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DOCTORAL THESIS

INTEGRATION OF INFORMATION & COMMUNICATION TECHNOLOGY IN PUBLIC SECONDARY SCHOOLS IN METRO-MANILA, PHILIPPINES

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HACE CONSTAR

Que la presente tesis de doctorado está concluida y autoriza su presentación ante la Comisión de Doctorado puesto que reúne los requisitos necesarios para su posterior defensa pública ante el tribunal correspondiente. Como director de la tesis valoro como buena la originalidad de la investigación, los objetivos, la metodología, la relevancia del trabajo y los resultados, así como la discusión y conclusiones.
Y para que así conste a los efectos oportunos, firmo este documento en Santiago de Compostela, a 13 de abril de 2012

Xosé López

Director de la tesis

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"Thank you for the fire you have set ablaze within me
With your kisses you´ve awakened
This old heart from its slumber
I feel like 17 again, It´s all because of you
Thanks for choosing me from all the rest
Though I´m far from being the best.
Most of all I want to thank you, love,
for loving me."
Jose Marie Chan – *Thank you Love*

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ABSTRACT

The purpose of the study was to examine integration of ICT in selected public secondary education schools in Metro Manila, Philippines. The parameters used included a)availability of ICT resources b)level of skills, c)extent of usage d)problems inhibiting adoption, and e)perceptions and goals. Samples of the study included 431 teachers, 1001 students and 17 principals representative of the divisions of schools in Metro Manila. The study employed both quantitative and qualitative research design. Methods used included researcher-prepared questionnaire, interview, focus group discussion, and document review.

Major Findings

The lack of hardware remains to be the most pressing and persistent problem. Relative to student population, the computer-to-student ratio is dismally low at 1:63. Access to computers is limited to those taking computer education subjects. Almost half of the schools do not have computer maintenance due to lack or low budget. While 88 percent of schools have internet connections, yet half of the students claimed that they do not use it.

Almost half of the teachers never attended ICT-related trainings. Trainings conducted were generally on computer literacy like basic operations, word processing, and spreadsheet. Critical applications using educational games, CAI, simulations registered lower usage. Most of the teachers do not use ICT in the classroom. The study revealed that ICT is used few times a year and type of use is concentrated on lesson preparation and class management. Majority of teachers accept that students know more about computer and internet and the result of data analysis confirmed this view.

Most students underscored the importance of education. With ICT, they believed it can facilitate and improve their learning achievements. Students indicated that they be given more responsibility for their learning. Their problems are primarily on lack of computer, time, internet, and software. Students' awareness in the relevance of ICT to their future employment is very high.

Conclusion

The benefits of ICT have not trickled in the classroom. ICT integration remains to be learning *about*, rather than learning *with* ICT tools. A policy review is needed for equitable distribution of sparse ICT resources across all learning areas. Public-Private Partnership program have to be strengthened given governments limited resources. A clear strategic plan, concrete actions, continuous measurement & evaluation, and strong leadership are needed to make ICT a transformative tool in teaching and learning.

Keywords : ICT integration, educational technology, ICT4E

RESUMEN

El objetivo del estudio era examinar la integración de la TIC en las escuelas de educación secundaria pública seleccionada en Metro Manila, Filipinas. Los parámetros utilizados incluyen : a) disponibilidad de TIC recursos b) nivel de habilidades, c) medida de uso d) problemas inhibiendo la adopción y e) percepciones y objetivos. Muestras del estudio incluyeron 431 docentes, estudiantes de 1.001 y 17 representantes de los directores de las divisiones de las escuelas en Metro Manila. El estudio empleó tanto diseño de investigación cuantitativa como cualitativa. Los métodos utilizados incluyen el cuestionario preparado por el investigador, entrevista, discusión de grupo de enfoque y revisión de documentos.

Principales Resultados

La falta de hardware sigue siendo el problema más apremiante y persistente. En relación con la población estudiantil, la proporción de equipo al estudiante es desalentadoramente baja en 1:63. El acceso a las computadoras se limita a los temas de educación de equipo. Casi la mitad de las escuelas no tienen mantenimiento de equipo debido a la falta o de bajo presupuesto. Mientras que el 88 por ciento de las escuelas tienen conexiones a internet, sin embargo, la mitad de los estudiantes afirman que no lo usan.

Casi la mitad de los maestros nunca asistieron a cursos de capacitación relacionados con la TIC. Los entrenamientos realizados eran, generalmente, sobre alfabetización informática como operaciones básicas, procesamiento de textos, hoja de cálculo. Las aplicaciones críticas mediante juegos educativos, CAI, las simulaciones registraron menor uso. La mayoría de los profesores no utilizan la TIC en el aula. El estudio reveló que la TIC se utilizan pocas veces al año y el tipo de uso se concentra en la gestión de la preparación y administración de la clase. La mayoría de los profesores aceptan que los estudiantes conocen más acerca del equipo e internet. El resultado del análisis de datos confirmaron este punto de vista.

La mayoría de los estudiantes subrayaron la importancia de la educación. Con la TIC, creían que podian facilitar y mejorar sus logros de aprendizaje. Los estudiantes indicaron que necesitaban más responsabilidades en el aprendizaje. Sus problemas son principalmente en la falta de equipo, tiempo, internet y software. Los estudiantes son conscientes de la importancia de la TIC para su empleo en el future.

Conclusión

Todavia, no se han fitrado los beneficios de la TIC en las aulas. La integración de la TIC sigue a estar aprendiendo, en lugar de aprender *con* herramientas TIC. Es necesario un sistema de recursion para la distribucion equitativa de escasos recursos dela TIC in todas las áreas de aprendizaje. El programa de asociación público y privado tiene que reforzarse teniendo en cuenta los limitados recursos del gobierno. Se necesitan para hacer de la TIC una herramiento de transformación en la enseñanza y aprendizaje : un plan estratégico claro, las acciones concretas, la medición continua y la evaluación, y liderazgo fuerte.

Palabras clave: Integración las TIC, tecnología educativa, ICT4E

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INTRODUCTION

"The Philippine Basic Education System is a system in crisis. The poor performance of students across the country in national and international achievement tests, and the consistently high drop-out rates in the elementary and secondary school levels, underscore the deterioration of the quality of the Philippine schools system. . . .At the root of the crisis is a combination of under-investment and poor management."

National Framework Plan for
ICTs in Basic Education (2005-2010)

BACKGROUND OF THE STUDY

With trend towards globalization, nations are investing heavily on knowledge economy, where knowledge is considered as significant factor in generating wealth, employment, growth. Education is the key ingredient to this new economic order. Today, the Philippines faces the challenge of transforming its fast growing population into a "human capital" to become a knowledge-based economy.

Based on the 2007 Philippines Census of Population, the National Statistics Coordinating Board (NSCB, 2009) reported that population is *88.6 millions*. Roughly thirty percent of the population are in the ages where they should enter the basic education program. Of this figure, only 19.3 millions are attending basic education program (DBM, 2009), and more than one third or about 7 million children are not in the classroom. There is also the issue of shortage of teacher causing a teacher-to-pupil ratio of 1:50. The more than 6-hours of actual classroom teaching translate into poor teacher performance and quality of learning. The dismal performance was clearly shown in the Trends in International Mathematics and Science Study (NCES, 2004)

where the Philippines ranked among the lowest – 23rd of 25 in Mathematics and 41th of 45 in Science. East Asian countries like Singapore, Korea, Hongkong, Chinese-Tapei, and Japan consistently outclassed all participating countries and these are the same high-economy societies with rapid technological progress and productivity growth.

The Philippines ranked 2nd in the Comparative Unemployment Rate in Asia (EIU, 2006) with 7.3 percent of its economically active segment of the population without work. Each year there are 386,920 graduates in the tertiary level (CHED, 2009) and most of them end up unemployed. While incidence of poverty coming from the unemployed is 9. 2.%, the agricultural, fishing and forestry sector's poverty incidence is 61.6% (ADB, 2005). These segments of society are the ones who generally lack education.

The Philippines government understands and accepts this challenge and have since given it the top most priority in its agenda. Budget had been refocused to education instead of defense. The Department of Education has the biggest budget appropriation of P172.8 (DBM, 2009) This is part of the goal of the Medium Term Development Plan (MTDP) of the Philippines that by 2010 "everyone should be in school, in an uncrowded classroom, and its surroundings conducive to learning" (NEDA, 2004a).

Science, technology, and innovations are key factors for economic growth and the use of Information and Communications Technology (ICT) is the enabler in technological progress and productivity. Economic

competitiveness depends on the strategic adoption of ICT. The key role of ICT had been recognized by the Philippine government through the MTDP which says: "ICT will be harness as a powerful enabler of capacity development. It will therefore be targeted directly towards specific development goals like ensuring basic education for all and lifelong learning among others"(NEDA, 2004a). The government instituted measures such as : e-commerce law, national information technology plan, government information systems plan, and the creation of Commission of Information and Communications Technology. Along with this, P1.1 billion had been earmarked for the purchase of computers and internet connectivity for 9,048 elementary and secondary schools (DBM, 2009)

There is a growing challenge in the Philippines in the appropriate and efficient use of information and communication technology (ICT) in teaching and learning. With the multitudes of programs launched by both private and public sectors there are questions of what happened, present status, and where the program is heading.

The resources poured into ICT in the supply of equipment, access to software, and availability of telecommunication infrastructures, capacity building for teachers, among others have reported to have been made in collaboration with the private sectors specifically Microsoft, Intel, and major telecommunications companies, organizations, and other governments, with the Department of Education.

It is imperative to examine the situation of learners and how information and communication tools help them prepare for the real life. The paper purports to

analyze the different domains, causes of problems, and relationships that have bearing to the teaching and learning process and subsequently present the total picture and formulate action plan that is cohesive, coherent, and sustainable.

Objectives of the Study

General Objective : The study examined the current situation in the adoption of ICT in the various public secondary education schools using various domains and indicators relevant to the study.

Specific objectives :

1. availability of ICT resources (computers, peripheral devices software, internet, etc);
2. level of teachers and student skills, type and extent of ICT usage for teaching and learning;
3. probable causes of slow integration of ICT in the schools;
4. goals, beliefs, and perspectives of teachers and students about ICT;
5. government program and non-profit organization support for enabling ICT integration;
6. develop and recommend actions to enable ICT integration.

Theoretical Framework

Ishikawa Diagram (Cause-and-Effect Model)

The Ishikawa or cause-and effect model is used (shown in Figure 1) to determine the various problems pertinent to ICT integration on education. This diagram is used for analyzing causes of quality defects or other possible (Dahlgaard, Kristensen & Kanji, 1998). This holistic approach addresses the different variables that causes the problem which are clustered into *machines, methods, men, materials, milieu, and management*. To better understand each cluster, *machines* are defined as the technologies used for the integration like computers, peripherals, internet, multimedia, bandwidth, and other resources made available for educational purpose. *Methods* includes the pedagogies, teaching strategies, rules, etc. *Manpower* factor comprises administrators, teachers, and learners including their level of competencies and trainings. *Materials* include the educational content given to the learners to include software, curriculum and instructional designs. Physical setup in the classroom, schools, and supports coming from community, home, business sector, government and private institutions are within the domain of *milieu*. Leadership or management will be the policies, plans, funding and innovations from the department of education and the school administration.

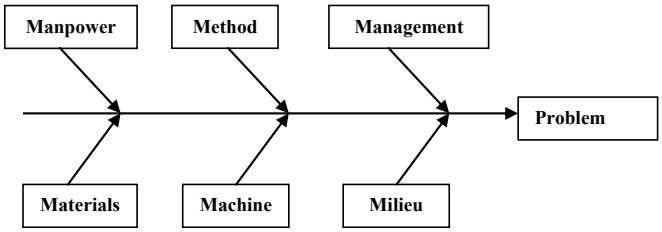


Figure 1. Cause-and Effect Diagram (Ishikawa Model)

The variables in the study are likewise infused in various studies and deliberations and these are critical dimensions to consider. In the 5th *Regional Workshop on Information Society Measurement,* UNESCO Institute for Statistics formulated standardized indicators for ICT use in Education. These are the following core indicators as reflected by proportions or ratios: 1) radio, 2) television, 3) telephone communication, 4) learner-to-computer, 5) school internet access, 6) learner internet, 7) proportions of enrollees in ICT-related fields, 8) ICT-qualified teachers, 8) schools with electricity (*UNESCO, 2009)*

Issues and problems can be raised based on three parameters on the use of ICT namely : *appropriateness, effectiveness, sustainability, and scalability* (Philippines National Framework Plan for ICT in Basic Education, 2005, p. 5).

Tinio (2002) included the various areas in her Survey of Information & Communication Technology Utilization in Philippine Public High Schools namely : 1) history and goals of ICT use, 2) ICT resources and use, 3) staff development, 4) technical support and needs, and

5) major obstacles to ICT use. Similar areas were covered for encouraging policy makers to integrate technologies and these are: 1) volume of ICT equipment, 2) participation of teachers in ICT training activities, 3) factors within the school (principal's use, ICT coordinator, ICT plan, and 4) participation of school in pilot projects (Mulkeen, 2003).

Conceptual Framework

Cause-and-Effect Conceptualization

The research paradigm (Figure 2) shows the different factors which have direct bearing in the integration of information and communication technology in education. First, the ICT facilities and infrastructure are resources like computers, internet, digital projectors, network, bandwidth, etc. The second factor involves teacher competencies, staff development and actual teaching practice and it indicates the level of computer literacy and training programs conducted for professional development. This factor also includes the actual usage of ICT in teaching and evaluation of students.

Management support/commitment not only include funding, purchase and maintenance of ICT resources, training of teachers and staff but the willingness of educational administrators to innovate according to the needs of the changing times. Curriculum and instructional design, as a factor, is defined as the adoption of new educational tools and technologies to deliver content. This would also include various modalities of delivery like e-learning and virtual schools. The student as a "player" and beneficiary of the educational system contributes to the conceptual model by certain indicators

like computer literacy, readiness, usage of ICT tools, attitude, competencies, life-goals, etc. Milieu consists of organizations and institutions like public-private programs, non-government organizations, alumni associations, Department of Education, local government, and business enterprises who contribute to the enhancement of the learning process. While these factors appear to be the dominant contributors to the educational information and communication system, there might be other variables which will emerge as a result of the study.

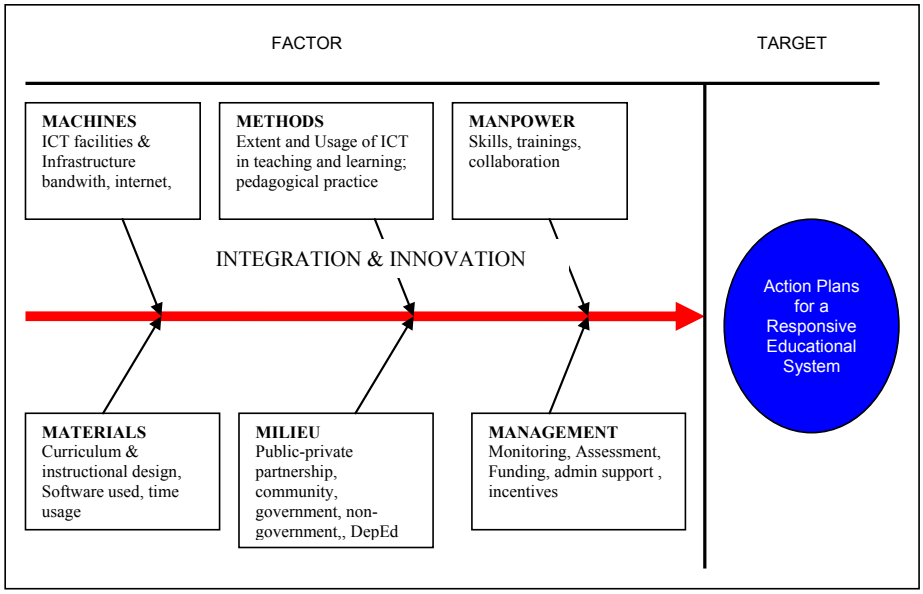


Figure 2. Concept of Analysis using Ishikawa Diagram

In the research, different issues and sub-issues for each factor was identified and analyzed. The conceptual model is similar to that of the Ishikawa's but instead of solely focusing on the causes of the problem, it endeavors to create a quality effect or a positive outcome. The target will be an action plan for the

maximization and utilization of ICT in Metro Manila public secondary schools.

SCOPE AND LIMITATIONS OF THE STUDY

The study covered the public secondary schools of National Capital Region. Each division was represented by a school which was picked randomly among various science, technical vocational and regular high schools. The respondents included mainly teachers, students, and administrators. The study is limited in the examination of 1) status of ICT in education, 2) the problems in ICT integration (machine, manpower, material, management, and milieu), 3)attitudes and beliefs of teachers and students, and 4) goals in the use of ICT.

The study did not include the impact of ICT adoption in the classroom with respect to students' learning and achievement. The domain of the study focused particularly on the school level where the ICT integration actually happens.

Chapter II
REVIEW OF RELATED LITERATURE

This paper is intended to investigate the underlying causes of information and communication technology (ICT) adoption in the educational institutions. In this chapter, various theoretical models and publications are utilized to help in understanding the major reasons why ICT is not adopted in the classrooms mainly by teachers and learners. The principal theoretical model that is used in this research is the *Fish-Bone Diagram or Cause-and-Effect* by Ishikawa to identify factors that causes failures in the integration of ICT in education and to develop recommendations.

Other supporting important theories include Leont'ev and Engestrom's *Activity Theory* which analyzes ICT integration both in the individual and social level, Davis' *Technology Acceptance model* (TAM) which stresses the importance of perception as to usefulness and use of ease, *Technology Diffusion Theory* by Rogers which focused on the different rates of adoption and characteristics of innovations, and *UNESCO Adoption Model*. Various articles and research papers on the topic of ICT integration are discussed in this chapter including studies made in other countries, Southeast Asian region, and the Philippines.

THE COMING OF INFORMATION AGE

To get a better understanding of the transition from the industrial age to the information age, it is important to consider the technological breakthroughs which transformed society on how they produce, consume, and live from mass production of goods to the use of

information to compete not only within their communities but outside their borders. A number of inventions such as computers, integrated circuits, and global networking are the significant milestones that brought about the information age.

Early Development (electromechnical machines*)*

The term "computer" dates back as early 1613 where this is referred to as a person who made calculations or computations and the term had been adopted in the 20th century to refer to machine which carried calculations. There were successive technological inventions that made automatic calculations and programmability from the 19th century onwards. The first programmable mechanical machine known as Difference Engine and Analytical Engine was developed by Charles Babbage in 1837. He is considered to be the "Father of Computer". Herman Hollerith to whose name was attributed to the invention and use of punched card and the subsequent use for the 1890 US Census. The punched card became the main input medium for early computers like IBM until it was replaced by other encoding machines using magnetic storage (Onifade,2010; Rojas, 2001).

In the beginning of 1940s, two prominent working machines were developed – the Zuse and Anasoft-Berry electro-mechanical computers. Konrad Zuse computer was called the Z3-computer and it used binary number system and calculated floating-points numbers. John Atanasoff and Clifford Berry created their own version of electronic computer which they called ABC (Atanasoff-Berry Computer). The ABC computers used logic circuitry and regenerative memory. World War II served as the catalyst in the development of computers for strategic

and military purposes. Like the Z3 which was intended for the design of airplanes and missiles, Howard Aiken developed the Mark I in 1944 to calculate and create ballistic charts. In the same purpose, the British's Collosus computer served to break German encrypted codes(Jones, n.d., Rojas, 2001, Schifter, 2008)).

Modern computer devices such as computers, cellphones, microwaves, etc., that are controlled by microprocessors, would not have been possible without the invention of integrated circuits. Jack Killby, in 1958, found the solution in miniaturization of electrical circuits. Transistors, resistors, capacitors and diodes are packed in a single chip or as we term "integrated". Another scientist by the name of Robert Noyce solved several problems that Kilby had to pave the way for the mass production of integrated circuits. Modern chips can contain several hundred millions of components on an area no larger than a fingernail(www.nobelprize.org, 2003; Rojas, 2001).

With the microprocessors technology, the first consumer computers were produced in the late 70s, such as Apple I and II, TRS-80 and Commodore Pet. Along with the availability of these microcomputers were software like Visicalc (electronic spreadsheet made by Dan Bricklin and Bob Franston), and Wordstar (word processor invented by Seymour Rubenstein and Rob Barnaby) which gave the office productivity use in computing. IBM produced its version of personal computer in 1981 with an operating system called MS DOS (short for microsoft disk operating system) (Bellis, 2011) Intel dominated the supply of microprocessor by virtue of the success of IBM. Most computers, if now all, have microcomputers made by Intel

as the advertisement aptly state it :"Intel Inside" If the Intel dominated the microprocessor business, so did Microsoft. Bill Gates, the founder of Microsoft, developed the operating system MS-DOS and later the Windows as its graphical user interface (GUI) for personal computers. Series of updates and versions such as Windows 3.11, Windows 95, Windows 98, ME, NT, XP, Vista, etc. were developed to run on various microprocessors(Rojas, 2001).

Networking, World-Wide Web, Search Engines

Internet traced its roots to group of pioneers and visionaries who saw the need to interconnect computers for information sharing, research, and military purposes. In the early 60s, DARPA (or known as Defense Advanced Research Project Agency) was formed to develop a framework of computer interconnection or network of computers. J.C.R. Licklider of MIT, who later headed this project conceptualized the idea global network. Concepts that followed with the help of the academic communities particularly packet switching developed into a system called ARPANET or Advanced Research Project Agency. A standardized protocol called the Transmission Control Protocol/Internet protocol (TCP/IP) to mean any internetworking or internet in short using this system. In 1989, Tim Berners-Lee invented a network based on hypertext which is now known as World Wide Web and considered as the de facto connection with web servers(Rojas, 2001).

The internet was made more significant with the development of search engines which allowed people find information. Development of search engines started in 1990 with the tool called Archie which stands for archive

without the ”v”. Archie was created by computer science students from McGill University in Montreal, Alan Emtag, Bill Heelan and J. Peter Deustch. The tool can create searchable database of file names from public anonymous FTP(File Transfer Protocol) but was not able to index the content. Web crawlers or “spiders” are programs which stores information about web pages and the content are analyzed on how these will be indexed and stored in a database for quick retrieval(Rojas, 2001). Larry Page and Sergey Brin, both students of Stanford University, developed the most popular search engine Google which included the algorithm in ranking the relevancy of web pages called PageRank. Google handled about 80 percent of all search request receiving an estimated 1 billion search request per day. (www.google.com; www. evolution-seo.co.uk).

More and more websites are created each day to address the fast growing demand from internet users for personal, commerce and business, education, science, research, social collaboration, work, among other purposes. There is also the shift from wired to wireless connections so that users can tap the internet anytime and anywhere. Social networking had grown to enable internet user to share and collaborate different field of interests for example Facebook, Twitter, YouTube, Second Life, Flickr, blogs, wikis, among others. Another trend is the growth of smaller devices such as smartphones, tablets, pocket PCs, ebook, gaming machines which are also capable of tapping into the web. International Data Corporation (IDC) reported that the sale of tablet pc grew to 2,000% to $3.3 billion dollars in 2010 and Apple’s tablet iPad continues to dominate the market (Daily Tech, 2011).

Networked Society Issues

The rapid development of the internet and the transformation of the modern society into a network society is rapidly changing the way individuals live, work, study, and play. This Network Society as Castells(2009)described is "a society whose social structure is made around network activated by micro-electronics-based, digitally processed information and communication technologies." While internet technology offers vast opportunities for development, there are also concerns on the widening digital divide within and among societies.

Norris (2001)propounded the concept of digital divide in three dimension: global, social, and democratic. *Global divide* is referred to as the disparity of access between the industrialized and developing societies. *Social divide* is the inequality of access between the rich and the poor within a society. *Democratic divide* signifies the difference in those who use or not use digital resources in public life.

