance, repairs, and upgrades.

Given the fiscal constraints under which the DepEd operates, it is imperative that whatever technology is actually deployed in the schools will be used optimally and in pursuit of clear educational goals. Optimizing technology use involves harmonizing technology choices with curricular needs, competencies, and fiscal realities. This means determining the level of preparedness of every school to adopt technology-enhanced learning practices, and based on this devising a national strategy of prudent acceleration in which sustainability is the driving principle. To this end, the following recommendations are made:

- Conduct a comprehensive assessment of the ICT environment at the school, division, regional and national levels. This "ICT profiling" would include an inventory of existing ICT resources and its utilization; the identification of both drivers of and barriers to ICT-integration, whether infrastructural, logistical, financial, institutional, curricular, pedagogical, or cultural; and the identification of key stakeholders. The resulting database would inform national strategic planning and implementation, and should be regularly updated.

- Formulate and circulate to all stakeholders an official National ICT for Basic Education Strategic Plan that would harmonize and direct present and future efforts of government, the private sector, and civil society groups to reform basic education through ICT.

  The Strategic Plan should include:
  - A unifying vision to fully integrate ICT in the secondary school system (i.e., not just to teach and learn the technology but to use the technology to improve teaching and learning) and clearly articulated and measurable curricular/pedagogical goals and objectives.
  - Design of the ICT architecture and engineering, with emphasis not on "how much technology" but on "how it will be used". This would include setting technology standards for different types and sizes of schools as well as different levels of use.
  - Development of specific guidelines, templates, teaching aids for integrating ICT in the curriculum.
  - Development of curriculum-specific software including those in the local language.
  - Development and implementation of a comprehensive in-service training program for teachers and administrators covering computing and information literacy skills, the instructional and non-instructional uses of ICT, curriculum integration and corresponding pedagogical strategies.
  - Incorporation of the same knowledge and skill sets at the pre-service training stage.
  - Development and implementation of a comprehensive program for building the capacity of schools to address technology and technical support issues.
  - A financing plan that includes measures to increase the national budgetary allocation for education in general and ICT-integration in particular; to institutionalize local government support through the Local School Boards, to get buy-in from Parent-Teacher Associations and actively promote community mobilization efforts, and to build public sector-private sector partnerships.
  - Institutionalization of monitoring and evaluation at the Bureau and Regional levels. This would also involve the development of tools for assessing the impact of ICT-integration on student achievement.

It is recommended that pilot testing be an integral part of the Strategic Plan, the results of which will be critical in addressing efficacy, sustainability, and scalability issues.

This Strategic Plan should be a rolling document, to be revisited periodically and, if appropriate, revised to accommodate changes in the technological, educational, sociocultural, and fiscal environments.

- Create the institutional mechanism for the effective and efficient implementation of the Strategic Plan, beginning with the establishment of a Center for Educational Technology within the Department of Education.

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