Castells (2009), in his book *Communication Power* underscored the impact of the network on culture. He theorized that the network being global in nature, works and integrates multiplicity of cultures. He argued that the common trend is not a homogeneous global culture but historical cultural diversity. The critical issue, he hypothesized, is the protocol of communication among different cultures as the basis of exchanging their resources and beliefs. The networking power of the various players in a network society operates by inclusion/exclusion. Valuable resources are accumulated through the network and those that do not add value are

barred or excluded (Castells, 2009: p. 42-43). Affluent countries have increased their lead and productivity gains over those nations that lack the requisites to invest in the information society (Norris, 2001, p.5).

UNDP Development Report characterizes marginalization in terms of "those with income, education, and literally connections" on one hand and "those without connections blocked by high barriers of time, cost uncertainty and dependent upon outdated information (Norris, p.5)"

Based on researches on *diffusion* theory by Rogers, it was observed that early adopters of technology are characteristically drawn from group of higher socioeconomic status. And education, literacy and social status are factors that provide access to financial and information resources (Norris, 2001, p. 71).

Initiatives have been made by governments and non-profit organizations to bridge the digital divide by way investing on infrastructure (electricity, hardware, and internet connection). Some developing societies are making investments technological infrastructures, training, and education . As can be observed from the next discussion below, the advanced industrialized societies remain to dominate and take advantage of the opportunities and productivity gains of a network society.

> *The fact that there are absolute inequalities between rich and poor nations in the virtual world is hardly surprising; it would be naïve to expect otherwise given the substantial disparities in every dimension of life from health care, nutrition to education and longevity* (Norris, 2001; p. 49).

Internet Penetration and Growth Rate

Based on the figures on population and internet users as reported by Internet World Stats (http://www.internetworldstats.com/stats.htm) by geographical regions, North America tops the list of internet penetration rate (78.3%) followed by Oceania/Australia (60.1%) and Europe (58.3%). In the contrast, Asia and Africa registered penetration rate of 28.8% and 11.4% respectively. Notice that developed economies registered the highest level of internet penetration. Asia accounts for 44% in the world ; Europe, 22.7%; and North America, 13%. Figure 3 shows that China leads the world in the number of internet users with 384 million. The world's internet growth rate, from 2010 to 2011, is 480.4% (Internet World Statistics, 2011).

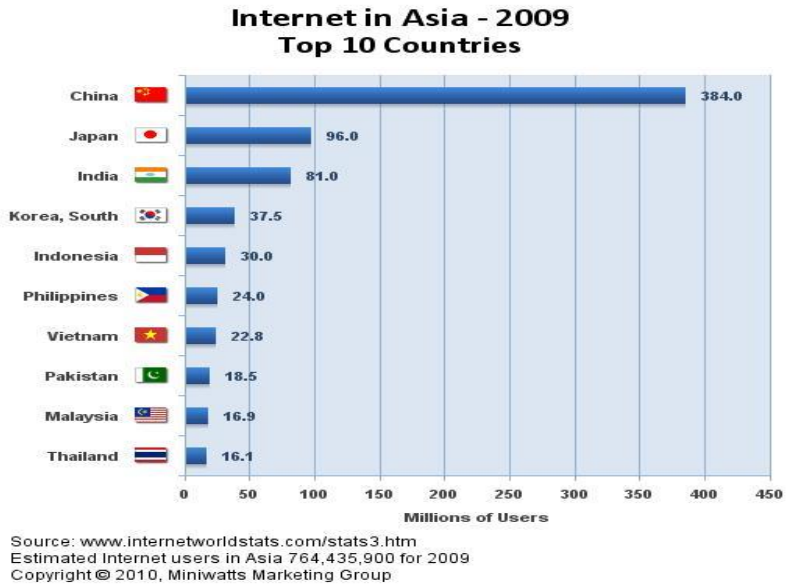


Figure 3. World Internet Penetration Rates
source : http://www.internetworldstats.com/stats.htm

Among the countries in Southeast Asia, Brunei topped the list of internet penetration (80.7%), followed closely by Singapore (77.8%), and Malaysia (64.%) (see Figure 4). Notice, that these countries have internet penetration rate above 60% of their population. The next group of countries like Philippines, Vietnam and Thailand have internet usage of a third of their population ranging from 26-30%. The countries with the least rate of penetration are Myanmar, Cambodia, and Laos below the 10%. The top three countries have very high competitiveness index according to World Economic Forum Report (2011) specially Singapore which ranked number 3 in the world. The gross domestic product per capita is also factor to consider, for example, Singapore's $32,293; Brunei, $36,325, and Malaysia, $6,897 while Cambodia, which is located at the 2nd lowest in internet usage, have only $775 GDP per capita (World Economic Forum, 2011).

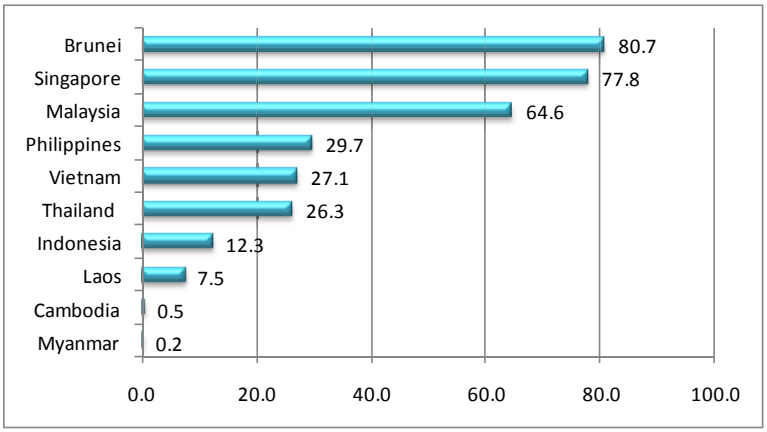


Figure 4. ASEAN Percentage of Internet User over Population – 2010
Source : Internet World Stats – Usage and Population Statistics
http://www.internetworldstats.com/stats.htm
Note : Asian Internet Statistics were updated as of June 30, 2010

Figure 5 shows that Vietnam have the highest and rapid growth rate of 12,034% from year 2000 to 2010 followed by Myanmar and Laos compared to more matured economies like Singapore's, Malaysia, and Brunei. While the growth rates are high for these countries, the internet penetration remains to be low for example Myanmar 0.2% and Cambodia's 0.5%. The rapid growth rate can be explained by several factors such as government investment, infrastructure building after war or neglect, and major foreign investment.

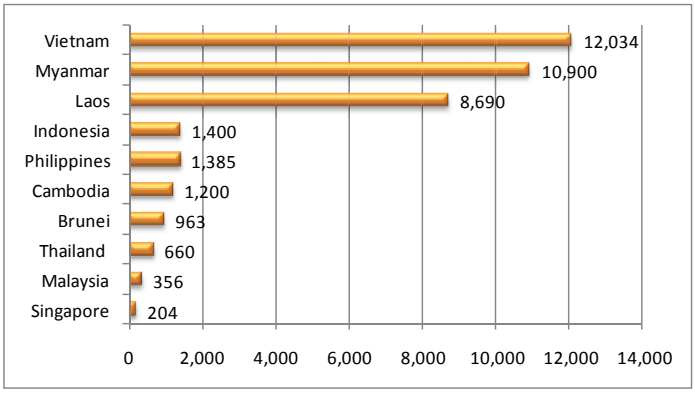


Figure 5. ASEAN Internet User Growth Rate from 2000-2010
Source : Internet World Stats – Usage and Population Statistics
http://www.internetworldstats.com/stats.html

POTENTIALS OF TECHNOLOGIES IN EDUCATION

The exponential development, growth, and usage of technologies such as microchips, internet, mobiles, databases, search engines, to name only a few had been amazingly significant given the short span of time for which it happened. These rapid developments put pressure to governments and nations to adapt to these technologies and translate them into social, political and economic advantages. "The world's most successful economies are no longer powerhouses of industry, but

rather powerhouses of information (Kante and Savani, 2003).” The race is about who holds the greatest amount of information and translate them into solutions and the generation of new knowledge. The question is no longer about “having” or “not having” these tools, but the vast opportunities that it can offer to revolutionize our way of dealing with persistent problems using traditional processes and tools. The lessons learned on the use of technology in businesses and industries can be adopted to solve recurring educational issues.

While technologies become more and more ubiquitous, affordable, user-friendly, adaptable the same educational issues persist. Haddad (2002, p.8) observed the inability to meet the demands and concerns in education with the way we see and think about education model that is – “a school constrained by space and time”. The educational model which was developed in the Industrial Age cannot be effectively solved in the Information Age. The need to evolve from this restricted model into a new model using information and communications technology should be made.

“Education will not be a location anymore, but an activity: a teaching/learning activity” (Haddad, 2002, p. 8). The potential of technology to address the issue of space is possible. The ability of educational enterprises to reach a large number of learners in different geographical locations, is attainable with the use of internet. Educators can collaborate, exchange best practice, design instructional materials, to name a few with other colleagues are some opportunities that ICT can do. If we look at the current statistics on internet, there is tremendous growth rate of 445 percent from

2000-2010 in internet usage! About 28 percent of the world population is now using internet (Internet World Stats, 2011). Education can capitalize on this connectivity using computers and new devices such as smart phones, android, tablets, etc. and the popular of social networking websites and media.

Learning throughout life is crucial as new skills are needed in the labor market in view of the rapid growth of technology, expansion of knowledge and information. Access to learning tools and programs, anytime to suit the schedule and styles of learners is where technologies can be of great assistance. Technology can help minimize disruption in business operations when the workforce undergo training by provisioning self-paced learning programs which they can access anytime.

What time will the learner learn best? Advances in neuroscience tells us that the human brain has its "periodicity" which refers to the "sensitive periods or windows of opportunity when the developing brain is particularly sensitive to certain stimuli and very ready to learn."(Wolff, 2003, p.7-8). Gathering learners to learn in a common period of time ignores the reality that individuals differ in their "periodicity" to learn. Education can tap the potential of technology to serve the different learning periods or sensitivities of learners. Computer can mimic a one-on-one dialogue and presentations and responses are real time and on-demand as need by learners. And technology serve as the tool or medium to individualize the content, pace, speed, and difficulty of instruction of learners(Fletcher, 2003, p.11)

THEORIES

ISHIKAWA DIAGRAM (CAUSE-AND-EFFECT)

The cause-and-effect invented by Kaoru Ishikawa to help identify, sort, and display possible causes of a specific problem or quality characteristics. Sometimes this is called "fishbone diagram" because of the similarity to the side view of the fishbone. The model is based on the premise that prior to taking actions to resolve a problem, the causes must be identified and understood (Morgan, C. & Murgatroyd, S., 1993). Ishikawa diagram was created by Kaoru Ishikawa in the 1960s for the Kawasaki shipyard as a tool for quality management. It is one of the seven basic tools for quality.

The diagram (Figure 6) graphically illustrates the interaction between the factors (causes) and the outcome (effect). This method of analyzing variables that affect a given process or outcome is done systematically by organizing the factors into groups. The root causes are successively broken down in layers of detail. Generally, causes are usually grouped into 'six Ms' (Dahlgaard, Kristensen & Kanji, 1998). These six most important potential causes are:

- **Manpower** – anyone involved with the process
- **Methods** – how the process is performed and the specific requirements for doing it, such as policies, procedures, rules, regulations and laws
- **Machines** – any equipment, computers, tools etc. required to accomplish the job
- **Materials** – raw materials, parts, pens, paper, etc. used to produce the final product

- **Measurement** – data generated from the process that are used to evaluate its quality
- **Milieu** – the conditions, such as location, time, temperature, and culture in which the process operates

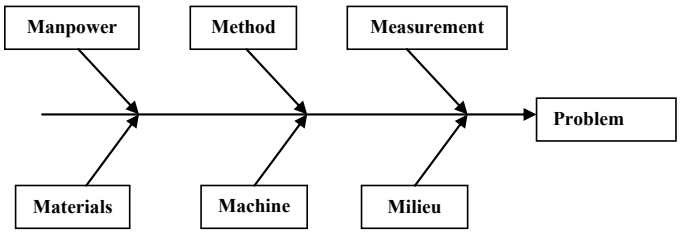


Figure 6. Ishikawa Diagram (Fishbone)

The effect can be stated as positive or negative. Negative effect is a problem being studied while positive effect is an objective or desired outcome. Using the positive approach or phrasing the terms of the effect in a positive way can foster productivity, pride, ownership and encourage group participation.

Ishikawa diagram is considered one of the seven basic tools for quality management because of the following benefits derived from its use, namely:

1. helps determine the root causes of a problem or quality characteristic using a structured approach;
2. encourages group participation and utilizes group knowledge of the process;
3. uses an orderly, easy-to-read format to diagram cause-and-effect relationship;
4. indicates possible causes of variation in a process;
5. increases knowledge of the process by helping everyone to learn more about the factors at work and how they relate, and

6. identifies areas where data should be collected for further study.

ACTIVITY THEORY

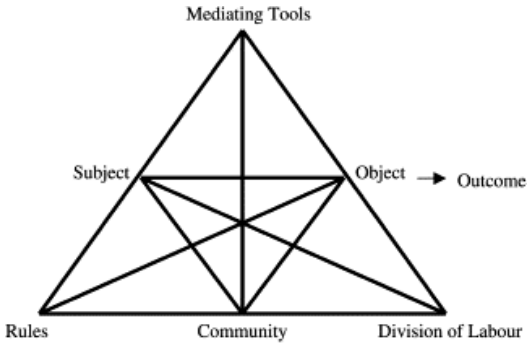
Vgotzky, a Russian psychologist during the first years of the Soviet Union, suggested that conceiving of the mind as historically created through praxis. His theory is that consciousness is a psychic organization based upon a dialectics between instruction and development. Instructions are understood to mean any directive which elicits activity and the development is the reorganization of consciousness through this activity (Axel, 1997 p. 131).

After the death of Vgotzy, Leont'ev together with a group of colleagues reworked the theory of Vgotzky espoused that activity is driven by motives made up of one or more actions. The activity and all the accompanying actions are realized under a specific contexts which determine the conditions in which these actions are realized and the initial motive is satisfied (Karasavvidis, 2009 citing Leont'ev, 1978). Leont'ev theory is that humans being are social beings and consciousness itself is socially created. Human potentials are conceived in relation to the world and in an evolutionary manner. (Axel, E, 1997). Individuals owes his or her existence to society and his needs and wants are sustained and nurtured by the community in which they live (Bakhurst, p. 147, 1997). Leontev believed that human consciousness are formed because of the accumulation of genetic information as a result of activity. Biological primacy stops where humanity begins and thus taken in the context that human activity and

consciousness are neither instinctually or genetically driven. Society is formed because of the accumulation of human experiences in contrast with the view of phylogenetic information by genes (Axel, E. p. 133).

In his article *Learning by Expanding: Ten Years Later,* Engestrom(n.d) said that "The individual could no longer be understood without his or her cultural means; and the society could no longer be understood without the agency of individuals who use and produce artifacts".

The activity theory (AT) is used as framework in the study to describe the activity system within the classroom and across schools on the use of mediating tools such information and communication technologies, policies, procedures, tasks and responsibilities, and the various players acting on the system. Activity theory had been used to analyze successes, failures in complex situations without reductionist simplification (e.g., Engestrom & Escalante, 1996; Lim & Hang, 2003). The activity system is composed of (a) subject, (b) mediating tools, (c) object (d) division of labor, and (e) rules. In Figure 7, the *subject* refers to individual or group whose point of view is being considered in the activity. The *object* is the target of the activity system. Tools are the mediating artifacts which are used to attain the objective. Rules refer to implicit or explicit regulations, norms, and conventions that controls the actions and interaction within the activity system. The delineation of tasks is what is referred to as division of labor (Demiraslan & Usluel, 2008).



Adapted from Cole & Engeström, 1993, p. 8

Figure 7. The structure of an activity system

Demisralan and Usluel (2008) map of the elements of the model to analyzse ICT integration is shown below :

Subject	Teacher (teaching experience, teaching approach, personal, administrational and instructional use of ICT, the place of ICT in daily life, the necessity of knowledge and skills related to ICT.
Object	The goals of using ICT in teaching-learning process (knowledge and skills acquisition, and problem solving).
Tools	ICT and tools other than ICT, methods which are used, problems which are encountered.
Rules	The evaluation criteria, expectations of the teacher, rules of the school.
Community	Students, teachers, school administration, ICT Coordinator.
Division of labor	The roles and responsibilities of students and teachers, cooperation among teachers, the support of administration.
Outcome	The reflection of the use of ICT in teaching-learning process to the learning of students and instruction (Demisralan, 2005).

The model of Engeström gives weight to the interplay of the individual, the mediating tools/artefacts, community, rules, and the object of the activity. The subject relies upon the help of physical and symbolic external and internal tools to attain his goal(Engestrom, 1993, p. 67). The *community,* are composed of individuals or groups who included in the system because of common or shared concern of the object. The distribution of tasks, powers, and responsibilities between the subject and the community are continuously negotiated and rules are reformulated. These rules, norms, conventions can be explicit and implicit. Likewise, objects are often characterized by ambiguity, surprise, interpretation, sense-making, and potential for change. The dynamics of these components produce conflicts and contradictions (Engeström 1999). The instability and contradiction serve as the driving force for change and development. The transition and change, in and around the activity system, is part of the evolution and that the individual and its environment are also transformed in the process (Engeström 1999, p.9).

"ICT integration here is interpreted as ICT which functions as an integral or mediated tool to accomplish specific teaching or learning activities to meet certain instructional objectives. For ICT to be effectively integrated in schools, it is used as a mediated tool in these activities to engage students in higher order thinking. Higher order thinking skills are goal-directed strategic processes that include analyzing, evaluating, hypothesizing, elaborating and synthesizing. And engagement entails mindfulness, cognitive effort and

attention of the students in the teaching and learning activities (Maftuh, 2011 citing Lim, 2007)."

TECHNOLOGY ADOPTION AND DIFFUSION THEORY

The diffusion theory in technology had been successful in the field of agriculture and marketing. This theory is potentially valuable not to be considered in the study of integration of ICT integration in education as it can uncover underlying factors which impedes of facilitates technology adoption by teachers and educational technologist.

Rogers (1995), presented four diffusion theories namely: 1) innovation decision process 2) individual innovativeness , 3) rate of adoption, and 4) perceived attributes. The theory of innovation decision process progresses from the acquisition of knowledge about the new technology, which the potential adopter is persuaded on the use of such tool. Thereafter, a decision is made whether to adopt it. Once a decision had been made the innovation is thus implemented, and the decision is reconfirmed or rejected. The individual innovativeness theory is based on the assumption that risk takers" or innovative will adopt an innovation earlier in the continuum of adoption/diffusion (see Figure 8).

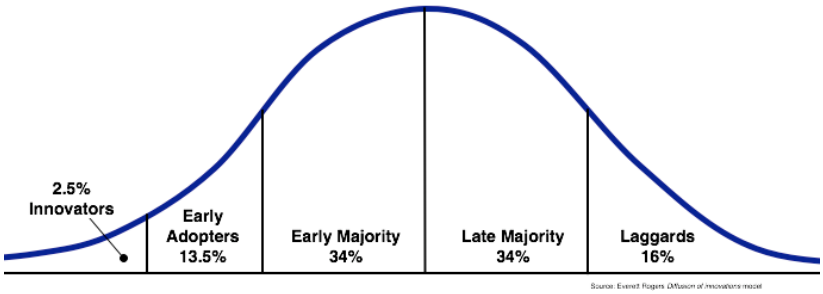


Figure 8. Bell-shaped curve showing individual inovativeness and their respective percentages.

Rogers added that, the rate of adoption takes place over time and it begins with a slow, gradual growth period and followed by dramatic and rapid growth, the gradual stabilization and finally a decline. Perceived attributes of the innovation is judged by whether it can tried, the results can be observed, has relative advantage, not overly complex , and if it will fit or compatible with the circumstances where it will be adopted.

Roger's Five Stages of Adoption

1. *Knowledge stage*, awareness of the innovation, but without complete information
2. *Persuasion stage*, or interest in the innovation, seeking more information
3. *Decision stage*, evaluation of the innovation mentally before actually trying it out, or intending to try it out
4. *Implementation stage*, trial of the innovation to determine usefulness
5. *Confirmation stage*, or individual decides to fully integrate the innovation and promote it to others

The lifecycle includes the innovativeness of the individual, rate of diffusion, and the characteristics of the change. The adopter

categories based on innovativeness is shown in Figure 8.

According to Moore (1991), the various groups are seen as different "markets" in the selling of an innovation. The transition from early adopters to early majority is essential in the success of adoption. The early adopters and early majority differences are striking. Early adopters are technology-focused, visionary users, project oriented, willing to take risk and experiment, individually self-sufficient, and communicate across disciplines. On the other hand, early majority are more pragmatic, process-oriented, averse to taking risks, look for proven applications, requires support and tend to communicate within disciplines. Early and late majority are pragmatist and tend to see technology in terms of real problem and task solutions (Ceoghegan, 1994).

Carr (n.d.) defined technology "adoption" as the stage in which technology is selected for use by an individual or an organization. In contrast, "diffusion" refers to the stage in which the technology spreads to general use and application. Typically, adoption of a new technology for education is based on its potential to alleviate a particular problem or to make job easier and efficient.

It is observed that each technology is widely perceived as meeting a need and each gains a measure of initial commitment of resources from high level administrative and legislative entity. The adoption and diffusion process is generally "top-down" process in which administrative "mandate" introduced the technology.

"Successful adoption was highly dependent on the degree, stability and wisdom of administrative sponsorship. These technologies have been available for individual or private use due to cost, scope or application. It would be impossible to generate a movement given the difficulty in influencing the faculty peers and administrator with a successful demonstration of applications. On the contrary, the personal computers, internet, and World Wide Web created another approach which started from the individually from faculty and students who can use their own system and own purposes. The impetus grow from individual users and as their influence move laterally through their contact, a body of support exert pressure on the institutional administration to commit to adopting the technology. There is a high-potential for a "bottom-up" or "grass roots" adoption process to succeed (Carr, n.d.).

Citing Everett, Carr said that diffusion of technology of today differs from previous innovations in three important ways: 1) critical mass of adopters is needed to convince teachers to use the technology, 2) regular and frequent use is used to ensure success, 3) internet technology is a tool that can be applied in different ways and purposes and is dynamic process that involve change, modification and re-invention by individual adopters.

Internet embodies different types of technologies like database, email, chat rooms, educational and information resources. The adoption of these elements create a culture or community with its own language, symbols, interaction, and other elements of communication. Since individuals uses and enters this

community, the approach thus begin from the "grassroots". With the expanding influence of the community, "internet can be perceived as a threatening competitor to the established norms of an existing culture or community such as academic department or some other institutional entity".

NEW TECHNOLOGY ADOPTION IN EDUCATION

According to Ahl (1977) there are six major requirements for the adoption of new technology by educational institutions whether in the field of communications or on the use of other new technology namely : 1) cost effectiveness, 2) implementation, 3) reliability, 4) serviceability, 5) extendability and 6) meet perceived needs.

In his paper he proposed that the new technology must be able to minimize or displace cost or add value and the new technology must not disrupt in the way the people do their business. For the new technology to be adopted, it also must handle the workload requirements of the students and faculty when it is needed. In case of failure, the new technology should be serviced promptly. Along with this, the new system should grow with the user's needs and meet the perceived needs of the users (Ahl, 1977 p. 167, 171).

Rogers(1995, p.223) proposed the following questions as guide in the acceptance of innovation.

1. Is the innovation considered better than what is currently use? (Advantage)
2. Is the innovation compatible with the culture of the school? (Compatibility)

3. Complexity, or, is the innovation simple and easy to understand? (Complexity)

4. Is the innovation available to be tested before adoption? (Triability)

5. Can the results of the innovation be observed by others? (Observability)

UNESCO ICT ADOPTION MODEL

UNESCO developed an ICT adoption which are divided into four stages starting from knowing about the tools, how to use them, how when to use it, and specializing the use.

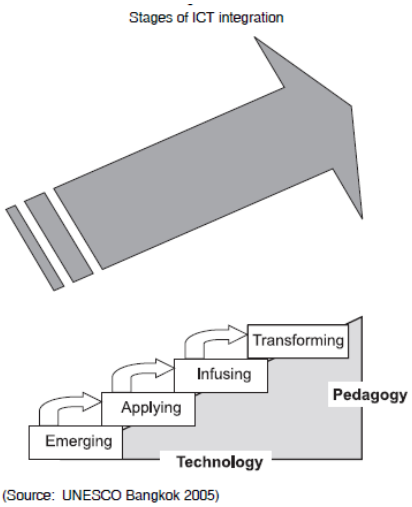


Figure 9. Stages of ICT integration
Source: UNESCO Bangkok

UNESCO's stages of ICT integration (Ng, Miao,Lee, ,2009, p. 71-72)proceeds as follows:

1. Emerging - discovering ICT tools and their general functions and uses, and the emphasis is usually on ICT literacy and basic skills.

2. Applying - learning how to use ICT tools, and beginning to make use of them in different disciplines.

3. Infusing - understanding of how and when to use ICT tools to achieve a particular purpose, such as in completing a given project. This stage implies the ability to recognize situations where ICT will be helpful, choosing the most appropriate tools for a particular task, and using these tools in combination to solve real problems.

4. Transforming - when the learning situation is transformed through the use of ICT. This is a new way of approaching teaching and learning situations with specialized ICT tools.

From these stages of ICT adoption the relevant delivery media are matched for example : in the emerging stage of adoption, presentation software are mostly used.

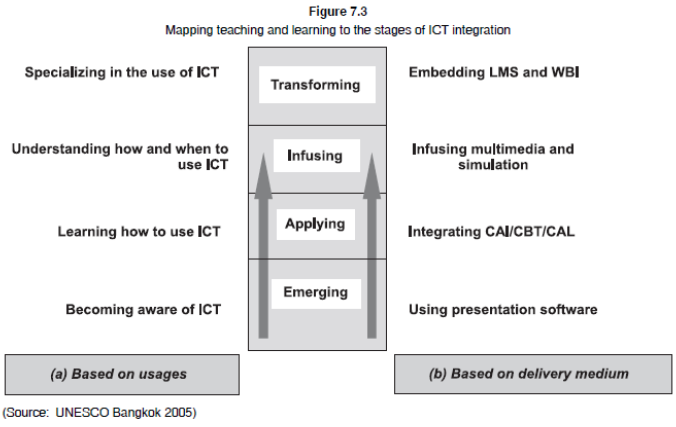


Figure 10. Mapping Teaching Learning to the Stages of ICT integration
Source: UNESCO Bangkok

TEACHER PROFESSIONAL ICT FRAMEWORK

A study made by Newhouse, Trinidad, and Clarkson (2002, p. 8) titled "Teacher Professional ICT Attributes: A Framework" for the Western Australian Department of Education developed a framework to describe the characteristics of effective learning and pedagogy and the stages of progress by teachers as they move towards quality as they relate to ICT integration. The framework focuses on the "characteristics of ICT to support learning of students, by effectively integrating the use of ICT wherever appropriate into constructivist learning environments, and contributing to relevant learning communities (p. 8)." The stages are as follows:

1. Inaction. At this stage there is a general lack of action and/or interest.

2. Investigation. At this stage the teacher has developed an interest in using ICT with students and is beginning to act on this interest.

3. Application. At this stage the teacher is regularly using ICT with students and knows how to do so competently and confidently.

4. Integration. At this stage the use of ICT becomes critical to the support of the learning environment and the opportunity for students to achieve learning outcomes through the learning experiences provided.

5. Transformation. At this stage the teacher is able to take on leadership roles (formal or informal) in the

use of ICT and be knowledgably reflective on its integration by themselves and others.

Figure 11 illustrates the relationships of the rationales, students, teacher ICT attributes, learning environment, school capacity, and system environment.

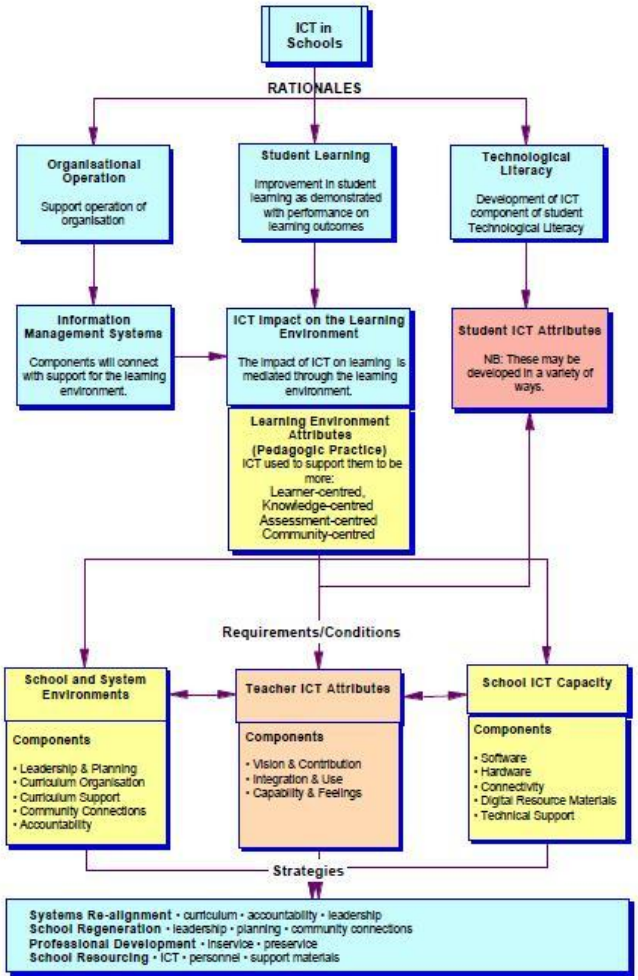


Figure 11. Teacher Professional ICT Framework
Western Australian Department of Education
Source : http://www.det.wa.edu.au/education/framework.pdf

ISSUES AND CHALLENGES

Institutionalization of classroom teaching

Ahl (1977) envisioned the coming of the knowledge economies when he wrote that "First is the tremendous accumulation of scientific knowledge. Along with the accumulation of technological knowledge is the institutionalization of technological change. And with the accumulation of scientific knowledge comes also the resistance to the use of such technology by certain intellectual elites, coupled with a growing increase in the power of the intellectual."

Jaffe (1998), as cited by Carr, suggest that the resistance to the adoption of asynchronous learning networks (ALN) which include internet/web based learning is attributed to the established practice and culture of the teaching profession. Ahl(1977, p.171) observed that: "While educators regard themselves as avant garde, in many ways they are tradition-bound and resist change." The traditional classroom teaching centralizes power and influence with the teacher as the center or focal point of this professional identity. The institutionalization of classroom teaching is major factor in the reluctance to use internet/web based learning compared to the use of television which only viewed as transmission and reception in a classroom setting. Virtual learning is viewed as threat and only conceived or at least presented as professional enhancing.

Roles played by teachers and learners continues to be a static process, as Haddad and Draxler (2002) noted, "The learners gather , the teachers communicate information, the learners reproduce what they have heard and seen, and they are evaluated on their accuracy."

Capper(2003, p. 60-61) observed that integrating technology requires a radical shift in both teaching style and vision. Many teachers are satisfied with their current teaching approach, feel that technology is too fraught with technical difficulties, and insufficient time to devote to lessons supported by technology. The vast majority of teachers are, generally, reluctant to change their teaching styles and habits as it takes away their time for other obligations like economic, familial, and educational, that they do not see the potential payoff in learning to use the technology (Carlson and Gadio, p. 122).

The United States ' National Education Plan of 2010 (NETP, 2010; p. 10-11) have recognized the urgent need to rethink the basic assumption of their educational measure on 'seat-time' and age-grouping which was introduced in the late 1800 and early 1900s. The need to redesign schools that are organized around competence rather than seat time, individual needs rather than traditional lockstep curriculum pacing and academic periods.

Funding, Cost, and Total Cost of Ownership

The initial cost of an innovation affect the rate of adoption (Shifter, 2009; Rogers, 2003). Limited fund acts a barrier in the issue to innovation. (Shifter p. 33). "Lack of interest or inability to fund 'special projects' out of district funds and lack of money for professional development and staff support for both continuing and new teachers signaled the end of many implemented programs" (Fullan, 2001, p. 88). When funding moves to another emphasis, the initial innovation may be stalled because of funding priorities. Special projects are considered target for budget cuts since they

are considered as non-essential. (Shifter,2008, p. 39). The financial cost of ICT acquisition in schools is usually a major focus of attention in policymaking and project planning. But the cost of acquisition is only one aspect, and policymakers and administrators need to budget for the recurring costs that form part of the Total Cost of Ownership (TCO). Maintenance and support account for about a third to half of the initial investment in computer hardware and software (Haddad 2007b). Thus, even if computers may be acquired for free, as in the case of donated computers, they require a substantial financial investment for maintenance and support.

Policymakers will need to make a choice between acquiring or creating new ICT-enhanced educational content and software. Suitability (including curriculum relevance), availability, and cost are key considerations in making this choice.

Compatibility, Complexity, Triability, and Observability

Shifter(2009) argued that the innovation should be compatible with the socio-cultural values and beliefs of the schools (e.g. inclusive classrooms), previously new ideas (e.g. balanced literacy), and overall need for the innovation. Teachers may not know the need until a change facilitator demonstrates to them the need they have. The complexity of an innovation may negatively impact adoption. The greater the learning curve for using a new software application by a classroom teacher, who must decide between activities that compete with his limited amount of time with students daily and weekly throughout the school year, the less likely the teacher will take up

that innovation. If the teacher can not try it out, the chances are the teacher will move to the next option that they can try out. The more likely the results of the innovation are obvious and observable to others, the more likely others may adopt the innovation.

Policy

Monahan (2004, p. 373) as cited by Miao, et. al. (2009, p. 68) underscored the importance of good policymaking. He said that, "Weaknesses in *policymaking* often lead to the *misallocation of resources*, which in turn exacerbates the existing *lack of resources*." He cited that tendency to give so much financial support finance for equipment and only a meager trickle for network support or staff training. "It is important to note that technology is only a tool and as such it can not compensate for weaknesses in education policy" (p. 68).

While there are other sectors and stakeholders in ICT in education programs, policymakers and teachers have a particularly important role to play in ICT integration. Policymakers shape a country's education policies, including policy on who shall be educated, what they shall be educated about, and how they shall be educated. With respect to ICT in education, policymakers set the framework and make high-level decisions covering all aspects of program implementation. Teachers, on the other hand, implement education policy. In ICT in education programs, teachers are the key to whether technology is used appropriately and effectively (p. 68).

Participation and Planning

The required competence and commitment cannot be inserted into a project as an afterthought, but must be built into conception and design[ed] with [the] participation of those concerned.' (p. 69)

All of the key components of ICT integration in education discussed above will need to be integrated into a *coherent plan* with clearly specified *targets, timelines, and costs*. Moreover, the plan should first be implemented in *pilot* mode rather than *full scale*, in order to determine whether the various elements work singly and in combination. The pilot implementation has to be closely monitored and the evaluation results used to modify the plan for full implementation. (Haddad, p. 69). Carr(n.d.) suggested that the adoption and diffusion of an innovation does not guarantee it successful integration, but rather as a planned learning experience.

In order to have long lasting effects, to be effectively infused into the schools' culture, and to be considered relevant by teachers and school administrators, an ICT policy should preferably not be designed in isolation. Rather, it should be part of a more comprehensive effort towards improving the equity and quality of an educational system. Also, educational initiatives ought to be coordinated through all possible administrative and operational levels in order to effectively send coherent messages to teachers, parents and administrators (Hepp, 2004, p. 2).

Technology-Centric Approach to Technology Adoption

ICTs are normally seen as the "silver bullet" to the problems that ill the educational system. More often than not, these equipment are often purchased solely because of their superiority and vendor's persistence (Miao, Ng, and Lee (2009, p. 67) . "The right conditions need to be in place before the educational benefits of ICT can be fully harnessed, and a systematic approach is required when integrating ICTs into the education system. Miao et. al. (2009) further observed that:

> The technocentric perspective on ICT in education is both a cause and an effect of the lack of capacity in ICT in education planning and implementation. In the first place, there is lack of capacity to systematically plan for ICT adoption. This in turn gives rise to failure to adequately provide for building the capacity of schools and education personnel to use ICT to improve teaching and learning. Thus, there is often poor implementation of ICT projects in schools.

One of the findings made by the World Bank showed that, "...the enduring difficulties of technology use in education is that educational planners and technology advocates think of the technology first and then investigate the educational applications of this technology only later (Trocano, 2005; p.5)". Key considerations must be met prior to its adoption such as appropriateness, cost-effectiveness and sustainability (Guttman 2003; Haddad 2007a as cited by Miao et. al.2009).

Professional development

Capacity building is the foundation of successful and sustainable development. The need to institutionalize

teacher's professional development is imperative. Carlson and Gadio (2002 , p. 119) argued that, "…spending scarce resources on technology hardware and software without teacher professional development as well is wasteful." Teachers who can integrate technology into curriculum to improve student performance is the key towards transformation and not technology alone (p. 119). Professional development requires more than skills training. The tendency to give training on sporadic basis or one-off crash course will not solve the objective of developing teachers who can master the use of ICT for their day-to-day practice (Miao, Ng, and Lee, 2000; p. 72). When teacher training approach specifically focus on the use of the technology in the context of their subject matter and pedagogy and not as generalized tool, then they are more likely integrate it in their classrooms (Gadio and Carlson, 2002; Otero, 2005; Miao, Ng, Lee, 2009, p 73). Kozma (2003, p. 6) suggested that teacher training need to be aligned to curriculum that emphasize skills in solving complex real-world problem, producing products, conducting investigation, and communicating and collaborating with others.

Goals and Lack of Meaning

The success of ICT integration depends on the clarity of the goals. Trucano (2005, p. 6) said, "ICT are seen to be less effective (or ineffective) when their goals for their use are not clear. " He further added that the specific goals for ICT are often "very broadly or rather loosely defined ". Becerra (2010) described the lack of meaning crisis in the educational system and defined its characteristics in his article, "What is

reasonable to expect from ICT in education?", as follows:

1. Students do not perceive the educational system, as useful, or having a purpose, and conclude education is meaningless.
2. School curriculum requires reductive bias in order to be taught in the required periods. The result is that students usually forget most as soon as they pass tests.
3. Teaching methods emphasize memorizing and repeating information. Even when teachers try to change these methods they are not concerned about giving students reasons why it should be important for them.
4. The constructivist approach, which aimed at transferring control from teachers to students and set the foundations for learning in the students' willingness to learn, can also fail if the teacher lacks the required knowledge to become an informed guide in the quest for knowledge construction.

Measurement

Trucano (2005, p. 6) noted that traditional pedagogies are seen to be more effective in standardized testing that measures the result of the transmission-type practice than the constructivist pedagogical style. Some studies have focused on the improvements of traditional teaching and learning processes instead of new processes related to ICT and measurements of its impact. There is also the issue on the lack of data about the nature and extent of ICT impact on teaching and learning because of the lack of monitoring and evaluation tools and methodologies. The awareness of these issues are known to

experts and advance practitioners but doesn't appear to policy makers, donor staff, and new educators (p. 9). Assessment of ICT in education depends on set of indicators which would determine its effectiveness. "There is no common set of indicators for international usage, performance, impact for ICT in education (Trucano, p. 9)". Emphasis are mostly on measurement of technical infrastructure rather than the program design, training, monitoring and evaluation, and maintenance issues. In the UNESCO Consultative Workshop on ICT use in Education (UNESCO, 2002) , the investment on ICT requires a greater need for performance indicators to monitor the use and effects of ICT and the accountability to the funding sources and the public. UNESCO further cited the critical need of monitoring and evaluation as integral part of the educational system which use ICT (p.33).

The power of technology can be used as leverage to measure what matters and use assessment data for continuous improvement through timely and actionable feedback. Moreover, there is the need to design and apply technology to assess learners for both formative and summative uses (NETP, 2010.)

Access

One of critical issue in integration is that of access - where schools, teachers and learners are able or not able to use technology to support their various needs. Guttman (2003) underscored the importance of access to technological tools and knowledge-sharing networks not only to improve their job opportunities, but for gaining broader and expanding information. UNESCO (2002) observed that ICT created newer problems of exacerbating the problem of access between the well-off students, in schools and homes, and the poor students who have less

access or no access at all, extending to disparities in gender, among teachers, students, and school administrators. Capper (2003, p. 60) observed that the cause of this digital divide is the limited and/or unequal access to computers and the internet, and unprepared teachers, and to narrow this gap requires considerable resources for hardware, technical assistance and teacher development. As an example of the digital divide in terms of internet connectivity, North America has a 78% internet penetration rate, which means that almost four fifth of its population can access the vast information available in the digital world compared to Africa's only 11.4%. Disparities also prevail within countries between urban and rural areas. The price is far more expensive in developing countries and more often they are available mostly in urban areas. "The divide is all the more unacceptable insofar as ICTs have been shown to play a pivotal role in tackling development problems in poor and/or marginalized communities (Guttman, 2003, p. 23)." The disparity in connectivity means less opportunity of using the tools available for development and growth.

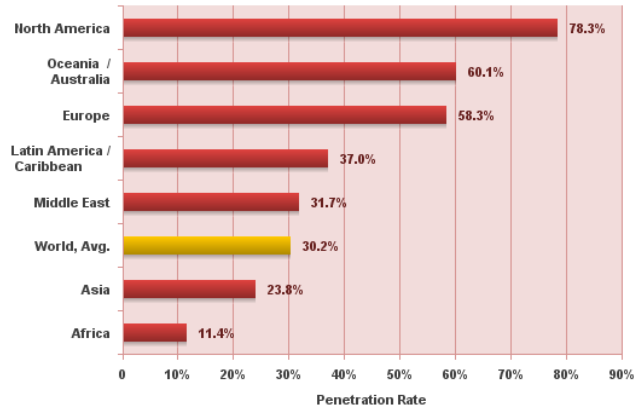


Figure 12. Internet Users in the World by Geographical Regions – 2011
Source : http://www.internetworldstats.com/stats.htm

Curriculum

Most curriculum cover too many topic and students learn isolated facts and forget them (Capper, 2003; p. 61). Curricula and tests emphasize memorization of facts and procedures and teachers who want to adopt a constructivist approach to teaching and learning are not able to because of the time need to cover the overly full curriculum (Kozma, 2002 p. 6; Capper, 2003; Bercerra, 2010).

In his report, Kozma mentioned that curriculum do not incorporate ICT activities nor was ICT included in national assessment making it difficult for teachers to integrate into their courses. Teachers need to cover the syllabus and if the amount of material is cut back, more time will be made to engage learners. "In countries that have high stakes examinations, the pressure to 'cover the curriculum' is exacerbated, and anything that does not support students' success on exams is likely to be neglected, including the use of technology(Capper, p. 61)."

Kozma also suggested that pedagogical philosophies and curricula need to be transformed to "emphasize skills in solving complex real-world problems, producing knowledge products, conducting investigations, and communicating and collaborating with others."

STATUS OF ICT INTEGRATION IN EDUCATION IN SOUTHEAST ASIA

The Southeast Asian Ministers of Education Organization (SEAMEO) established ten dimensions which are necessary to support the integration of ICT in education : (1) national ICT in education vision; (2) national ICT in education plans and policies; (3)complementary national ICT and education policies; (4) ICT infrastructure and resources in schools; (5) professional development for teachers and school leaders; (6) community/partnerships; (7) ICT in the national curriculum; (8) teaching and learning pedagogies; (9) assessment; and (10) evaluation and research (SEAMEO, 2010). From these dimensions, the status of each countries integration are assessed using the UNESCO four-stage adoption model.

Table 1. UNESCO Four-Stage Adoption Model

Adoption Stage	Description
Emerging	those who have just started their ICT-in-education journey
Applying	those who have developed a new understanding of the contribution of ICT to learning
Infusing	those who have integrated into existing teaching, learning and administrative practices and policies
Transforming	those who have used ICT to support new ways of teaching, learning and administration

Source : SEAMEO 2010

Maftuh (2011) reported on the *Status of ICT Integration in Education in Southeast Asia Countries* that revealed the following findings (Table 2) based on case studies and assessments made by member countries.

Table 2. Overview of SEAMEO Member Countries' Stages of ICT Integration in Education

	Stages of ICT Integration in Education*			
ICT in Education Dimension	**Emerging**	**Applying**	**Infusing**	**Transforming**
1. National ICT in Education Vision	Lao PDR; Timor Leste	Cambodia; Myanmar	Brunei and Vietnam (Towards Transforming); Indonesia; Philippines; Thailand	Malaysia; Singapore
2. National ICT in Education Plans & Policies	Lao PDR; Timor Leste	Cambodia; Myanmar	Indonesia; Philippines; Thailand	Brunei; Malaysia; Singapore; Vietnam
3. Complementary National ICT & Education Policies	Lao PDR; Timor Leste	Cambodia; Myanmar	Indonesia; Philippines; Thailand	Brunei; Malaysia; Singapore; Vietnam
4. ICT Infrastructure & Resources in Schools	Cambodia; Indonesia; Lao PDR; Philippines; Timor Leste	Cambodia; Indonesia; Philippines; Myanmar	Malaysia; Thailand; Vietnam	Brunei; Malaysia; Singapore; Thailand; Vietnam
5. Professional Development for Teachers & School Leaders	Lao PDR; Timor Leste	Cambodia; Indonesia; Myanmar	Malaysia; Philippines; Thailand; Vietnam (Towards Transforming)	Brunei; Singapore
6. Community/ Partnership	Lao PDR; Timor Leste	Brunei; Cambodia; Indonesia; Myanmar	Philippines; Thailand; Vietnam	Malaysia; Singapore
7. ICT in the National Curriculum	Cambodia; Lao PDR; Timor Leste	Indonesia; Myanmar; Philippines; Thailand	Brunei; Malaysia; Singapore (Towards Transforming); Vietnam	
8. Teaching & Learning Pedagogies	Cambodia; Indonesia; Lao PDR; Myanmar; Timor Leste	Cambodia; Indonesia; Malaysia; Myanmar; Thailand; Vietnam	Brunei (Towards Transforming); Indonesia; Malaysia; Philippines; Thailand; Singapore; Vietnam	Malaysia; Singapore; Vietnam

9. Assessment	Cambodia; Indonesia; Lao PDR; Myanmar; Philippines; Timor Leste	Thailand; Vietnam	Brunei; Malaysia; Singapore	
10. Evaluation & Research	Cambodia; Lao PDR; Philippines; Timor Leste	Indonesia; Thailand; Myanmar	Brunei (Towards Transforming); Malaysia; Vietnam	Singapore

Source : Maftuh, Bunyamin (2011). *Innovation of Classroom Teaching and Learning through Lesson Study*. *Reference: Regional Guidelines on Teacher Development for Pedagogy-Technology Integration, UNESCO and Asia-Pacific Programme of Educational Innovation for Development, 2005.

*Note : *In dimensions 4 (ICT Infrastructure & Resources in Schools) and 8 (Teaching & Learning Pedagogies), some of the countries appear in more than one stage of ICT in education due to the differences in stages of development among the provinces or areas within each of these countries.*

The various countries were grouped into three according to the stage of adoption. Countries like Brunei, Malaysia and Singapore are in the transforming stage because they have excellent national educational plans and policies, high student-computer ratio, internet access, and delivery system increasingly online. Differences, however, within this group particularly in teaching and learning pedagogies and community/partnership where Malaysia and Singapore are ahead of Brunei (Maftuh, 2011; SEAMEO, 2010).

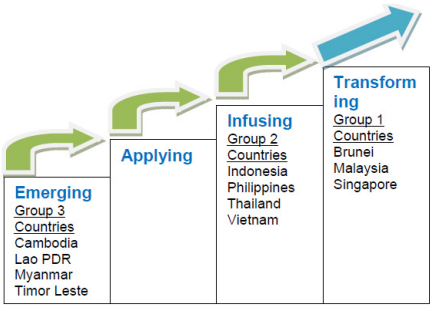


Figure 13. Three Groups of SEA Countries in the Stage of ICT integration
Source : Maftuh, Bunyamin (2011). *Innovation of Classroom Teaching and Learning through Lesson Study.*

Group 2 composed of Indonesia, Philippines, Thailand and Vietnam are in the infusing stage where ICT are integrated into existing teaching, learning and administrative practices and policies. Within these countries, there are gaps between the rural and urban areas and some part of the countries are still in the emerging and applying stages. Maftuh also observed that Thailand and Vietnam are more in advanced stage than Indonesia and Philippines.

Group 3 comprising Cambodia, Lao PDR, Myanmar, and Timor Leste are still in the emerging stage where their main concern are ICT infrastructure, hardware and software. Cambodia and Myanmar are ahead of the other countries in this group in terms of ICT-in-education visions, plans and policies, complementary national ICT and education policies and ICT infrastructure. There are some schools in Cambodia and Myanmar that are in the applying stage in teaching and learning pedagogies (SEAMEO, 2010; Maftuh, 2011).

PHILIPPINE ICT INFRASTRUCTURE

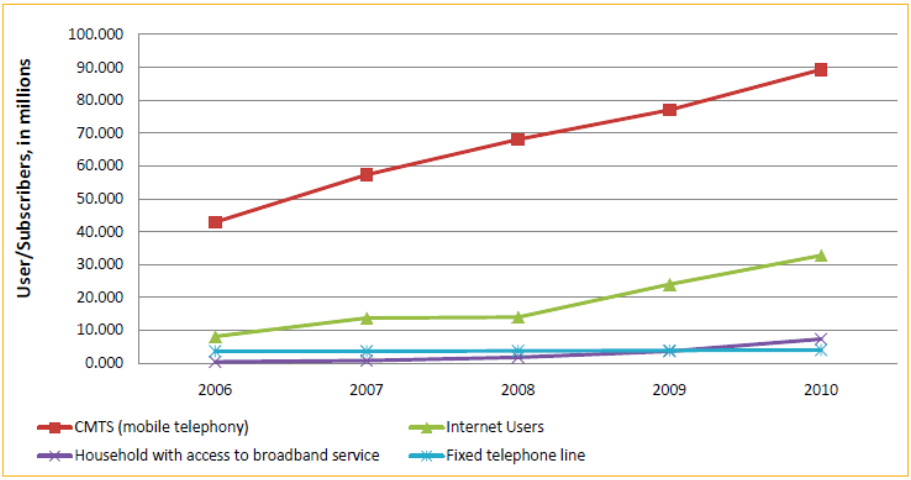
The government of the Philippines recognized the importance of ICT to foster economic growth, social equity, global competitiveness, governance, standard of living, interconnection, among others. The ICT sector continues to expand because of private sector investment in developing ICT infrastructure. These ICT services facilitated the development of efficient and effective applications both in the government and private sector.

At present there are 7 mobile operators, 73 local-exchange carriers, 14 intercarrier service providers, 11 international gateway facility, and 471 value-added service providers. ICT technologies and services includes fixed telephone lines, wireless communications, broadband Internet, among others. Cellular mobile telephone service (CMTS) is the dominant telecommunication service comprising about 94.7 percent coverage of total municipalities as compared to 53.9% of fixed telephone lines. About 761 cities and municipalities (50%) are considered to be covered with fixed or mobile broadband internet. Owing to the geographic reach of mobile broadband, services are often limited to urban centers and boundaries (National Economic Development Authority, 2011).

The phenomenal growth of CMTS subscribers is attributed to the massive use of the short messaging service (SMS) or "text messaging". More than two billion texts or SMS are handled by mobile service providers daily. The prevalence of the SMS is due to its cheap cost per message and some mobile service providers are taking this opportunity to offer cheaper rates through unlimited

SMS by buying a certain amount of prepaid load or mobile recharge.

As shown in Fig. 14, the growth rate of mobile telephone subscribers is going up 40 million in 2006 to 90 million in 2010. However, the users for the other ICT services remains to be low. There is a big gap between the internet users and the mobile users. Households with access to broadband has to catch-up with mobile telephony service and fixed line, which appears not to be growing need to be invigorated as well.



Source: CICT, NTC

Figure 14. Growth Rate in Number of Users of ICT Services (2006-2010)

Personal computer penetration in the Philippines is still considered low especially in the rural areas which maybe to due financial constraints, lack of electricity, infrastructure, among other things. With the low level of personal computer ownership in the households, other alternative modes of access filled this gap. These alternatives are in the form of internet café, WiFi hotspots, offices, schools, etc. NEDA reported that there are about 30,000 to 40,000 Intenet café and an estimated

2,000 WiFi hotspots in the country. The internet café or shop is a fast growing business catering to the big number of users who do not own personal computer and/or internet connectivity. The recent rating of the country's in social networking penetration, which is 83.1 percent and higher than the world's average of 57.5 percent, just shows that the lack of personal computer does not as a barrier to the use of ICT (NEDA, 2011). The affordability of internet access through Internet café or shop made it a popular choice for bigger segment of the country's population especially among the poor. Likewise, the government initiatives towards shared access facilities called Philippine Community e-Center (CeC) Program have successfully connected 1, 200 communities to the internet and as an access point for e-Government services.

In terms of internet connection speed test conducted by Speedtest.net, the Philippines ranked 72nd worldwide in download speed and 65th in worldwide upload speed. The Philippines' internet average download speed is at 2.34 megabits per second (Mbps), while the upload speed is at 0.65 Mbps. (NEDA, 2011). (Upload speed means the amount of time at which data is sent from the computer to the Internet and Download speed is the time required to sent data from the Internet to a particular computer.)

THE PHILIPPINE EDUCATION SYSTEM

The formal education system of the Philippines consists of three levels: elementary, secondary, and tertiary education. The elementary or primary level involves six grades in public school and seven grades some private schools. Children of age 3-4 may start kindergarten schooling until 5, and at 6 they may enter the primary level.

Secondary education, or second level, consists of four years of high school. Students enter the secondary level at age 12 and normally finish it at 15. Public secondary schooling is offered free just like in the primary grades. Post-secondary consists of two or three years of non-degree or technical courses. The third level or tertiary level is divided into collegiate, master's and doctorate level, where students enter this level at age 16.

Non-formal or outside-of-school education serves adult education, out-of-school youth, or some other specific learners for example literary development or livelihood skills.

The Department of Education (DEC) is responsible in supervising and regulating basic education – primary and secondary. DEC seeks, "…to provide the school age population and young adults with skills, knowledge, and values to become caring, self-reliant, productive and patriotic citizens. (from www.deped.gov.ph)" Higher education is administered by the Commission on Higher Education. The responsibility of supervising the post-secondary technical-vocational education focusing on skills orientation, training of out-of-school youth and unemployed is with the Technical Education and Skills Development Authority (TESDA). The diagram for the Philippine education is shown in Figure 15.

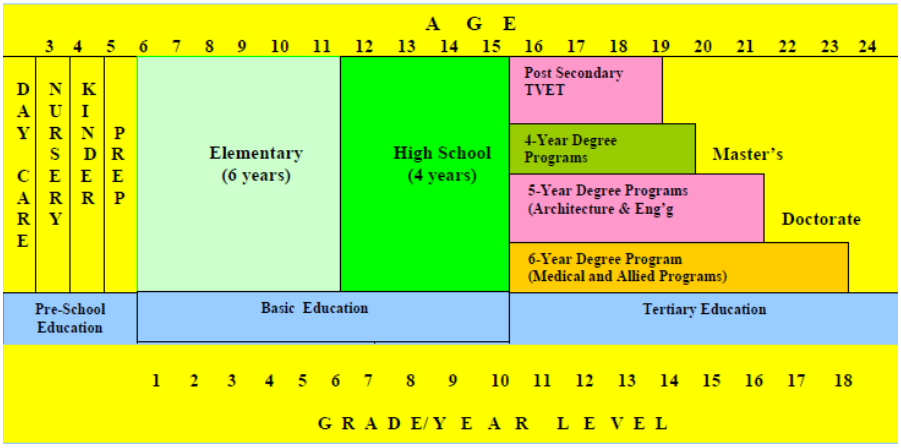


Figure 15. The Structure of the Philippine Educational System
Source : UNESCO, 2009

According to DEC Basic Education Statistics as of September 2010, there are 44,846 elementary schools and 84% of these are public 16% accounts for private schools. For secondary schools there are 10, 384 secondary schools. The percentage of public schools in the secondary level is almost the same as that of the private schools, i.e., 55% to 45%. The number of students in the elementary is 13.9 million and the public pupils comprise 92% of the enrollee population. On the secondary level, the total enrollee is 6 million and 80% of these are in the public schools. The teacher to student ratio for public school is 1:38 for secondary schools and 1:36 for elementary schools (see http://www.deped.gov.ph/factsandfigures/).

Table 3. No. of Schools and Enrollees

Level	No. of Schools		
	Public	Private	Total
Elementary	37,762	7,084	44,846
Secondary	5,677	4,707	10,384
	No. of Enrollees		
Elementary	12,799,950	1,134,222	13,934,172
Secondary	5,465,623	1,340,456	6,806,079

Source : Factsheet – Basic Education Statistics,
Department of Education from http://www.deped.gov.ph/factsandfigures/

CURRENT SITUATION IN PHILIPPINE EDUCATION

While the Philippine government assigns the highest priority on education, the performance indicators of quality education is not showing a good picture. Enrollment rate declined from 90.1 percent in 2002 to 88.1 percent in 2010. The poor quality of education is manifested in the National Achievement Test (NAT) where the overall mean percentage score (MPS) is only 45.56% in the secondary school. Secondary students scored poorly in mathematics (39.64%) and science (43.80%) with reference to a passing mark of 75%. (DepEd Statistics, 2010). NAT performance of students deteriorated from 54.7% to 45.6% from 2006-2010 (SEPO, 2011). Figure 16 shows that achievement scores in mathematics, science, and english are not improving and these are way below the 75% passing mark.

In the 2003 Trends in International Mathematics and Science Study (TIMMS), the Philippines is among the worst performer among participating countries. The country scored way below the average international score. It ranked 23rd among 25 in the elementary level and 41st in 45 countries in the secondary level for the mathematics examination. Likewise in science, the Philippines ranked

23rd among 25 in the elementary level and 42nd among the 45 countries that participated in the secondary level countries that participated. (TIMMS, 2003). These observations are collaborated by World Economic Forum's Global Competitiveness Report of 2010-2011, that finds the country ranking low in the quality of science and mathematics, i.e., 112th among 139 countries surveyed (Swab, 2011; p. 275).

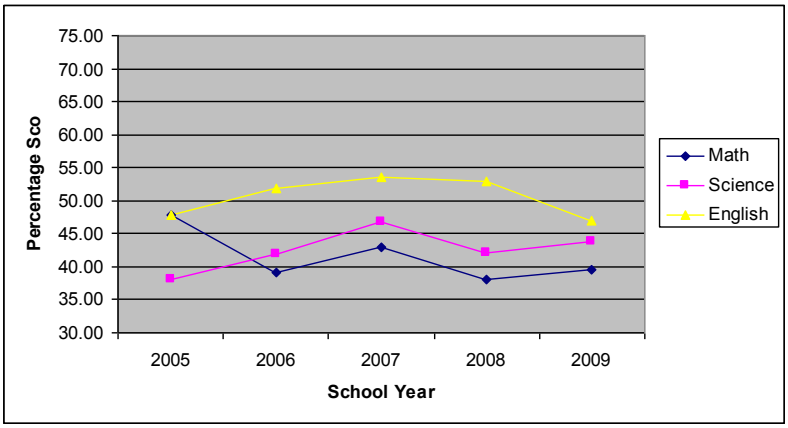


Figure 16. National Achievement Test – Secondary Level (2005-20010)
Source : Department of Education Basic Education Statistics 2010

For the past 5 years, the statistics provided by the Department of Education showed that for every 10 elementary and high school students who enroll only 7 graduate (DepEd, 2010). The underdevelopment of alternative learning system to solve the basic educational need of an estimated 16 million out-of-school youth and adults exacerbated this problem. "The Philippines spends only USD 417 per student per year compared to USD 995 in Thailand, 2,289 in Korea, USD 4,369 in the Netherlands (National Framework Plan, 2005)".

In the Philippine Senate report(SEPO,2011) the major factor of the poor performance of learners is attributable to a congested curriculum, where the students are pressured to learn in 10 years curriculum which is actually designed for 12 years in other countries. As a result, Filipino students are not able achieve comprehension and mastery of the core subjects. According to the 2008 Functional Literacy, Education and Mass Media Survey (FLEMMS) 14% or 9 million of the estimated 67 million Filipinos 10 to 64 years old are not functionally literate! The poor quality of education is also reflected in the survey that shows 19% of elementary graduates and 10% high school graduates are non-functionally literate (Literacy Coordinating Council, 2008; Action on Economic Reforms and e-Net, 2008). What is most disturbing picture of Philippine education is that the functionally illiterate have increased compared to 1994.

Table 4. Basic and Functional Literacy Situation

	2008	2003	1994
Basic Literacy	95.6%	93.4%	93.9%
Functional Literacy	86.4%	84.1%	83.8%

The study also showed that there is a consistent decline in functional literacy after the age of 20-24 which simply means the lack of a continuing interest to engage in a life-long learning beyond said age bracket. In terms of sex, the functional literacy rate among females is higher than among males (88.7 percent vs. 84.2 percent). The disparity in terms of economic is glaring – almost 20% points difference.

Table 5. Functional Literacy by Economic Classification

	Literate	Non-Literate
Poor	72.9%	27.1%
Non poor	91.2%	8.8%
Total	**86.4%**	**13.6%**

Source : Action on Economic Reforms

The educational system is likewise beset with physical infrastructure problems. Classroom shortage is a perennial problem due to the increasing student population and damages caused by natural disasters. As of school year 2009-2010, the Department of Education has a total of 18.2 million enrollees. As a consequence of this huge student population, classroom shortage is estimated at 113,000 which would cost Php77 billion to construct. With the persistent pressure to close the classroom gap, the country is seeking alternative delivery modes using ICT(NEDA, 2011).

Disparity is observed in classroom-student ratio with a 1:78 in elementary in NCR and 1:82 in high school in the Autonomous Region in Muslim Mindanao for school year 2009-2010. The national average of teacher-student ratio stands at 1:36 for elementary and 1:38 for secondary levels and there are wide disparities across schools (NEDA, 2011).

UNESCO 2010 EFA Global Monitoring cited the Philippines as a "striking example of underperformance" (UNESCO, 2010, p. 70).

> With an average income four times that of the United Republic of Tanzania or Zambia, it has a lower net enrolment ratio. The unfavorable comparisons do not end there. Whereas the United Republic of Tanzania and Zambia have been steadily increasing net enrolment ratios, the Philippines has stagnated. Given the

> country's starting point in 1999, achieving universal primary education by 2015 should have been a formality. There is now a real danger that, in the absence of decisive political leadership, the country will miss the goal. In 2007, out-of-school numbers for children aged 6 to 11 broke through the 1 million mark and there were over 100,000 more children out of school then than in 1999. Around one-quarter of those entering school drop out before grade 5.

The Philippine government have recognized the pressing concern in improving the quality education to be able to participate in a dynamic global economy. Among the critical governmental efforts are: the priority budget for education, basic education reform agenda (BESRA), medium term development program for 2011-2016, curriculum reform (e.g., K-12), and the ICT for education (ICT4E).

In the fiscal year 2011, the Department of Education maintains the biggest budget appropriation amounting to Php 207.3 billion which represents 12.6 percent of the total budget. This amount represents an increase of 18.4 percent (Php32.3 billion) from the previous Php 175 billion appropriation. The increase in the budget will be for the construction of 13,147 classrooms and the creation of 10,000 teaching positions (DBM, 2011).

The Basic Education Reform Agenda (BESRA) have 5-key reform thrusts (KRTs) based on the following principles (DepEd-BESRA).

1. School-based initiatives
2. Standards
3. Strategies
4. Systems
5. Stakeholders engagement

The KRTs are expressed by the following objectives:

1. continuous school improvement facilitated by active involvement of local stakeholders;
2. better learning outcomes achieved by improved teacher standards;
3. desired learning outcomes enhanced by national curriculum strategies, multi-sector coordination, and quality assurance;
4. improved impact on outcomes resulting from complementary early childhood education, alternative learning systems and private sector participation; and
5. change in DepED culture from prescribing actions through orders and memos to facilitating school initiatives and assuring quality.

The Philippine Development Plan for 2011-2016 intends to pursue a quality education for all and for lifelong learning by using alternative delivery modes (ADMs) in formal education and alternative learning system (ALS) for out-of-school youths and adults. The plan aims a 93 percent participation or net-enrollment rate by 2016. This includes the use of ICT in technology-based student learning packages to enhance teaching-learning approach in basic education (e.g., indexing of curriculum concepts and competencies for systematic development of e-learning materials).

ICT FOR EDUCATION (ICT4E)

In order to cope with the challenges of improving the quality of education and new challenges of rapid development, globalization particularly the role of technology, the Department of Education embarked to

transform education into an ICT-enabled system. This vision will transform students into dynamic life-long learners, values-centered, productive and responsible citizens, where education happens anytime, anywhere.

With the vision of "21st century education for all, anytime, anywhere", DepEd set forth to continue doing the following:

1. revitalize our schools to make them into dynamic, collaborative and innovative learning institutions where students can become more motivated, inquisitive and creative learners.

2. link up our students with the vast networked world of knowledge and information to enable them to acquire a broad knowledge base and a global outlook and provide them with the resources for the development of a creative mind;

3. develop in our students skills and capabilities to critically and intelligently seek, absorb, analyze, manage and present information;

4. create new knowledge and products; and

5. develop in our students habits of self-learning to nurture the attitude and capability for lifelong learning.

The DepEd ICT4E Strategic Plan within the next five years has the following agenda :

1. completely integrate ICT into the curriculum, which includes the development of multimedia instructional materials, and ICT enabled assessment;
2 intensify competency based professional development programs;
3. establish the necessary ICT infrastructure and applications.
4. develop processes and systems that ensure efficient, transparent and effective governance.

The DepEd have recognized and made commitments to address issues on student/teacher-computer ratio and the infrastructure for connectivity and access to technologies. Training of teachers is generally limited to basic computer literacy and computer literacy is not part of the teacher certification/licensure. With this, the ICT4E envisions for more training towards integrating ICT into the curriculum.

To effectively use ICT in the teaching and learning process, it is suggested that there is an accompanying curriculum reform or enhancement. ICT4E Strategic Plan envisaged to approach to proceed by two stages (1) enhancing the level of awareness and use of ICT in the existing curriculum and (2) full integration of ICT in the enriched curriculum.

Various independent sectors had developed customized teaching and learning digital contents. However, access to these existing digital contents remains to be a challenge. The ICT4E plans to develop a sector-wide standard called Digital Content Develoment and Usability Framework for multimedia instructional materials (MIMS).

These MIMS will supplement existing (printed) instructional materials.

The development of an assessment framework is one of the objectives considered critical in the plan. This framework includes the development of assessment standards, test and other instruments, conduct of training and advocacy programs and the formalization of assessment roles and responsibilities. ICT will be used to enable efficient and effective tests, planning, collecting, analyzing and reporting results and findings.

The plan identified the following areas as learning competencies in ICT for education :

1. Basic operations and concepts
2. Social, ethical and human issues
3. ICT for Producing
4. ICT for Communicating
5. ICT for Researching
6. ICT for Problem-solving

NATIONAL FRAMEWORK PLAN FOR ICT IN BASIC EDUCATION (2005-2010)

The Philippines educational leadership saw the need to develop a national framework plan for ICT in basic education to address the educational crisis caused by "underdevelopment" and "poor management". Deteriorating student performance in achievement tests, high drop-out rate, and the underdevelopment or lack of alternative learning system for out-of-school youth are among the problems cited.

Recognizing the benefits of integrating ICT integration, the framework sets the parameters and articulates the goals and strategies for the adoption of ICT in education. The plan supports national policies as stated in the Medium Term Development Plan of the Philippines which also recognize the crucial role of ICT as a development tool and which states, "ICT will be harnessed as a powerful enabler or capacity development. It will therefore be targeted directly towards specific development goals like ensuring basic education for all and lifelong learning among others." (NEDA, 2004a).

Aside from the Medium Term Development Plan, the ICT framework dovetails with the intents of the Basic Education Curriculum of 2002 which sees the value and role of ICT in the for acquisition of life skills, understanding and internalization of principles and values, and the development of multi-intelligences. The plan includes other programs of the government such as Schools First Initiative and the National Action Plan to Achieve Education for All (NAP-EFA) . The Schools First Initiative (SFI) program was developed by the government to improve education outcomes by strengthening accountability and responsiveness, and enhancing management and leadership. NAP-EFA, on the other hand, was developed along with the worldwide campaign of UNESCO on Education for All (EFA) to ensure universal access and provision of education for primary education and to reduce illiteracy by the end of the decade.

The various programs of the government towards educational reforms can be facilitated with ICT. The plan set three important parameters for the use of ICT in

education, namely: appropriateness, effectiveness, and sustainability.

Appropriateness refers to the suitability of the tool with respect to: goals and objectives to be met, content to be processed or delivered, availability of technology accessibility, skills needed and support services. Appropriateness not only means the latest but the mixing and matching of old and new technologies.

Effectiveness refers to the extent to which stated goals and objectives are realized. The effective use of ICT is measured against the goals of formal educational curriculum and the alternative learning system. Moreover, the objective of ICT use does not stop from learning about the tool but proceeds to exploit its advantage to teaching and learning. Continuous professional development of teachers in ICT and pedagogy are crucial to teaching and learning in an ICT enhanced environment.

Sustainability is the extent of the implementation of an ICT-based program that can continue based on economic, social, political, technological and educational support. Important considerations such as : funding, total cost of ownership, maintenance and repairs, technology upgrade, community involvement, policy and leadership, pedagogical practices, trainings, etc are critical in the sustenance and continuing implementation of an ICT-enhanced program.

The goals and strategies to improve the quality of education thru ICT on the four programmatic areas are enumerated as follows:

1. ICT will be used to provide educational opportunities to those who have little or no access to the formal school system : school age children who are not in school, as well as those over 16 years of age who have not finished the requisite 10 years of basic education;
2. ICT will be used to promote learner motivation, mastery of basic concepts, and the development of higher order thinking and lifelong learning skills;
3. ICT will be used in pre-service and in-service professional development programs for teachers and instructional management, to develop teaching competencies, including but not limited to competencies necessary for the effective and appropriate use of ICTs to improve the quality of learning;
4. ICT will be used to improve information collection, analysis, and dissemination within DepEd and between DepEd and education stakeholders, support administrative functions, and enhance monitoring and evaluation.

The framework proposed the following strategies to sustain the use of ICT in the four goals aforementioned. These strategies address the dimensions of sustainability such as : economic, political, social, technological, and educational.

1. Strengthen policy and leadership on ICT concerns by establishing a Bureau of Educational Technologies with DepEd, with corresponding units at the regional and division levels. This Bureau shall be DepEd's policy making, implementing and coordinating body that will also be responsible for

initiating national level programs and projects, and for research development, monitoring and evaluation, and policy advocacy.

2. Mandate strategic planning for ICTs in Basic Education at regional, division, and school levels, in line with national goals, strategies, programs and projects.
3. Perform research-based standards setting (in relation to curriculum and competencies as well as technology choice), model building and piloting, systematic monitoring and evaluation, and upscaling of good practice models.
4. Develop an ICT advocacy and promotions program, and encourage the same at local levels.
5. Encourage community participation in program/project development and implementation, when appropriate.
6. Foster the building of a community (online and offline) of teachers, instructional managers, students, parents, education administrators and policy makers, researchers, technology experts, and other education sector stakeholders as a mechanism for providing instructional, technical, administrative, and other necessary support for ICT-based innovation, and to encourage a sense of ownership among all stakeholders.
7. Rationalize personnel position and/or function to more effectively and efficiently support the integration of ICTs into DepEd, including the creation of appropriate incentive structures.
8. Optimize the use of available resources and intensify resource mobilization, at national and local levels, to defray the total cost of ownership of ICT-supported initiatives.

INTERNET CONNECTIONS IN PUBLIC SCHOOLS

Based on the 2009 study made by the Japan International Cooperation Agency, only 29 percent secondary high schools have internet connection from the total 6,650 secondary public high schools. Across, all regions, the average rate is 30.1 percent. The National Capital Region tops the list with 71.4 percent connectivity while the lowest ranking, Cordillera Autonomous Regions, only has 7 out of 243 schools connected (2.9 percent). Other regions which have lower than 10 percent internet connection are, Region II (7.4 percent) and Region V (6.5 percent) (NEDA, 2011). Of the 4,714 schools without connection, 1,150 can only be serviced by existing telecommunication companies while 3,564 schools are out of their coverage area (75.5 percent). This simply means that not only budgetary constraint is considered as an issue in the lack of internet connection in these schools but the availability of telecommunication service in these areas. In the Philippine Development Plan of 2011-2016, the government is inviting the private sector to invest and provide digital opportunities for these unserved and rural areas (NEDA, 2011).

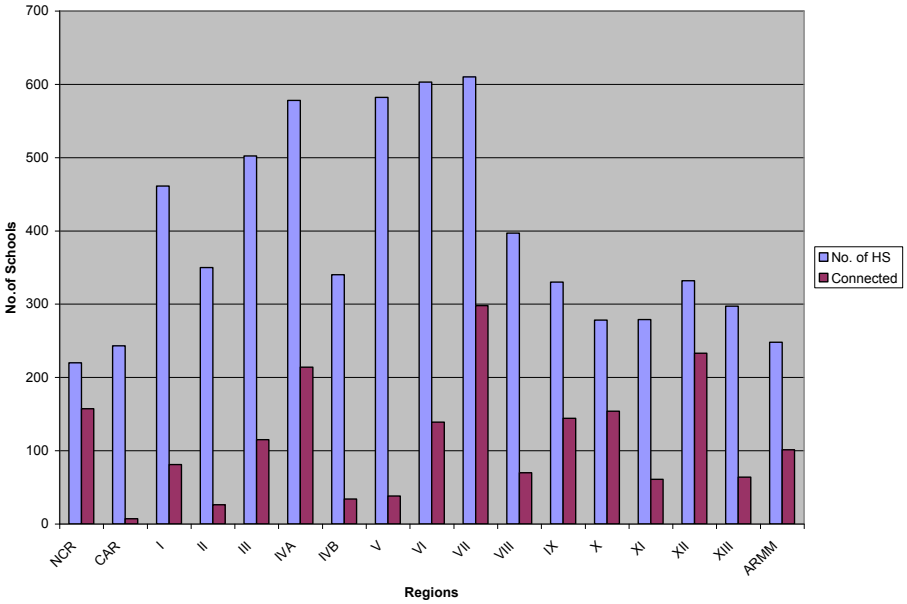


Figure 17. Internet Connection in Philippine Secondary Schools By Region as of 2009
Source : Japanese International Cooperation Study (NEDA, 2011)

SURVEY OF ICT USE IN EDUCATIOIN IN THE PHILIPPINES

In the survey of ICT in education conducted by Tinio(2002), the following were the ranking of the major barriers to the use of ICT in teaching and learning.

1. Insufficient number of computers
2. Not enough technical assistance for operating and maintaining computers and/or insufficient help for solving technical problems with ICT.
3. Not enough training opportunities for teachers
4. Not enough space to locate computers appropriately
5. Lack of funds
6. Insufficient peripherals (printers, scanners, etc.)

7. Teachers lack knowledge/skills in using computers/the Internet for instructional purposes.
8. Not enough staff for supervising computer-/Internet-using students.
9. No time in teachers' schedules to explore opportunities for using computers/Internet.
10. Not enough copies of software for educational use
11. Insufficient time for teachers to prepare lessons in which computers/the Internet are used.
12. Weak infrastructure (telecommunications, electricity, etc.)
13. Problems in scheduling enough computer/Internet time for different classes.
14. Lack of interest/willingness of teachers to use computers/ the Internet
15. Inadequate administrative support or initiative at the school/division/regional level.

Based on her study, the dominant use of computers are in Science (77.1%), Math (67.7%) and English (62.5%) and this is related to the availability of digital content or resources. The lack of digital resources in local language is one reason why the other subjects such as Filipino, Social Studies and Values Education are not mediated by the use of computers.

Findings from her study showed the urgent need to improve the provision of computers to students and teachers. The mean student-to-computer ratio is 267:1 (range 12-1,098, modal ratio=209, sd=209). Teacher-to-computer mean ratio is 9:1 (modal ratio = 8 : 1, sd = 8).

Most the software available for teaching and learning are word processing, spreadsheet, and presentation

graphics. However, software for pedagogy such as simulations, drill and practice, tutorials are less available.

Internet access is very limited. Only 13 out of every 100 schools surveyed have internet access. Out of these schools with internet access only eight or nine allow students and teachers access to computers that can go online. The mean student-to-computer with Internet ratio is 1,763. The amount of time to use internet ranges from 1.5 hours to 160 hours per month. The mean access time, for educational and non-educational purposes, is 32 hours per month.

Tinio's study showed that 52 percent of the schools surveyed claimed that their teachers have knowledge of computer fundamentals and can use productivity tools. Of the 13 percent of these schools, 10 percent or less of their teachers have basic computing skills. In 54 percent of the schools, only 10 percent or less can email or research online.

Maintenance and repair of computers need to be improved. Majority of the respondents (42%) reported that it takes a month or more for their computers to be repaired. A relatively big number of the schools claimed that their computers were never repaired (19%). This is correlated with the reason that the schools have no funds for repair and parts replacement (38.7%) and that one no one in school knows how to repair computers (33%). Only half of the schools surveyed have air-conditioned computer laboratories and these factor can adversely affect the performance of the computers.

Tinio(2002) concluded her study on the pressing need to address the student-to-computer ratio and teacher-to-computer ratio from its present mean ratio of 267:1 and 9:1 to a double digit and ultimately single digit. From the fundamental issue on lack of computer is the issue of funding and investment. She recommended that investment be made on only on the computers but on peripherals and subject-specific software to broaden ICT use and to target curricular goals. The variance between stated goals i.e., to prepare the students to become a productive workforce and the school's goal of improving student achievement is another issue. Given the financial constraint and huge capital investment needed for ICT in education, she recommended that technology should be used optimally and in pursuit of clear educational goals.

Chapter III
METHODOLOGY

RESEARCH DESIGN

The study used the survey research method. It utilized a researcher-made questionnaire, document review, interview, and focus group discussion. The research used purposive and stratified random sampling in schools and teachers and students. Mixed design approach was used to analyze both quantitative and qualitative data.

RESEARCH LOCALE

The research locales of the study was conducted in public secondary schools in Metro Manila, Philippines. Respondents were taken from the following:

Table 6. Respondents of the Study

Respondent	Number
DECS Central Office	3
School Principal/Administrator	17
NCR Regional/Division Coordinator	16
School ICT Coordinator	17
Teachers	431
Students	1,001
Community (e.g., industry partners)	3
Total	

SAMPLING TECHNIQUES AND SUBJECTS

- **Schools**. The schools were picked randomly from the different divisions of the National Capital Region(NCR). Likewise, all the divisions are represented.

- **Teachers and Students** . Random sampling technique was used to pick the teachers and students from the various disciplines and year levels.

- **Administrators/ICT Coordinators.** The heads of schools were picked based on the schools which were randomly selected. The ICT coordinator was also selected based on the chosen school.

- **Department of Education -National Capital Region and Division ICT Coordinators.** The NCR ICT Coordinator/Planning Director and division coordinators.

- **Community.** Private institutions assisting in creating an ICT enabled environment e.g., Intel, GILAS, Microsoft, PCPS, iSchools, etc. and other stakeholders.

RESEARCH INSTRUMENTS

Questionnaire

The questionnaires were customized for the three group of respondents, namely: administrators/principals, teachers, and students. For administrators, the data gathered were : 1) background of the school 2)technology resources (hardware, software, laboratories), 3)usage and objectives, 4)skills and trainings of the respondent, and 5) perception on the use of ICT in school. The data that were in the teachers' questionnaire are : 1) background of teacher (age, sex, subjects taught, etc.), 2) skills and trainings, 3) usage and goals and 4) perceptions on the use of ICT. Students data were comprise the following: 1) background of the student, 2) skills and trainings, 3) usage and goals, 4)issues and problems, and 4) ICT-related perceptions.

Document Review/Library Research

The document review/library research included finding relevant orders, policies, laws, guidelines, labor and employment statistics, higher education enrollment and graduates statistics, integration efforts done locally and abroad.

Interview

A face-to-face interview was conducted with the officers of the Department of Education at the central and regional officers, principals, ICT coordinators, and community partners to gather pertinent policies, implementation, and monitoring of ICT programs.

Focus Group Discussion

The purpose of the focus group discussion is to gather qualitative feedback from the regional and division ICT coordinators, and planning director, about the issues and concerns concerning ICT in education and elicit suggestions and recommendations.

DEVELOPMENT OF RESEARCH INSTRUMENTS

The instruments were pre-tested using 5 schools for heads, teachers, and students to identify probable problems in the administration of the survey and to avoid or delete ambiguous questions or choices. Some errors found during the pre-testing were :

- Alignment of question to the answer
- Answering labels were not carried to the next page
- Confusion in the ranking
- Ratings were answered using tick marks
- Grammatical error

The perception statements in the questionnaire were item-analyzed to determine their reliability. Four kinds of statistics were computed in order to refine the scale, namely, descriptive statistics (frequency distribution, mean, and standard deviation); discrimination index; correlation coefficient; and alpha coefficient.

Items were analyzed using mean and standard deviation to determine the distribution and spread of the item scores.

Discrimination Index was calculated per item. The mean of high scorers are deducted from the mean of the low scorers item by item. If the difference is small, the particular item does not differentiate the high scorers and low scorers. Items were selected based on Table 7. Items with low discrimination index were analyzed and improved.

Table 7. Discrimination Index Guide

Index	Interpretation
0.40 or higher	Very good items
0.30-0.39	Reasonable good, but possibly subjected to improvement
.20-.29	Marginal items, usually needing and subjected to improvement
.19 and below	Poor items, to be rejected or improved by revision

Source : Popham, W.J. (2000). Educational Measurement : Practical Guidelines for Educational Leaders (3rd Ed). MA: Allyn & Bacon.

The items were likewise analyzed using summated rating method where the subject item score is correlated to his/her total score. Items with zero or negative correlation were scrutinized and improved.

Alpha coefficient was used to analyze items or scales for the perception and attitude measurement items. Each item were examined how it contributed to the reliability of the scale. Items that decreased or did not change the reliability coefficient were examined for improvement. The computed alpha coefficient of the teacher scale was 0.74 which indicates acceptable reliability, whereas, the alpha coefficient for the student scale registered good reliability (α =0.812).

DATA ANALYSIS

The tabulation of data was processed using Statistical Package for Social Science (SPSS). In addition, Microsoft Excel was used to encode data, calculate, and generate some graphs.

Descriptive statistics (mean, frequency distribution, standard deviation) were used and Analysis of Variance (ANOVA) to compare means of teacher-student, and subject area. The confidence level or alpha was set at *0.05* for the ANOVA.

Correlation Coefficient was employed to determine if there are relations among the variables and groupings.

Data from the interview schedule were content-analyzed in order to determine trending of responses and to

surface some underlying factors which contribute to the improvement of the ICT integration to education.

Frequency distributions in the form of tables or graphics were generated to support the data analysis of the study.

Qualitative information from focus group discussion were utilized to expound causes of ICT integration. Ideas from the brainstorming activity in the discussions served as one basis for some of the actions and recommendation of the study.

Document review/Library research on laws, regulations, policies, statistics (graduates, enrollment, etc), previous studies/existing ICT integration projects.

INDICATORS AND METHODS USED

Based on the list of instruments aforementioned, the following were various indicators, their definitions, and the statistical methods employed.

INDICATOR	DESCRIPTION	METHOD/STATISTICS
Availability of computers, internet connection, and peripherals.	Number computers and peripherals, type of internet connectivity	Frequency distribution of the number of computers Percentage of computers per school Percentage of schools with various types of peripherals Ratio of Student-to-Computer (population) Ratio of Student-to-Peripheral (population) Correlation between student population and number of computers

Availability of computer laboratories	Number of computer laboratories, computers per lab and students using the lab	Average number of computer laboratories per school Average number of students per laboratory Average number of computers per laboratory Ratio of student-to-computer (laboratory)
Connectivity	Number connected, type, and budget	Percentage of schools connected to the internet Common type of connectivity Average budget for internet
Availability of maintenance support services	How are equipment maintained	Percentage of schools with maintenance Frequency distribution on types of maintenance
Funding to support ICT program	Sources of funding and support	Mean ranking of various sources of support
ICT Coordinator	Presence of ICT coordinator	Percentage of schools with ICT coordinator Status of ICT coordinators
ICT Plans and Policies	Presence of ICT plans and policies	Percentage of schools with ICT plan and policy Document review
Competency of Teachers and Professional development	Respondents' skill level, number of years ICT is being used, last year attended training	Descriptive statistics ANOVA of skill level by teachers' subject area Comparative of skill level (teachers and students)

		Percentage of training by ICT skill Percentage/Frequency distribution of Last training date
Monitoring and Evaluation	System of monitoring ICT integration	Percentage of schools with monitoring and evaluation system on ICT integration
Curriculum with ICT integration strategies	Objectives defined in the curriculum for the teaching or the use of ICT Year level where ICT is taught	Document review and interview with DepEd Percentage of schools offering ICT courses in various year levels
Availability of software used for teaching and learning	Type of software available and appropriateness	Percentage of teachers using various software Percentage of teachers who think the software is/are appropriate for certain subject areas
Goals of teachers and students in using ICT	Goals and objectives of respondents in using ICT	Ranking of priorities and objectives ANOVA (teacher and students)
Use computer and internet for teaching and learning	Number of teachers and frequency, amount of time, type of use (actual teaching, lesson preparation, class management)	Descriptive statistics on the frequency of use Analysis of variance on frequency of use by subject area Descriptive statistics on the type of use Analysis of variance on frequency of use by subject area Percentage of teachers using internet applications and

		services
Challenges in using in the use of ICT	Obstacles and issues in the use of ICT Perceptions and beliefs on ICT from teachers and students	Ranking of problems Percentage of agreement or disagreement with scale statements ANOVA Content analysis of narrative statements from survey/interview Focus group discussion
Relative performance rating teachers, and students	How the teachers and students rate themselves in relation to other groups	Descriptive statistics
Students' attitude on ICT	Students' attitude and perceptions regarding technology	Descriptive statistics
Master plan on ICT for education	National framework Plan for ICT in Basic Education	Document review Library research Interview Focus Group Discussioin
Other support	Degree of support from computer enterprises, non-government organizations, community organizations, etc.	Document review Library research Interview

Note : List of choices for computer skills and goals were adopted from Tinio's 2002 *Survey of ICT Utilization in Philippine Public High Schools.*

Availability of computers, local area network, internet connection, and peripherals.

The indicator includes a mixture of old and new technologies namely, computers, color printers, scanners, inkjet printers, laser printer, CD writer, graphical tablet, overhead projector, TV and decoder, and video/LCD projector and others. Aside from the hardware, local area network (LAN), type of internet connection, and the predominant operating system used, are part of the inventory. Computer laboratories per school is counted and how many students can laboratory accommodate. The statistics used is frequency distribution by type of equipment.

Sources of funding to support ICT program and budget.

The survey determines which particular group the funding is coming from and this includes alumni association, Department of Education, foreign aid, local government unit, non-government organization, parents-teachers association, private/industry sector, and other sources. The administrator ranks the various support group by order of their degree of contribution.

Availability of software used for teaching and learning

The type of software stated in the survey are: word processing, spreadsheet, presentation software, graphics, database, encyclopedia, recreational games, desktop publishing, tutorials, internet browser, educational games, among others. Statistics generated show the available software per type and compared with the other variables such as what tools the teachers/students are using in the various subject areas.

Availability of maintenance support services

The indicator determines the availability **of** maintenance support and the type of service whether the equipment are maintained in-house, by contract or on-call. It also show how responsive will be the school when equipment breakdown occurs and the level of support to teachers using it in the classroom. Administrators and/or ICT coordinators will be the prime sources of this information.

Student-to-Computer ratio

This is a measure of the number of computer vis-à-vis learners. Student-to-Computer ratio is measured both on students enrolled in computer education subjects and the student population. The ideal computer-to-learner ratio adopted in this study is one computer per student.

Goals of teachers, and students in using ICT

These are goals and objectives why the teachers, and students use ICT for teaching and learning. The respondents will rank the goals according to their perceived importance, i.e., 1 being the highest goal. The mean ranking of each goal is computed and compared between the two groups.

Subject areas and year level where ICT is taught

This refers to where ICT is being taught. Comparisons are made among the various schools with reference to curriculum requirements or standard.

Percentage of teachers and students who use computers and/or the internet in the classroom

Integration is premised on the actual use of ICT in the classroom. Teachers are asked how often do they use ICT in the class and how much time is actually spent with respect to preparation, teaching, and class management. What internet tools to they use? (facebook, friendster,blog, skype, etc).

ICT plan and monitoring

This indicates presence of an ICT plan, policies, monitoring and evaluation. The plan will also be analyzed in relation with the recommendations of institutions like UNESCO to establish monitoring and evaluation system.

Curriculum with ICT integration strategies

This is a review and analysis of existing curriculum including the identification of the level of ICT application of teaching and learning in various subject areas. The indicator also includes problems raised by teachers and students about ICT adoption associated with curriculum.

Competency of administrators and teachers in ICT

This indicator measures the level of competency of school teachers and students in terms of ICT knowledge and skills. Other parameters, in relation to this, are the frequency of training, when was the last training done, and the specific training undertaken. Descriptive and analysis of variance are applied in this indicator.

Problems in the use of ICT

These are listings of obstacles by the respondents ranging from teacher knowledge, time, curriculum, infrastructure, etc. Frequency distribution and descriptive statistics and analysis of variance are utilized for this indicator. The open-ended question is content-analyzed to identify other sources of problems.

Relative ICT performance rating of teachers and students

Teachers rate themselves in relation to their supervisor, co-teachers and students. On the other hand, students rate themselves in relative to their teachers, and co-students. This indicator will show the discrepancies of perceived competencies of the various respondents. Descriptive statistics, correlation coefficient, and analysis of variance is used in this variable.

Appropriateness of ICT in subject areas

This shows how teachers rate the appropriateness on the use of ICT on various learning areas such as science and technology, mathematics, journalism, music, physical education, social science, Filipino, etc.

Software used for teaching

These are the ICT tools which teachers used for teaching and learning. Percentages of schools that use the software will be generated and compared with the other schools.

Percentage of use of internet sites

The indicator measures the type of internet sites which the teacher belongs to like facebook, email, friendster, multiply, skype, blog, yahoo messenger, etc. Percentage of teachers and the type of internet sites will be computed and analyzed.

Percentage of time used for lesson preparation, teaching, and class management

This refers to the amount of time (hours per week) teachers spend in lesson preparation, teaching and class management. Descriptive statistics and analysis of variance will be calculated.

Student Skill Level

The is a self-rating of students on their knowledge and skills on various aspects of computing like operating a computer, writing documents, making illustrations, etc. Measure of central tendencies, dispersion, distribution, analysis of variance by factors such as school and age will be computed. Comparison of mean will be made with that of the teacher's skills.

Students' perceptions and beliefs on ICT

These are statements which measures the perception of the students about the use ICT, about the value of education, value of ICT, online lessons, etc. The student's responses are selected from a 5-point Likert scale. Statistics on the different statements using mean, standard deviation, analysis of variance (school, year level/age) are generated.

Master plan on ICT for education

The strategic plan embodies the vision and thrusts by the Department of Education along with other government institutions in the use of ICT in education. Content analysis will be made on the areas such as : curriculum, professional development/competencies, infrastructure, and management. Other documents will be read such as department orders, memos, etc.

Other support

These are the support given by private and public organizations to schools in terms of hardware, infrastructure, financial, trainings, technical support, etc. The level of collaboration and participation will be studied. Interview and document review will made and values and amounts of contributions are to be computed.

Chapter 4

RESULTS AND DISCUSSIONS

This chapter presents and discusses the results of the study on Integration of Information and Communication Technology (ICT) in public secondary schools in Metro Manila, Philippines. The discussion will begin with the background of the various secondary schools, including the demographic profiles of the teachers and students. Following the discussion on demographic profiles, the paper will present the statistical results as well analysis and interpretations based on following general cause-and-effect domains:

- **Machine(**computer, peripherals, internet, repair/maintenance, time usage, ratio)
- **Manpower**(skills, training, incentive, ICT usage, time usage, collaboration, teachers' perceptions, goals)
- **Material**(digital materials, software)
- **Method** (effectiveness of ICT on subject area, collaboration, software used)
- **Milieu**(private-public partnership, policy, visions and plans, curriculum, community support, and students' problems, beliefs and goals)
- **Management**(monitoring, assessment, administrative support, funding, ICT coordinator, ICT plan, ICT policy, year taught)

BACKGROUND

The respondents of the study included public school principals (*N* = 17), teachers(*N* = 431), and students (*N*=1,001). A purposive and random sampling was used to pick the representative schools, teachers, and students. All the division of schools in Metro Manila were represented. Notwithstanding, data sampling considered representation in terms of the curriculum program such as : the regular, science, and technical vocational high schools. Teachers were likewise picked from all the subject disciplines within the sample schools. Student random samples comprised of all the year levels from 1st to 4th year.

School Profiles

The study included seventeen (17) government schools in Metro Manila (Table 8) with at least one representing each division of school in the national capital region. The oldest (66 years) was founded in 1945 while the youngest (7 years) schools was established just in the year 2004.

Table 8
Participating Public Secondary Schools in Metro Manila

School	Location
Caloocan City Science High School	Caloocan City
Don Alejandro Roces Science Technology High School	Quezon City
Dr. Arcadio Santos National School	Paranaque City
Eulogio Rodriguez Vocational High School	Manila City
Kapitolyo High School	Pasig City
Las Pinas National High School	Las Pinas

Makati Science High School	Makati City
Mandaluyong High School	Mandaluyong City
Manila Science High School	Manila City
Panghulo National High School	Malabon City
Pasay City East High School	Pasay City
Pedro Diaz High School	Muntinglupa City
San Francisco High Sch	Quezon City
San Juan National High School	San Juan City
Sta. Elena High School	Marikina City
Taguig Science High School	Taguig City
Talipapa High School	Caloocan City

Student Population

The average student population is 2,835 students (*SD*=1,973). The largest percentage (35%) of population is between 1,501 to 3,000. Students. The biggest population size is 7, 248 and the lowest number is 257. The total number of students for all the 17 schools is 48,206.

Table 9
Percentage of School's Student Population

Population	%
below 1,500	23.50
1,5001 to 3,000	35.30
4,501 to 6,000	23.50
4,501 to 6,000	11.80
6,001 and above	5.90
Total	100.00

Teacher Population

The teacher population for the 17 schools is 1,707. The average number of teachers per school is 100 (*SD*=53.46). There is a wide range in the number of teachers from a maximum of 205 to a minimum of 21. Forty-seven percent (47%) of the schools have at least 100 teachers. While, schools that have 101 to 200 teachers is also 47%. Only 6 percent of the schools have 201 to 300 teachers.

The result yielded teacher-to-student average ratio of 1:27. Most of the schools (47%) have a teacher-to-student ratio from 1:31 to 1:40. The highest registered ratio is is 1:41.

Teacher Profiles

The respondents of the study were 431 secondary school teachers. Their ages range from 20 to 63 years and with an average age of 38 years. Majority of the respondents(76%)are females and 24 percent of the teacher population are males. Among the teachers participating in the study, 147 have masters units/degrees (34%) and only 6 have doctoral units or degree(1%). The distribution of the teachers in terms of subject areas they are teaching is shown in Table 10.

Table 10
Distribution of Teachers by Subject Areas

	f	%
Mathematics	79	19.8
Science	75	18.8
English	59	14.8
Technology	62	15.6
Others	123	30.9

Student Profiles

There were 1,001 Metro Manila secondary school students who participated in this study. The composition of the respondents in terms of their year level is shown in Table 11. Almost half (46%) of the respondents, 4th year, were graduating students. The average age of the respondents is 14.47(*SD* = 1.45). The youngest respondents were 11 and the oldest were 23. With respect to gender, they were almost equally distributed i.e., 553 females (56%) and 439 males (44%).

Table 11
Respondents by Year Level

Year	*f*	%
1	171	17.3
2	193	19.6
3	169	17.1
4	454	46.0

*14 missing data

MACHINES

Computers

The average number of computers per school was 47(*SD*=25.13. Table 5 shows that most of the schools(59%) have between 26 to 50 computer units. One school have 110 units which is the largest number reported in this study and the lowest number of computer was only 13 units.

Table 5
Percentage Number of Computer per school

Computer	# of School	%
1 to 25	4	23.5
26 to 50	10	58.8
51 to 75	1	5.9
76 to 100	1	5.9
above 100	1	5.9
Total	17	100.0

Computer Peripherals and other ICT media

Table 12 shows that majority of the schools do not have the following in their inventory such as : scanner, laser jet, inkjet, CD writer, OHP, TV decoder, LCD project. For instance, 18 percent of the schools do not have any LCD projector to use in the classrooms. Most of the schools (41%) are limited to just a single unit of LCD projector (M = 2, SD = 2.24). More than of half of the schools (59%) have only one printer; however, 24 percent have more than two units.

Table 12
Percentage of Schools with Computer Peripherals and other media

Peripheral /Media	Number of Units			
	0	1	2	3 >
Printer(dot matrix)		**58.8%**	17.6%	23.6%
Scanner	35.3%	**41.2%**	11.8%	11.8%
Laser jet	**64.7%**	23.5%	11.8%	
Inkjet	**64.7%**	17.6%	5.9%	11.8%
CD Writer	**35.3%**	11.8%	29.4%	23.6%

OHP	**35.3%**	4.71%	5.9%	11.8%
TV Decoder	**35.3%**	23.5%	23.5%	17.7%
LCD Projector	17.6%	**41.2%**	11.8%	29.4%
Graphing Tablet	-	-	-	-

Note. * CD Writer Mean = 12, LCD Projector Mean=2
BOLD – highest percentage

If all the schools' hardware resources and the population of teachers and students are lumped together, the ratio of one peripheral in relation to number of teachers and students is very low (see Table 13). The problem on the lack of sufficient hardware is greater considering that the ratio is based on the exclusivity of use by either teacher or student. Based on actual talks with teacher and observations, most of the time, equipment are being used by the students for their computer education subject. It also obvious in the ratio, that LCD projector with a wide ratio of 1 per 50 teachers or 1 per 1,418 students would be difficult to address or solve given budgetary constraints. Some schools have taken initiatives by sourcing equipment or funds outside of the government.

Table 13
One Peripheral per Teacher/Student Ratio

Hardware/Media	Teacher	Student
Printer (dot matrix)	57	1,607
Scanner	100	2,836
Inkjet	142	4,017
Laserjet	213	6,026
TV Decoder	66	1,854
LCD Projector	50	1,418
Overhead Projector	78	2,191
Tape Recorder	569	16,069

Radio	122	3,443

Note. Population : Teachers = 1,707, Students = 48,206.
Ratio = Population /Total Number of Peripheral

Computer-to-Student Ratio based on Population

The study revealed an average ratio of computer-to-student population of *1:63*. The ratio was computed by dividing the total number of students of all the schools by the total number of schools' computers. As shown in Table 14, most have a ratio between 1:1 to 1:30(31%) The same percentage (31%) is found for ratios 1:61 to 1:90. The calculated ratios vary significantly from a minimum of 1:11 to a maximum of 1:413.

Table 14
Computer-to-Student Population Ratio

Ratio	*f*	%
1:1-1:30	5	31.3
1:31-1:60	3	18.8
1:61-1:90	5	31.3
1:91-1:120	1	6.3
1: 121 above	2	12.5

Figure 18 shows that there is a moderately positive relationship between the total number of computers and students (r = 0.422**)**. However, the graph also indicated that there are schools with disproportionate allocation which means high student population with low number of computers or vice versa.

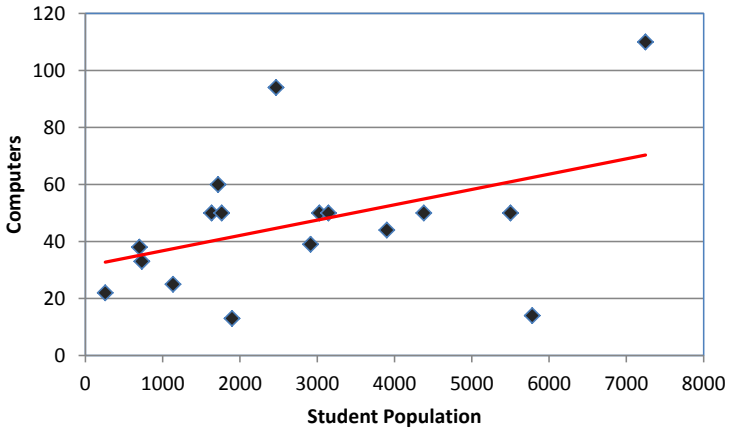


Figure 18. Scatter plot of the number of computers and student population

Student-to-Computer Ratio for Computer Education Classes

Figure 19 shows the percentage of schools' computer-to-student ratio. The result revealed that more than half of the school respondents (53%) reported to have a student-to-computer ratio of 1:2. Two out of fifteen schools (13%) have a 1:1 ratio. Four out of fifteen (26%) schools have computer-to-student ratios of 1:3 and 1:5. Only one school reported a 1:6 ratio. The total percentage of schools which do not have the ideal 1:1 ratio is 87 percent. However, only students taking computer education classes have access to the computer laboratories.

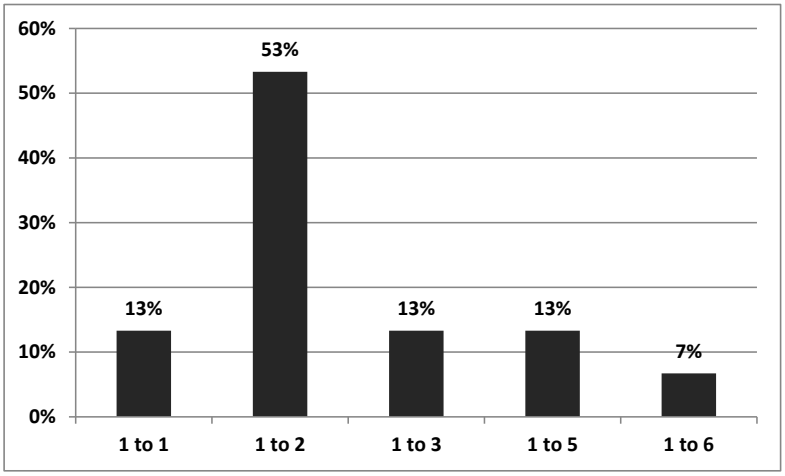


Figure 19. Percentage of schools' computer-to-student ratio for computer education classes

Computer Laboratory

The study revealed that 47 percent of the schools have 2 computer laboratories and 29 percent have at least 1 computer laboratory. Three schools have from 3 to 4 rooms for their computer equipment. The average number of computer laboratory per school is 2 (*SD* = .85)

Meanwhile, it was found that there was an average of 41.81 students per computer laboratory (*SD* = 19.47) whereas, the average number of computers per laboratory was 18.44 (*SD* = 9.57). From these averages, the calculated average computer-to-student derived was 1 : 2.

Based on actual observation, the computer laboratory area varies depending on the availability of space. Some computer rooms are crowded and others are more spacious (Figure 20). There is no standard computer laboratory size across all schools. Computer laboratories are sometimes crammed due to lack of school space.

(a) Computer laboratory with insufficient access space

(b) Computer laboratory room with sufficient access space.

Figure 20. Computer laboratory rooms vary depending on location and available space in the school.

Internet Connection

Most of the schools surveyed have internet onnections (88%). These schools with internet connections are wired through a local area network while some schools have ixed wireless connectivity. The schools are connected to the internet using digital subscriber line (DSL) and majority of them have a speed of 1Mbps. The monthly subscription

rate varies from Php999 (approx. USD23) to Php5,000 (approx. USD 114). According to the Department of Education, schools are given an annual internet subscription allowance of Php48,000 (USD1,109).

Internet Usage

Half of the student respondents reported that they do not use internet in the class. Of those who use internet in class, the average amount of time use is 3.75 hours per week or 45 minutes per day (*SD* = 4.24).

Maintenance Support

According to the survey results, only above half of the schools have maintenance (59%) of the schools have computer maintenance while rest of the schools (41%) do not have any. It should be mentioned though that some schools are still covered by warranties for parts and/or services. School principals pointed to the lack of budget as the reason for the problem in repairs and maintenance.

Those schools that have computer maintenance use variety of approaches. Thirty-three percent of the schools use their own teachers to repair the computer equipment. A bigger number (*42%*) of the respondents resort to 'on-call' where technician is paid only for the services rendered to repair. Schools that have regular contracts with outside service provider is not very popular (8%) since most of the schools have no budget provision for computer maintenance and repairs.

Given the limitation of teacher's expertise and time to repair the computers, some schools adopt an in-house-then-on-call system style approach. With recurring problem of computer breakdowns and repairs, the Department of Education central office issued Memorandum

Order No. 36 (DepEd, 2011) directing all schools to communicate to the nearest Technical-Vocational schools regarding repair/maintenance of computer units that are out of warranty. The memorandum primarily aimed to lessen the cost of repair/maintenance incurred by the schools. The efficacy of this new approach has yet to be proven.

When asked about the DepED memorandum, one ICT teacher from the vocational school raised issue on the lack of time to repair/maintain the computers and availability of parts replacement. He further said that they can repair the computers but they can not commit for the delivery time since they also have teaching loads in their school. On the other hand, some school administrators mentioned that they are reluctant to have their computer units repaired for fear that the technical-vocational students might "experiment" with them.

For lack of parts replacement and fund, it was also observed that some schools resort to 'cannibalizing' serviceable part(s) from non-functioning computer(s) to make another complete computer unit running and these include hard disks, motherboards, video cards, keyboards, power supply, mouse, etc. From the standpoint of the ICT teacher this is just practical. However, this practice posed a problem with property management when parts are moved from one unit to another. With the lack of fund to buy parts, other school initiatives include getting from the proceeds of the school canteen, collecting a few pesos weekly from students who use the laboratory (although this is explicitly prohibited by DepEd), and fund raising among others.

MANAGEMENT

Funding and Other Support

The respondent schools were asked to rank their funding and other forms of support for their ICT program and Figure 21 shows the mean ranking of each source. The local government unit (LGU), or the city government, ranked 1 with a mean rank of *1.56* (*SD=0.53*) among the other support sources. The Department of Education ranked close to LGU with a mean ranking of 1.67 (*SD =1.18*). Notice that both LGU and DepEd are government entities.

Ranked third as source of ICT support of the school is Non-government organization *(M=*2.13, *SD* =1.81*)*. Alumni association and Private/Industry have an equal mean rank of 3.00 and standard deviation of 2.07 and 2.*00* respectively. School administrators have ranked assistance from Congress with a mean of *3.33* and Foreign aid with *3.50* with the latter having a bigger standard deviation 3.70 compared to the former's 2.52. The Parent-Teachers Association was ranked lowest as source of funding and support for ICT program with a mean of 4.50. As reported, the schools are given a monthly budget allocation of P28,000 per month ($647 USD) for general maintenance and repairs. Aside from the aforementioned amount for general maintenance operating and other expenses , the DepEd also allocates the amount of Php48,000(US$1,109) for ICT-related maintenance and operating expenses.

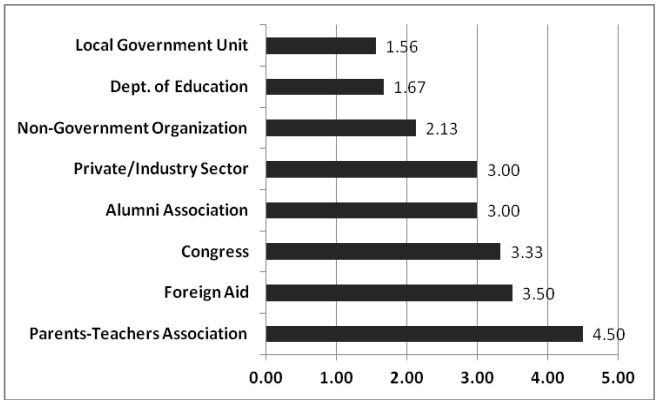


Figure 21. Mean ranking of sources of ICT funding and other support

Some school administrators commented that it "depends" on city mayor if he believes that education or in particular technology will improve the quality of teaching and learning. In some cases, the school ICT program is abandoned when there is a change in the local government leadership. Department of Education because of its lead role in the computerization program provides the necessary equipment and training for the various schools. But the amount of investment comes from government funding. DepEd involves other government agencies like the Commission of Information and Communication Technology, Department of Science and Technology, Department of Trade and Industry, and private sectors to finance the program.

One principal succinctly proposed a, "*sariling sikap* (self-help)" solution to address the problem. "*Huwag nang aasahan ang gobierno* (Don't expect anymore from the government)", suggested another administrator.

ICT Coordinators

Almost all the schools (88%) have indicated that they have ICT coordinators to manage the activities related to technology. However, these coordinators are working either full-time or part-time. More than half of the schools (63%) designated full-time coordinators, while some are working as teachers and at the same time coordinators (37%).

ICT Policy, Plan, and Monitoring

The school heads were asked whether they have written educational policy on ICT use. Sixty seven percent answered that they have. Almost all of the schools (87%) indicated that they have ICT plans. However, only half of them (57%) have monitoring and evaluation for ICT use and this is mostly quarterly (67%) or annually (22%).

Year level where computer education subjects are taught

It was observed that there was a variation on what year level computer education subjects are given to students. Results showed that more than half of the schools (59%) offer computer education subjects in all the year level. Whereas, 24 percent of the schools provide computer education to 1^{st} year and 4^{th} year or 4^{th} year only. The other schools do not offer it in the 3^{rd} year and 1^{st} year levels. As shown in Figure 22, the 4^{th} year level (94%) are given more computer educational courses compared to the other year levels and this is followed by 1^{st} year level (82%).

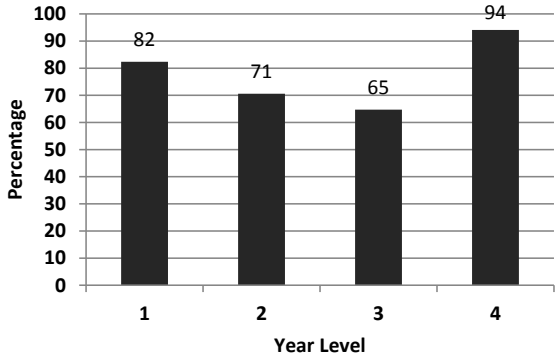


Figure 22. Percentage of schools offering computer education subjects in the different levels.

Monitoring of ICT Integration (Teachers)

The data revealed that there is a very large number of teachers (80%) who indicated that they do not have any monitoring and evaluation on ICT integration (*M* = .21, *SD* = .41). Of those who have regular monitoring and evaluation, 40 percent reported this is done quarterly, while 31 percent indicated only once a year. In contrast, some teachers mentioned that evaluation is only done if there is a need (23%). Other teachers commented that the monitoring is not necessarily focused on ICT integration but more on general teaching demonstration and evaluation. The average frequency of monitoring and evaluation is done yearly (*M* = 2.69, *SD* = .90).

Learning Collaboration

Teachers were asked if they have a form of collaborative learning with their colleagues, other persons, and organizations about ICT. Less than half (45%) of those who answered indicated that they have some form of collaborative learning. In addition, most of them discuss with co-teachers, computer teachers, co-teachers

within their department, students, and trainers. Some teachers reported to relying on members of their family and friends. Generally, the teachers get assistance or work with the technology teachers and their colleagues within the department who are more knowledgeable regarding their problems in computer use in teaching and learning.

MANPOWER

Teacher ICT Proficiency

Teachers were asked to rate their level of proficiency in using information and technology tools. The 4-point rating scale represents the degree of ICT proficiency as follows : 0-no skill; 1-beginner, 2-intermediate, and 3-advance. The skills studied were in the areas of: operating a computer, writing a document, illustrating using graphics, computing using spreadsheet, searching and receiving electronic information, communicating with email, designing presentations, creating webpages/websites, among others. Most of the teachers are moderately above the intermediate level in terms of operating a computer (*M* = 2.39,*SD* =.76), writing a document (*M* = 2.29, *SD* =. 79), and communicating with email (*M* = 2.13,*SD* = .94). ICT proficiencies that are almost in the boundary between beginner and intermediate are in the areas of sending, searching using electronic information (*M* = 1.97,*SD* = .94) and calculating using electronic spreadsheets (*M* = 1.87, *SD* = 1.02*).* It can also be observed that teachers have only moderate beginner skill in making presentations (*M = 1.50, SD = 1.07*) just as in writing simple programs and creating web pages (*M = 1.10, SD = 87*). Majority of the teachers; however, have no skill in terms of local area administration (*M = .61, SD =.88)* and repair (*M* = .47, *SD* = .80).

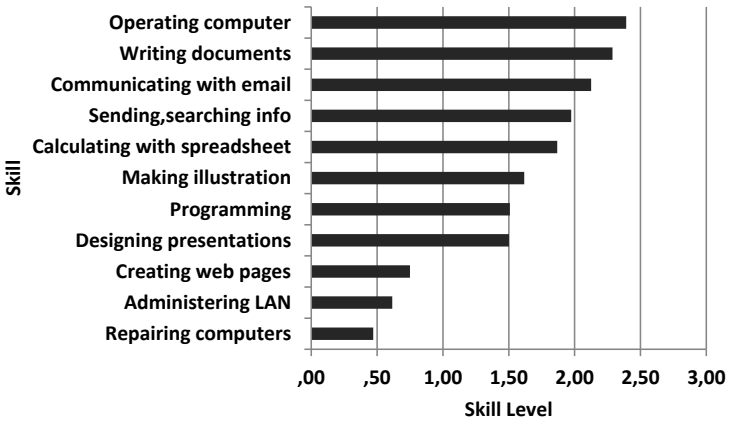


Figure 23. Mean Skill Level of Teachers

The statistical results also showed (see Table 14) that the proficiency in the use of ICT tools would differ based on the subject areas they teach when their means are compared. Obviously, technology teachers have higher level of proficiency in almost all (72%) the skill areas than the rest of the teachers for the subject areas like science, mathematics, English, and others. Understandably, mathematics teachers have higher proficiency in the use of spreadsheet, English teachers in communicating, and science teachers in programming. It was also interesting to note that English teachers ranked 2nd in four areas such as programming, word processing, sending and searching, and illustrating. On the other hand, science teachers placed 2nd in web designing and designing presentations. Other teachers who teach Filipino, social science, music and arts, values education did not show any higher mean in all skill areas compared to the other group of teachers.

Table 14. Mean Skill Scores by Teachers' Subject Area

Skill	Highest	Mean	2nd Highest	Mean
Operating a computer	Technology	2.56	Mathematics	2.41
Calculating with Spreadsheet	Mathematics	2.18	Technology	2.07
Simple Programming	Science	1.59	English	1.56
Wordprocessing	Technology	2.58	English	2.41
Searching, Sending info	Technology	2.13	English	2.09
Communicating via email	English	2.29	Technology	2.23
Web designing	Technology	1.19	Science	0.80
Making Presentations	Technology	1.87	Science	1.56
Local Area Networking	Technology	1.19	Others	0.57
Repairing Computers	Technology	1.02	Others	0.39
Illustrating with graphics software	Technology	1.84	English	1.68

ANOVA by Teacher Subject Area on Skill level

Analysis of variance showed that effect of the subject area of teachers were not significant on the skill level for the following (*df* = 1, 429) :

1. Making illustrations with graphical programs (F=2.405, p=.049)
2. Writing simple programs (F=2.636, p = .674)
3. Sending/searching information (F=1.442,p=.219)
4. Communicating with email (F=1.298, p=.270)

Comparison of Skill Level between Teachers and Students

A graphical comparison of skills between teachers and students is shown in Figure 24. It is observed that teachers are more skilled in the use of electronic spreadsheet than students. Meanwhile, students show better technology skills in programming, communicating with email, web designing, and designing presentation, and local area networking.

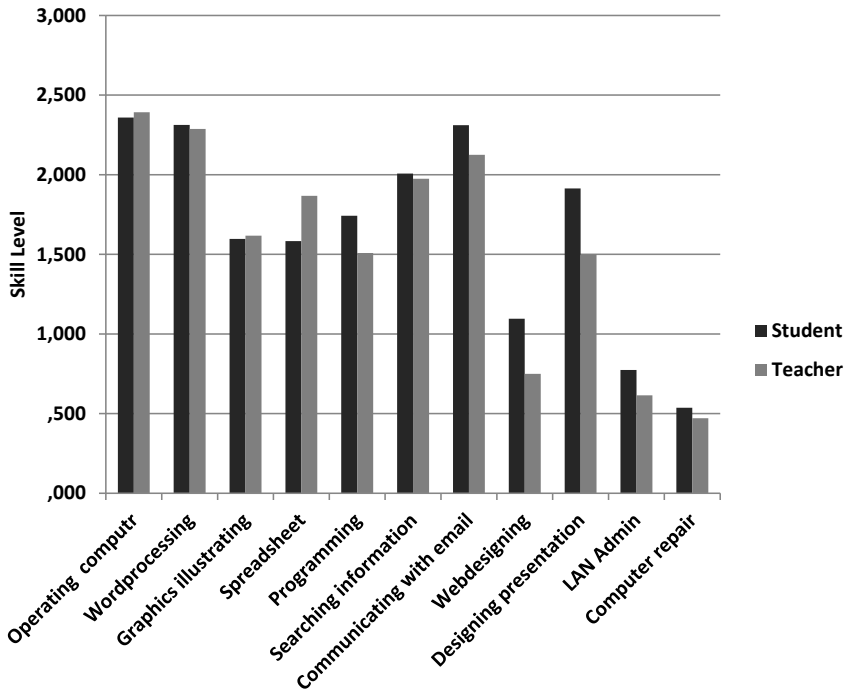


Figure 24. Skill levels of Teachers and Students in various ICT skill areas

Analysis of variance of Skill level between teachers and students

An analysis of variance was used to determine if there were significant differences in the mean skill

level for teachers and students. Result indicated (Table 15) that there are statistical significant differences in the mean skill level of teachers and students (marked in asterisk) in the various areas. Students showed higher mean skill levels in writing documents, writing simple programs, communicating via email, creating web pages, designing presentations, and networking administration. Whereas, teachers showed higher skill in calculating with spreadsheet. In other areas of skills, both teachers and students showed non-significant difference in their mean skill levels.

Table 15
ANOVA Statistics for Teachers and Students Skill Scores

	Mean			
Skill	Teacher	Student	F ratio	Sig
Operating a computer (saving files, printing	2.39	2.36	0.586	0.444
Writing documents with a word processor	2.29	2.31	0.545	0.000 *
Making illustrations with graphical programs	1.62	1.59	0.143	0.705
Calculating with spreadsheet programs	1.87	1.58	26.736	0.000 *
Writing simple programs	1.51	1.74	17.378	0.000 *
Sending,searching for and using electronic forms of information	1.97	2.01	0.395	0.530
Communicating via e-mail with teachers and other students	2.13	2.31	13.608	0.000 *
Creating webpages and websites	0.75	1.10	42.551	0.000 *
Designing presentations	1.50	1.91	52.608	0.000 *
LAN Administration	0.61	0.77	9.690	0.002 *
Computer repair	0.47	0.54	2.254	0.133

Note : df = 1,1430

*p < .05.

Relative Scoring of ICT Skill between Teachers and Students

Teachers were asked to rate their ICT skills in relation to their students and vice-versa. More than half of the teachers(51%)claimed that they are better than

their students in ICT (better-30%, much better 21%).In contrast, only 44% percent of students rated themselves to be better than their teachers (better-25% and much better-19%). About the same percentage (31 and 30%)of teachers and students rated themselves to be "equal". Figure 25 illustrates this comparison.

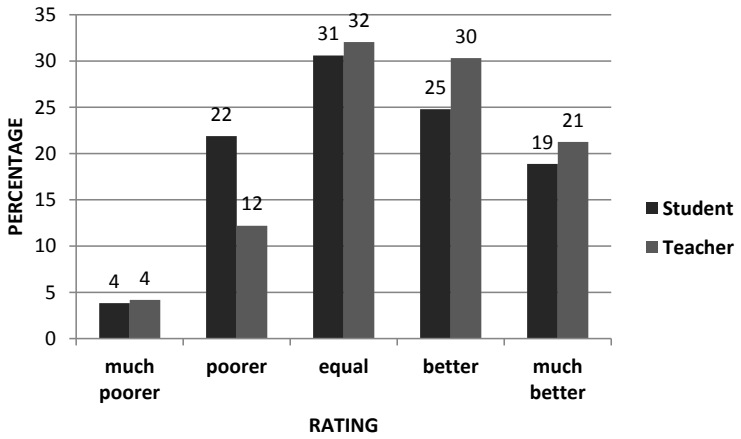


Figure 25. Comparison of self-rating between teachers and students on ICT skills.

Teacher Training

The study revealed that half of the teachers (53%) received ICT-related training and almost equal number of them have not attended any (47%). Majority of the teachers attend trainings once a year (44%), and 9 percent for twice a year participation (Figure 26). The mean for the frequency of training is .62 (SD =.643). No training is coded as 0. The respondents likewise mentioned that trainings are normally conducted only during summer break.

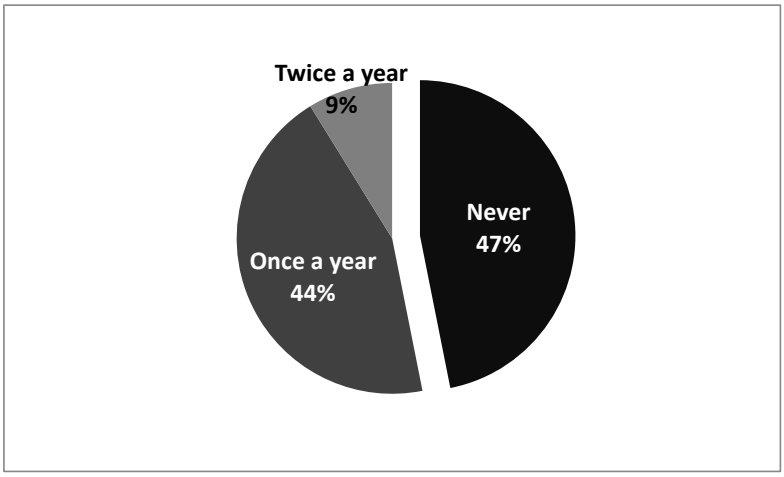


Figure 26. Percentage of teacher with and without training and frequency of training

The number of ICT-related trainings received by the teachers in the different skill areas manifest their potential to integrate technology into their pedagogical practice. Figure 27 shows that most of the trainings attended are in word processing(66%), basic computer operations(65%), and electronic spreadsheet(61%). The graph also illustrates that a large proportion of teachers have not taken other trainings like operating systems, database, graphic design, among others. Training on ICT-focused integration, which is considered to be essential in an ICT-enabled learning, only has 21 percent of teachers who attended. Equally important in the delivery of content is on graphic presentation and multimedia. In this aspect, only 30 percent of the respondents have received training on graphics web design/multimedia. Only one out of four teachers had training on web designing.

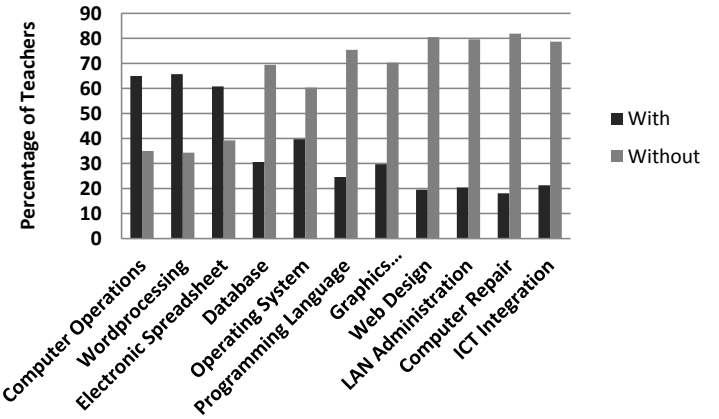


Figure 27. Percentage of teachers with and without ICT training on the different skill areas

Last Training Attended

Result showed (Figure 28) that highest percentage of teachers last training period was '1 year ago' (29%). This is followed by responses indicating that they received their last training 'more than three 3 years ago' (25%). Teachers who have participated trainings two years ago is 21 percent. Those who just received training just this year accounted to only 13 percent. Teachers who participated in trainings 2 years ago registered 12 percent. The average of last period of training attended is two years ago (M = 3.00, SD = 1.39; 2 years ago is coded as 3)

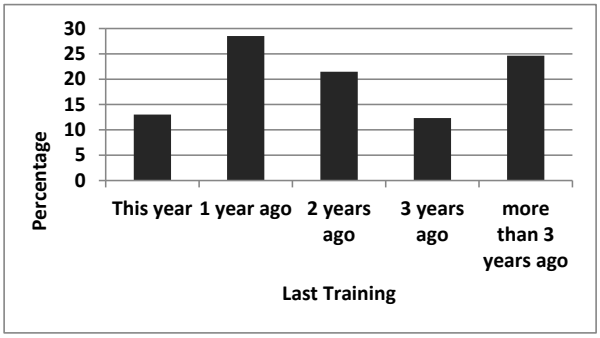


Figure 28. Percentage of teacher period of last training

Number of Years Using the Computer

The average number of years the teachers have been using computer is 6.21 (*SD* = 4.04). One out of three teachers has used computers between 1 to 3 years (33%). In comparison, one out of every four teachers had likewise used computers between 4 to 6years (28%). And those teachers who worked with computers between 7 – 12 years accounted to 32 percent. Respondents who reported they use computers for more than 12 years are relative small (8%). The bar graph (Figure 29) shows the comparative difference between the various years of use relative to the number of teachers. The result revealed that teacher computer experience is relatively recent (i.e., 1 to 3 years, and 4-6 years).

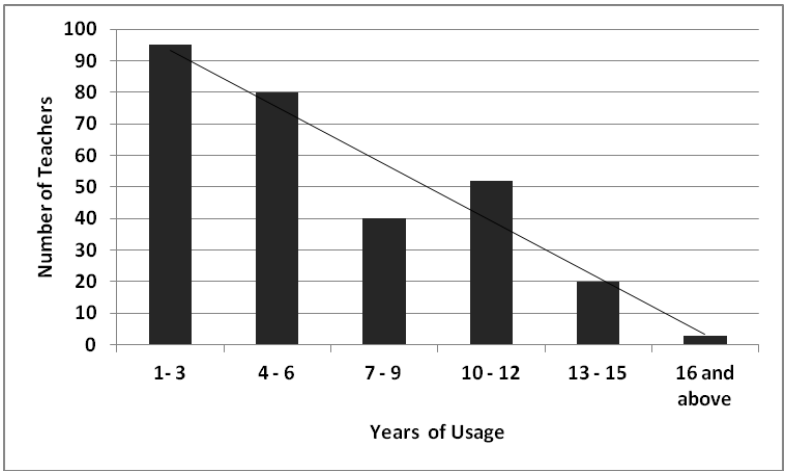


Figure 29. Number of years that teachers use computers.
Note. Actual years were grouped into 3 year class interval.

The statistics in Table 16 indicated the technology teachers have higher mean in using computers compared to the other group. The average years of usage is 6.21 (SD=4.040). Using ANOVA, the result yielded non-

significant difference in the number of years in the use of computers among the subject areas, $F(4,267)= 2.102$, $p = .081$.

Table 16
Average Years of Usage by Teachers' Subject Area

Subject Area	Mean Years	Std. Deviation
Mathematics	6.16	3.33
Science	5.80	3.48
English	6.10	4.52
Technology	7.54	4.59
Others	5.53	3.80

MATERIALS

Software used

Teachers were asked to select what type of software they use for teacher and learning. It is observed that half of the number of teachers do not use any of the computer software in teaching. Result shows (Figure 30) that software for *word processing* is highly used (53%). Next to word processing are : presentation software and internet browser (both 46%). Spreadsheet is likewise considered to be one of the mostly used (38%). It worth mentioning that a smaller percentage of teachers use software for cognitive skills like educational games(23%), drill and practice(23%), simulation (12%), statistical/mathematical software (12%), and tutorials (10%). It was observed that the use of these software have a direct bearing to the trainings teachers attended (refer to Figure 30) which are mostly word processing, presentation graphics, and spreadsheet. The software used like word processing, spreadsheet, and presentation

graphics are considered teaching tools rather than to develop student intellectual skills.

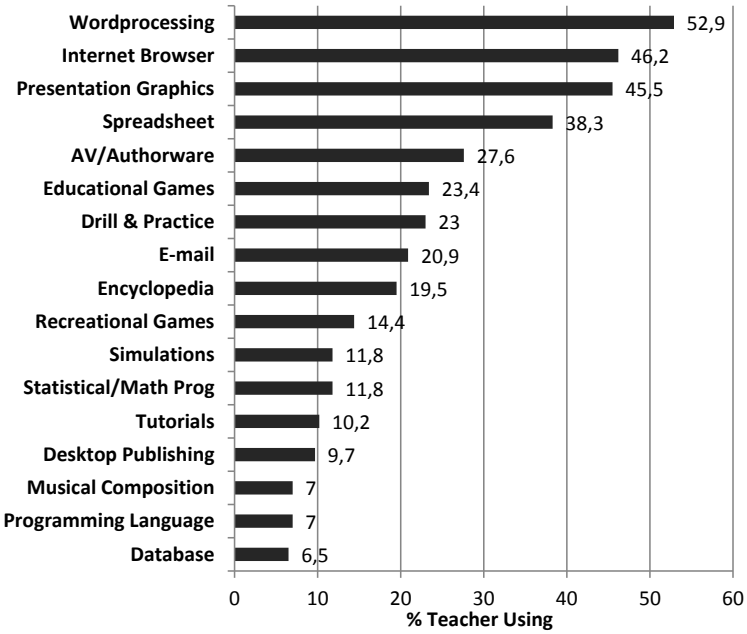


Figure 30. Percentage of teachers using various software for teaching (*N*=431)

Learning areas where ICT is used

The teachers were asked to select among a list of the different ICT tools which they believe to be effective or appropriate to their teaching practice. Figure 31 shows that a large number of teachers (82%), think that ICT is more effective and appropriate in science subjects like General Science, Biology, Chemistry, and Physics. While most teachers (61-63%) indicated it to be a good teaching and learning tool in Technology-Livehood and Mathematics. Social Studies (53%), Literary, and Journalism (52.9%) were selected by slightly half of the teachers surveyed. Some 209 teachers selected Music, Arts, and Physical Education (48%). A relatively smaller group of teachers reported their preference to use ICT

on Filipino(39%), Values Education(34%), and Multi-disciplinary project activities (37%). Only 77 teachers find ICT to be appropriate on Citizens Army Training (18%).

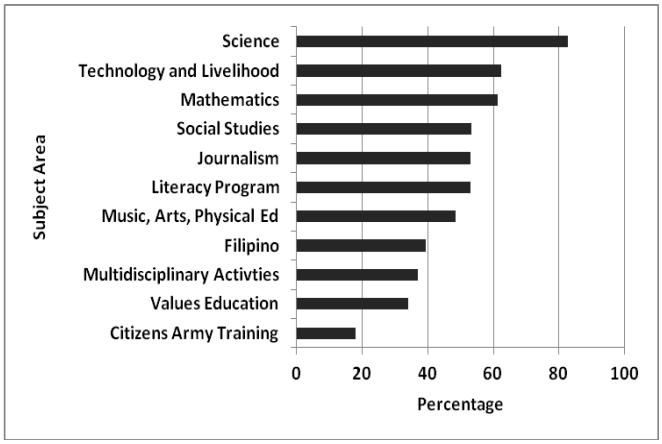


Figure 31. Percentage of teachers who think that ICT is more appropriate or effective on certain subject areas.

Software standardization

ICT coordinators and teachers revealed an important issue on the standardization of operating systems and software. For example in certain schools, within the same laboratory class, there are two platforms used like Linux and Microsoft. Some institutions like iSchool Project, an initiative of the Department of Science and Technology, provided computer packages to schools with Ubuntu(Linux variant)as its standard platform and advocated the use of free open source software (FOSS).

In contrast, the Department of Education as a matter of policy, prescribed the use of specific proprietary software like Microsoft in all its acquisitions.

According to iSchool, DepEd preferred Microsoft because "it is 33% more expensive to train teachers in open source(www.iSchools.ph)." Some coordinators to avoid a confusing set-up and software mismatch in their laboratories, decided to adopt a singular operating system and productivity tools and usually using Microsoft's Windows and MS Office products.

METHOD

Frequency of Use in the Class

The 431 teachers were asked about the frequency of ICT use for teaching and almost half (42%)of them answered 'A few times a year'. In contrast, about a quarter of the respondents (24%) indicated that they 'Never' used them for teaching. Few teachers use them monthly (11%). Teachers who use ICT weekly or more times accounted to 23 percent. The mean of frequency of use is 2.33 (a few times a year) and a standard deviation of 1.09.

Figure 32 shows the different subject areas with their corresponding mean and standard deviation. The result indicated that Technology and Livelihood education teachers used ICT approximately monthly (M = 3.10, SD = 1.17), while Science teachers usage is between monthly to few times a year(M =2.44, SD = 1.00). English and other subject teachers usage is slightly more frequent per year but not on a monthly basis (M = 2.44, SD = 1.00 and M = 2.44, SD = 1.00 respectively). The frequency of use by Mathematics teachers is fewer times a year (M = 1.73, SD = 0.73)

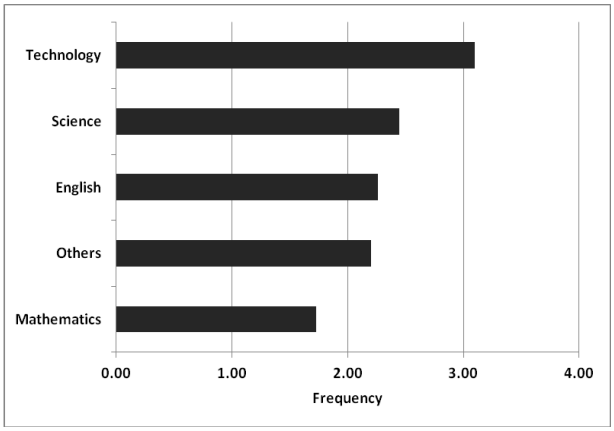


Figure 32. Frequency of ICT use in the class by different subject areas.
Note. Frequency is coded as 1 = Never;2 = A few times a year; 3 = Approximately monthly; and 4 = weekly or more.

Analysis of variance on frequency of use by subject area

A one-way analysis of variance showed that ANOVA that the effect of the subject area of teachers was significant $F(4,367)= 16.40$, $p =.000$. Post hoc analyses using the Scheffé post hoc criterion for significance indicated that the average frequency of use by Technology subject teacher is significantly higher (M = 3.10, SD =1.17) than all the other subject areas. The mean for Science teachers (M = 2.44, SD = 1.00) have a significant difference with that of Mathematics (M = 1. 73, SD = .73). Mathematics, likewise, differs slightly lower than the other subject areas (M = 2.20, SD = 1.02). In the sample, 15% of the variance in frequency of use is associated with the subject area.

Time Usage by Activity

Aside from the frequency of use, the 431 respondents were asked how many hours per week do they use computers for actual teaching, preparation of lessons, and class management. The descriptive statistical result showed an average of 3.12 hours per week (*SD* = 6.62) are spent for actual teaching, 3.96 (*SD* = 5.42) lesson preparation, and 3.60 (*SD* = 5.12) for class management such as recording of grades, attendance, etc.

Actual Teaching Use

Figure 33 shows the more than half (56%) of the teacher do not use ICT for actual teaching. Teachers mostly used the computers between 1 to 5 hours per week (29%), 6 percent between 6 to 10 hours per week. The percentage drops significantly in the 16 to 20 hours usage to 4 percent, above 20 hours to only 3%, and 11 to 15 hours usage to a low of 2 percent.

Lesson preparation use

As compared to actual teaching time use, the number of teachers who spend time in lesson preparation using computers (66%) is bigger than those who do not use (34%). Forty-five percent of the teachers use computers within the range of 1 to 5 hours per week. The percentage of the amount of time between 6 to 10 is only 13 percent which reflects a much lower than the previous range. Computer time spent from 11to 15 per week drops at much lower percentage (4%). Usage above 15 hours accounts only for 4 percent.

Class management use

For class management i.e., recording, grading, etc., the result also revealed that there is a bigger percentage of teachers who use (67%) than those who do not (33%). Fifty percent of these teachers reported usage from 1 to 5 hours a week. Percentage of use in the 6 to 10 hours per week significantly drops to 10 percent. A small percentage (6%) was observed for the 11-15, 16-20, and 21 and above groups combined. The result indicated that majority of the teachers use the computers from 1 to 5 hours per week be it in actual teaching, lesson preparation, and class management. It was also observed that the amount of time for class management (50%), is higher than lesson preparation (45%), actual teaching (29%). The trend showed that percentage of time usage drops abruptly beyond 5 hours (see Figure 33).

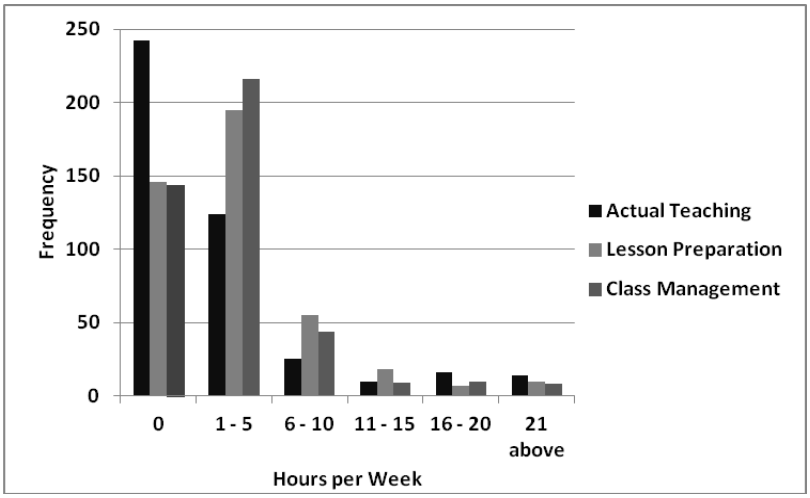


Figure 33. The amount of time teachers use the computer by activity
Note. Actual time were grouped into 5-hour class interval.

Frequency of time (hrs/week) use by subject area

With regard to the amount of time use by subject area, Technology and Livelihood subject have a higher mean hours per week compared to the others in terms of actual teaching use (Table 17). English, however, have the highest average in relation to class preparation and class management. Science subject area, placed second to English in class preparation and class management Mathematics has the lowest time usage in actual teaching.

Table 17
Time Use per Week by Subject Area

	Actual Teaching		Lesson Preparation		Class Management	
	M	SD	M	SD	M	SD
Mathematics	0.68	1.63	3.39	4.94	3.87	4.44
Science	2.94	4.74	4.82	5.99	4.21	6.23
English	3.86	8.13	5.11	6.07	4.37	6.95
Technology	7.84	10.56	4.16	5.12	3.18	3.91
Others	1.80	4.22	3.39	5.42	3.21	4.74

Analysis of variance on type of use by subject area

Actual Teaching

The result indicated that there is a statistical significant difference in the actual teaching time use among the different subject area, $F(4,393) = 14.049$, $p=.000$. The eta squared value of 12.5 percent indicated the amount of variability is associated with subject area.

Lesson Preparation

Results revealed that there is no statistical significant difference in the time use for lesson

preparation among the subject areas, $F(4,393) = 1.643$, $p=.163$.

Class Management

There was no significant effect of subject area on the time usage for class management, $F(4,393)=.859$, $p =.489$

Internet Service Application Used

In the study the 431 teachers were asked if they have existing account for various internet service applications. The highest percentage of adoption on these applications is the social networking website Facebook (85%). It is no big surprise that the result indicated a high prevalence since the Philippines ranked 4th in the top growing countries on Facebook in the last six months (Socialbakers, 2011).

Most respondents (85%) also have email accounts and Yahoo messenger (65%) for chat, call and email. Skype (30%) is also popular among teachers for its text, voice and video but not as high as that of Friendster (45%) which is the original social networking site and popular in Southeast Asia. Twitter, another social networking and microblogging service has only 17 percent followings and equal to the rating of Chikka (a Philippine wireless application service that provides SMS and instant messaging). Blog, which provides commentaries for a certain subject matter, registered 11 percent just like Multiply (a social networking site similar to Facebook, Friendster, Bebo, and the like). Other websites reported are Tagged, ThinkQuest, MySpace, Yahoo groups, Tumblr, TeacherTube, and SlideShare, which represented a small fraction of the total respondents (2%). Figure 34

illustrates the ranking of these popular internet service applications based on the teachers' responses.

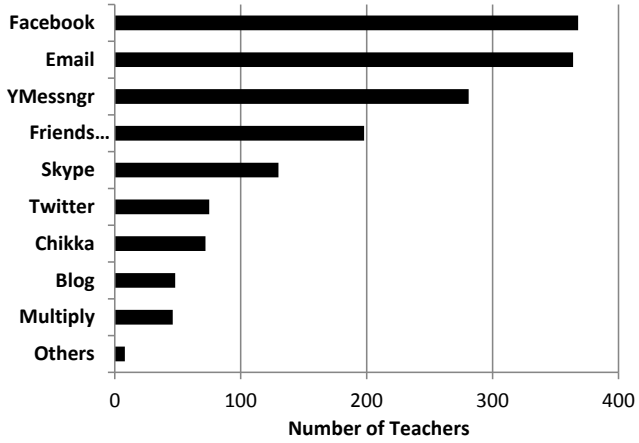


Figure 34. Teacher adoption of popular internet service application

MILIEU

Student number of computer and time usage of computer at home

The data revealed that majority of the students (66%) have computers in their homes. More than half of these students have one computer (67%), whereas a smaller percentage have two computers (22%). Corollary to this is that a large number of students reported that they use their home computers for learning (78%). This is consistent with what the teachers reported that students generally do their research at home using their computers. Meanwhile, with the student's resource and time available at home, it can be also be believed that these students know more about computers and internet than their teachers (this is collaborated by what the teachers reported earlier; see # 19 of Table 15). The

average amount of computer time spent is 10.29 hours per week (*SD* = 11.39) or 2 hours per day.

Public-Private Partnership Program

Considering the limited capital resource and technological expertise, major companies have taken initiatives to assist the government in expanding the use of ICT in education by providing educational equipment, teacher/student trainings, connectivity, and technical support.

The Department of Education entered into partnership program with the telecommunication companies, technology related firms, business associations, and other government institutions to provide needed financial, equipment, materials, connectivity, training to improve the quality education for public schools with the use of technology or ICT.

The more known public-private partnership projects are:

1. Intel Teach to the Future
2. GILAS (Gearing-up Internet Literacy Access for Students)
3. Partners-In-Learning Microsoft
4. PCPS – Personal Computer for Public Schools(Department of Trade and Industry) Japanese Government Funded

Intel Teach to the Future

As part of its corporate social responsibility commitment, Intel Teach was launched in 2001 to help

improve the Philippine education by providing teacher training component of the government computerization program. The program is aligned with the government's computerization programs for public schools among them are the Personal Computers for Public School and Adopt-a-School-Program (Intel, 2011).

In 2005, Intel tapped the Foundation for Information Technology Education and Development (FIT-ED) as it implementing agency. Meanwhile, the University of the Philippines National Institute for Science and Mathematics (UP-NISMED) was responsible for the content localization and professional development of the Intel Teach program for both pre-service and in-service teachers.

The program creates a network of trainers where, senior trainers from UP-NISMED conduct the in-service training for master trainers nominated by the school, and in turn, they will echo the training to 20 teachers in their respective schools. For pre-service training, senior trainers from UP-NISMED, train 25 faculty members from teacher education institutions and then they will also train two classes or 20 students.

The Intel program trains teachers on how to effectively incorporate ICT into their lessons. At the end of the training, teachers are expected to produce unit plans produce outputs and products enhanced by ICT. A pedagogical support system was established to assist newly trained master trainers in enhancing and implementing the unit plan they have developed and in the conduct of training in their respective schools.

The financial support afforded by Intel for the program covers the various expenses incurred during the formulation, implementation, and monitoring and evaluation stages. Expenses covered are operational expenses, accommodation of participants, honoraria of trainers and monitoring and assessment.

According to Intel's report, since its launch in 2001, it was able to train over 25,000 pre-service faculty and students and more than 50,000 in-service teachers.

Gearing Up Internet Literacy and Access to Students (GILAS)

Recognizing the government's inadequate budget to supply the needed educational facilities and resources, GILAS was formed, in 2005, to provide computers and internet connectivity to public schools and students. GILAS is a program of "leveling the playing field for Filipino students by providing them with access to the internet a powerful tool to boost education…(GILAS, 2009).

GILAS is a multi-sectoral initiative composed of private corporations and non-profit institutions. The consortium is made up of the following, American Chamber of Commerce, Apple, Ayala Corporation, Ayala Foundation, Bato Balani Foundation, BayanTel, Commission on ICT, Dept. of Education, Dept. of Trade and Industry, Digitel, Globe, GMA-7, HP, IBM, IMI, Intel, Makati Business Club, Microsoft, Mitsubishi, Narra Ventures Capital, Phil. Business for Social Progress, Phil. Star, PLDT-Smart, and SPI.

According to GILAS 2011 Final Report, the total number of schools connected since its inception is 3,306. This figure represents 46.21 percent of the country's 7,154 public high schools. Over 4.399 million students were able to gain access to vast digital resources through their internet provision. The program was not merely focused on students alone. The report also indicated that they have provided trainings to 13,538 teachers in internet literacy, LAN administration, PC maintenance and program sustainability.

For schools without computers, the GILAS package is composed of 10-20 PCs, a server, printer, LAN, and internet connection. (given free for one year). The average cost of the package is P300,000 (approx. USD 6,600). Those without computers, have the same package component except without the PCs (average cost of P100,000 or approx. USD 2,200). It also includes training for teachers, school heads, and technical assistance for one year(GILAS, 2011; p. 12).

Resources provided by non-government sectors were used to leverage counterpart funds from the local government unit on a 50:50 cost-sharing. Deployments were done on a province or city basis (by DepEd division) or depending on the preference of the donor. As part of its strategy, the program engaged the participation of the community (parents, barangay leaders, youth group, and other community residents).

For the National Capital Region (NCR), the overall percentage of schools connected is 91 percent. The report also indicated that only 3 out of 14 divisions (cities)

in NCR are 100-percent connected (Table 18). The average number of schools connected is 91 percent.

Table 18
Status of NCR Schools Connectivity

Caloocan City	28	/	30
Las Pinas City	8	/	11
Makati City	9	/	10
Malabon/Navotas	13	/	13
Mandaluyong City	8	/	9
Manila	32	/	32
Marikina City	9	/	10
Muntinglupa City	4	/	5
Paranaque City	10	/	10
Pasay City	7	/	9
Pasig City/San Juan	12	/	13
Quezon City	46	/	47
Taguig/Pateros	13	/	13
Valenzuela City	16	/	18

Source : GILAS Final Report
As of *October 31, 2011*

To address the issue of sustaining the GILAS program and its own computerization program, the DepEd in 2009 issued a department order (creating the DepEd Internet Connectivity Project (DICP). The order directed all public secondary schools to subscribe to internet services. Each school is given a budget allotment of P48,000 (approx. USD 1,056) per annum (DepEd Order No. 50 S. 2000).

Microsoft Corporation's Partners in Learning (PiL)

The PiL is an initiative of Microsoft Corporation to help students and teachers access technology and provide

trainings on how to use them. PiL provides for the provision of software and grant of over US$250 million in cash and grant worldwide for the integration of ICT into curricula and learning.

According to Ms. Michelle Casio, Microsoft Philippine education lead, the objective of PiL is to "empower teachers and educators realize their potential." She cited three pillars of the program compose of teachers, educators, and students.

Microsoft partners with the Department of Education along with the local government and private sector to "increase access to digital content, thus increasing the quality and relevance of learning, and hopefully lowering dependence on paper-based resources"(DepEd website)

The PiL project consists of three components:

1. The Learning Grant Program (worth US$250 million)
2. Training for school leaders and teachers in various Microsoft IT Academy Centers.
3. Provision of free licensed copy of Windows operating system for donated computers (called Fresh Start for Donated PCs).

Microsoft and the Department of Education signed a Memorandum of Agreement in November 2003 that established regional training centers (called Microsoft IT Academy) for teachers. The trainings offered basic literacy, Microsoft office, and software development. Each participating college/universities is committed to train 100 teachers within six months in their school laboratories. There are around 140+ colleges and

universities who serve as training centers(www.deped.gov.ph).

The provision of free Windows licensed operating system for donated PCs started in June 2004 including upgrades to Windows XP. The project also gives significant discounts for Office productivity software to public and elementary schools.

In 2009, the Department of Education extended its partnership with Microsoft for another 5 years. In the first phase of the PiL, it was able to train 20,000 teachers locally and sent 28 teachers abroad for advance studies in curriculum delivery (DepEd March 2009 press release).

PiL developed a portal for teachers for the purpose of sharing lesson plans and best practices. According to Microsoft Philippines, there are about 40,000 members to this online community. The Microsoft education lead, Ms. Michelle Casio reported that they were able to train directly about 43,000 teachers and 3 million through cascade trainings and workshops.

iSchools Project (Department of Science and Technology)

iSchools is a project conceived to render support to public high schools in the use of ICT. The project is computerization initiative undertaken by the Department of Science and Technology (formerly by the Commission for ICT). iSchools deploys Wireless Internet Computer Laboratories (WILL) composed of 19 desktops, server, printer, multimedia projector, and one year internet subscription.

As part of the WILL package, the program includes capacity building workshops for teachers such as Computer Internet Literacy Course, laboratory management, web development, library management, pc recycling, and sustainability seminars. Selected instructors from state universities and colleges serve as trainers for public high school teachers.

iSchools advocates for Free Open Source Software (FOSS)as manifested by their use of Ubuntu platform and EdUbuntu in contrast with the prevailing DepEd policy on the use of paid proprietary software in partnership with Microsoft.

The project closes with a record of 1,000 recipient public high schools or about 14% of the total number of high schools under the DepEd(www.ischools.ph). iSchools foresee the problem of sustaining the FOSS after the program closes since the laboratories will eventually be managed by the DepEd.

Personal Computer for Public Schools (PCPS) with the Government of Japan

The PCPS program is a joint undertaking of the Department of Trade and Industry and the government of Japan. Its goal is to "enhance the Filipino youth's information technology skills as the country's future knowledge workers and promote IT culture in Philippine classroom as an avenue to develop Filipinos' skills to at par with global standards(www.dti.gov.ph)".

According to the report of the Department of Trade and Industry, the PCPS have accomplished the following (www.dti.gov.ph) :

Phase I (2001-2003)

- Provided of 19,920 computers (20 computers/schools) nationwide.
- Trained 24,389 Science and Mathematics teachers on the use of computer technologies and internet tools. This included basic computer operation, troubleshooting, and preventive maintenance.
- Trained 500,000 high school students for an average of 9.22 hours per week under the one-year computer education curriculum.

Phase II (2003-2005)

- Provided additional 12,320 computers to 1,232 public schools at 10 units per school
- Trained 13,343 teachers on basic computer operations and integrations of computers in classroom instructions

Phase III (2005-2007)- provided more computers to public schools which reduced the backlog from 76 percent to 55 in Phase I and in turn further reduced to 36 percent in Phase III.

Phase IV – have a funding support of P170 million budget from Japan which provide 11 desktop computers and peripherals per school for 425 Muslim Mindanao public schools. The package comes with desktop computers, wireless broadband router, printers, uninterruptible power supply, and Microsoft operating system and Office. This phase is in line with the program of the Department of Education to close the gap between the Muslim traditional school and the DepEd basic education curriculum.

According to DTI's website, PCPS phases 1,2, and 3, provided 3,714 public high schools with 47,100 computer packages from a total grant of P1.8 billion funding support from the Government of Japan thus reducing the computer backlog from 75 percent to 37 percent as of year 2010.

PROBLEMS IN ICT INTEGRATION

In the questionnaire, there were 13 listed possible problems that affect ICT integration. These obstacles are about professional development, computer hardware, internet, administrative support, software and digital materials, time, interest to learn, planning, rewards and incentives, monitoring, curriculum, maintenance and repair, and pedagogical models. The teachers ranked these factors from highest (1) to lowest (13) according to what they believe or experienced to have effect on the implementation of ICT use in the teaching and learning.

Teachers' Ranking of ICT Problems

The mean of all the rankings of all the problems were computed. Based on the computed mean of the different problems, 'insufficient computer hardware' was selected by the teachers as the biggest problem in the implementation of ICT integration (M = 3.55, SD = 3.08). Secondly, teachers also reported that they do not have enough knowledge and training (M = 4.04, SD =3.68) to be able to use technology for teaching.

Ranked third is the lack of software and digital materials that they can use (M = 5.24, SD = 3.21). Fourth, there is poor technical support, maintenance, and repair (M = 5.45, SD = 3.17). Fifth, is the issue of lack

or slow internet connection (*M* = 6.62, *SD* = 3.54) which denies or frustrates teachers to tap the vast pplications and materials in the web.

It is observed that the result of the ranking validates other results. For example, the lack or infrequency of actual teaching, lesson preparation, and class management using computer is attributable to the lack of logistics (hardware, software, and internet).

Another issue is the maintenance of working equipment since the purchase of new computers and other devices are not regular and highly dependent on budget coming from the national and local governments. Most of the schools do not have any maintenance (41%), and if ever, most of the repairs are done by the teachers (33%) who handle the computer education subjects.

One critical issue in on the inadequacy of administrative support/leadership (*M* = 5.69, *SD* = 3.42). Administrative support and leadership come from their school, the division of schools and the Department of Education. Administrative support are mostly the provisioning of machines, and funds to purchase equipment, repair, and sponsor trainings. One example of inadequacy administrative support is the lack of funds for computer maintenance and repairs. and the availability of computer and peripherals for teachers and students.

Leadership, on the other hand, can be interpreted on how the head of the school i..e, the principal, pursue the goals and objectives of ICT integration given meager resources, motivate his/her teachers, and continually

improve processes and tasks. Poor planning, cooperation and coordination (M = 5.91, SD = 3.31) is translated in the lack of coherent plan on how to implement integration (objectives, goals, measurement, etc). Good time scheduling on computer and peripheral use needs planning and coordination. Lack of time to use computer (M = 5.77, *SD* = 3.95) can be attributable to lack of computers, time slot for teachers, or rigidity of the curriculum.

The curriculum issue, ranked 6th, reflected the teacher's concern on the prescribed curriculum. The curriculum is the reference for subject matter to be learned and the expected knowledge the student should acquire on a certain period of time. It was observed that there are no standard or specific prescriptions on when and how to use ICT to accomplish certain teaching or learning activities or learning objectives and it all depends upon the teacher innovativeness. Monitoring and evaluation in the use of ICT was not considered to be a priority problem for teachers(*M* = 7.15, SD = 3.72) considering that they are not yet regularly using ICT; thus, there is no need of for monitoring. Other problems which are considered low priority are : ICT-enabled pedagogical model and examples (*M* = 7.28, *SD* = 4.09), interest to learn (M = 8.22, SD = 3.85), and incentives (M = 8.31, SD = 3.86).

Table 18
Teachers' mean ranking of ICT in education problems

Rank	Problem	M	SD
1	Insufficient computer hardware	3.55	3.08
2	Not enough knowledge and training	4.04	3.68
3	Not enough software/digital material	5.34	3.21
4	Poor technical support/maintenance/repair	5.45	3.17
5	Lack or slow internet connection	5.62	3.54
6	Inadequate administrative support/leadership	5.69	3.42
7	Lack of time to use computers	5.77	3.95
8	Poor planning, cooperation and coordination	5.91	3.31
9	Loaded curriculum	6.01	3.39
10	Lack of monitoring and evaluation on ICT use	7.15	3.72
11	Inadequate ICT-enabled pedagogical models and examples	7.28	4.09
12	Lack of interest to learn or use computers	8.22	3.85
13	Lack of incentives	8.31	3.86

Students' Ranking of Problems

Based on mean ranking, it was found that the top three problems is about hardware, time, and internet connectivity. Insufficient number of computer (M = 4.06, SD = 3.00) topped the list of problems facing ICT integration. Then, lack of time to use computer computers (M = 4.10, SD = 3.05) comes slightly lower. This can be traced to causal effect of inadequate number of computer as it was observed that computer education classes are normally conducted an hour per session. During the one-hour period, 2 or more students take turn in using one computer.

Meanwhile, students indicated lack or slow internet connection to be a pressing problem (M = 4.45, SD = 3.19) which is understandable with the low bandwidth (usually 1 Mbps) available that is shared by an average of 41 students per computer laboratory. Given the average number of laboratory per school is 2 then multiplied by

41 which is the average student per laboratory, the estimated total number of students using the internet at the same time is 82. The average bandwidth per student is approximately 12kbps (1 mbps divided by 82 students). This bandwidth is extremely low compared to 2,526 kbps required for 82 simultaneous users at 10% large file transfer requirement which is 2,526 kbps (source of bandwidth calculation: https://www.jpiworldwide.com/bw_calc.html).

Likewise , they also cited problems on lack of software/digital materials (M = 4.49, SD = 2.91), poor technical support (M = 4.65, SD = 2.90), and loaded subjects to learn (M = 4.96, SD = 3.12). In some instances, schools have programs and software available but they do not run in the dominantly old computers' operating systems. If ever these are compatible, programs run very slow because of the low processor and inadequate main memory storage. Students raised the problem on loaded subjects (M = 4.96,SD = 3.12). This problem can be attributed to tight schedule of their classes as prescribed in the curriculum.

The least significant concerns are : poor classroom monitoring (M=6.18, SD=3.25), lack of interest to learn or use computers (M=6.51, SD=3.45), and not enough teacher knowledge (M=8.01, SD=3.83).

Table 19
Students' mean ranking of ICT in education problems

Rank	Problem	M	SD
1	Insufficient computer hardware	4.06	3.00
2	Lack of time to use computers	4.10	3.05
3	Lack or slow internet connection	4.45	3.19
4	Not enough software/digital material	4.49	2.91
5	Poor technical support/maintenance/repair	4.65	2.90

Rank	Problem	M	SD
6	Loaded subjects to learn	4.96	3.12
7	Poor planning, cooperation and coordination	5.65	3.07
8	Inadequate administrative support/leadership	5.80	3.08
9	Lack of incentives	5.80	3.20
10	Poor classroom monitoring	6.18	3.35
11	Lack of interest to learn or use computers	6.51	3.45
12	Not enough teacher knowledge	8.01	3.83

Analysis of variance of the problems

An analysis of variance was used to determine if there are significant differences in the mean problem score for teachers and students (an alpha level of 0.05 was used in all statistical tests). The result showed (Table 14) that there are statistical significant differences in the mean problem scores of teachers and students (marked in asterisk).

Table 20
ANOVA Statistics for Teachers and Students Problem Scores

Problem	F	Sig.	
Not enough teacher knowledge	118.443	.000	*
Lack of time to use computers	60.625	.000	*
Insufficient computer hardware	.775	.379	
Lack or slow internet connection	24.542	.000	*
Poor technical support/maintenance/repair	13.322	.000	*
Inadequate administrative support/leadership	.007	.933	
Not enough software/digital material	19.170	.000	*
Lack of interest to learn or use computers	41.245	.000	*
Loaded curriculum	30.894	.000	*
Poor planning, cooperation and coordination	3.628	.057	
Lack of incentives	80.408	.000	*
Lack of monitoring and evaluation on ICT use	16.428	.000	*

Note. df = 1,678
*p<.05

It was observed that large differences in the mean of teacher and students are found in problems involving

knowledge (3.43), incentives (2.53), time (2.15), and interest (1.87). Fifteen percent of the variability for knowledge; incentive, 11 percent; 8 percent for time; and 6 percent for interest are associated with the grouping (teaching or student).

Meanwhile, there were no statistical significance difference in the mean problem scores of teachers and students pertaining to : insufficient computers, $F(1,678)=.775$, $p=.379$, inadequate administrative support, $F(1, 678)=.007$, $p=.933$, and poor planning/coordination, $F(1, 678)= 3.628$, $p=.057$.

Using an open-ended question, teachers further reported the following problems and comments which inhibit the infusion of ICT in teaching and learning in the classroom as follows:

Area	Problem
Machine	Lack of computers/laptop, multimedia, projectors Low computer-to-student ratio Computers are not available for academic subjects but only for computer classes Computer viruses Low specifications of computer units Inadequate electrical and wiring installations Teacher personal laptop to manage time and schedule Availability of internet Not open to all students and teachers Difficulty in setting-up equipment from one class to another Need at least one computer per classroom Need at least one LCD per department Damage threat to equipment by students without guidance
Manpower	Lack of knowledge about ICT integration Lack of technician Teachers who were trained in ICT integration did not teach other teachers Mindset that ICT is the end rather than the means In-house technician to monitor hardware & software in the computer labs

Area	Problem
	Poor initiative of [unmotivated] teachers due to lack of units Limited trainings/seminars in ICT integration Irregular frequency of trainings/professional development Age factor to learn ICT
Material	Lack of materials Unavailability of needed materials Poor maintenance of the software Insufficient guide and materials for ICT integration Lack of textbooks in ICT
Management	No planning at all Lack of budget Regular budget for maintenance Only some year-levels are allowed to use computers No program for ICT integration Proper support and continuous development for teachers to adopt ICT Infrequent monitoring & evaluation Bias on teachers who will attend ICT trainings No incentives to those teachers who use ICT in the class Encouragement Lack of intensive planning and assessment
Method	Lesson preparation using computer is time consuming Need technician to monitor student use of computers Extra time needed to prepare effective and interesting lessons Class time is short to accomplish computer-based activity Lack of control on class size Need more student exposure outside the school Lack ICT enabled models and examples Only 1 hr lab per week
Milieu	Time and use of computer lab Need for security Lack of space and time No available room used for presentation Curriculum is not aligned to ICT integration Lack of support from national & local officials Curriculum not flexible Not enough support from community(parents, private org, govt) ICT room is not available for teachers Lack of appropriate curriculum, textbooks, materials from DepEd Class schedule not flexible to prepare lesson using ICT Financing to buy teacher laptop AVR room for big classes

Students, on the other hand, raised the following issues about their actual experiences on access to and use of ICT in their schools as follows:

	Problem
Machine	Insufficient number of computers Poor or no internet connection Defective computers not replaced Wirings and electrical connections Booting/Logging in is very slow Computers are only available in computer labs and computer subjects Lack of funding Computer viruses Useless computers because they don't have internet Insufficient number of computers Malfunctioning parts (mouse, keyboard, AVR, etc.) Substandard computer quality Lack of projectors Others have flat screen Computers are slow, outdated, and damaged Computers not updated, older versions are slower. Different kinds [models] of computers Lack of printers Low bandwidth Access to computers is not allowed for home works Not all students are given chance to use computers Fighting over computer Loss of time because of slow internet connection We need to pay 5 pesos to use the PCs in the library. Old version of browsers Computers are donated years ago It is hard for the teacher to carry the computer Our computer hardware are older than history books
Manpower	Lack of student discipline Doing games, facebook, twitter, chat during class Fear that students might destroy them[computers] Teachers do not know how to use computers Teachers prefer traditional teaching Lot of teacher do not engage in ICT-based lessons Clinging to traditional ideas/Lack of skill and ability Students get addicted to computer Students become dependent on ICT Distractions using social networking while doing school works Lack of teachers who have knowledge in computers Playing games during classes and not paying attention to

	the teacher Some students open others files Spending more time in social networking Teacher knowledge in computer is lacking No time for teachers to use computer Teachers have not time to use computers
Material	It is better if we use books but computers are faster You can get faster information using the computer Lack of CD-based materials that do not need internet (example: Encarta) Some students don't read books Software are not always available Programs are outdated Not enough programs
Management	Poor scheduling Equal computer schedule for all year level Poor class monitoring Not all students are given the chance to use computer Overtime of classes
Method	Limited time in the use of computers It's better if teacher write on the board and explain Depends on how teacher/students [used] them [ICT} makes students more creative and work faster Lack of time because we are only using 45 mins/day Lack of time and discussion Lack of time to go to the computer room Only few computers are available so we use it alternately
Milieu	Shared room with other classes Broken chairs, tables Power failures Crowded area and lack of space to move Lack of security and computers and parts are stolen Lack of room for computers Loaded subjects to learn Budget problem of school

GOALS IN THE USE OF ICT

Teachers' Goals

To determine the purposes of using ICT, teachers were asked to rank the list of goals in the questionnaire (1 is considered the highest goal). The mean of each goal was calculated with their corresponding standard

deviation and sorted from highest to lowest (Table 21). The result of the statistics showed that the respondents considered to 'make learning more interesting' as their most important objective in using ICT. This is followed by the goal to 'promote active learning' which reflected a pedagogical shift in teaching and learning. Third is the goal to 'improve student achievement' which is considered a priority because the scores in the achievement test serves as an indicator of the performance of the school in particular and the educational system as a whole. Fourth, is the use of the computer to 'develop student independence and responsibility of their own learning' which could be interpreted as a shift to teachers being facilitators and guide in learning and give more autonomy to the students in searching and analyzing information, solving problems, collaborating, among others. Meanwhile, teachers considered 'prepare students for future jobs' as the least important of their goal.

The probable explanation could be that if the students have learned and acquired the required competencies for learn and acquire skills and knowledge easily through technology, this could result to better prepared students to their future jobs. It could also mean that the immediate concern of the teacher is for student to learn the subject matter and pass the subject. Individualized student learning was ranked last with a mean of 5.01(SD = 2.04). Again, this goal was selected to be the last goal probably because the schools do not have the basic resources such as computers and digital materials to individualized the learning process.

Table 21
Mean ranking of teachers' goals in the use of ICT

	Mean Ranking	Std Dev
1. Make learning more interesting	2.30	1.60
2. Promote active learning	2.80	1.57
3. Improve student achievement	3.19	1.75
4. Develop student independence and responsibility for own learning	3.63	1.75
5. Encourage more cooperative and project-based learning	4.01	1.83
6. Prepare students for future jobs	4.45	2.39
7. Individualize student learning experiences	5.01	2.04

Students' Goals

The student samples revealed (see Table 22) a different ranking of goals in the use of ICT compared to the teachers. The students ranked the goal : ' to prepare students for future jobs' as the number 1 overriding purpose of ICT use. This signifies that, acquiring skills in ICT will give them better opportunities in the job market. Second, the students believe that ICT will improve their academic achievement or performance.

The learners acknowledged that the vast materials available in the internet, communication for collaborative project, and the power of the computer in data processing will make them perform better. Thirdly, students believed that ICT is the medium to 'develop student independence and responsibility for their own learning. This is consonant to the potential of ICT to create an autonomous learning environment where learners can be free from the rigidities of schooling, and constraints of space and time.

The statement to 'make learning more interesting' was ranked 4th (teachers ranked this as number 1). It can be broadly explained that students know that ICT can make the lesson interesting and engaging and the opportunity to exploit this and use it to create ICT-mediated instructional materials rest upon the teachers. Of interest is the goal to 'individualize student learning experiences' which ranked second to the last (teachers ranked this as last goal). There is a general understanding that the availability of computers and education software, among others, determine the individualization of learning experiences. While the rationale of using ICT for individualizing learning is one the modes of delivery the content, student may not find it as important as acquiring the skills through collaboration. The students ranked to 'promote active learning' the last goal in ICT usage and interestingly, teachers ranked it 2nd. Again, there is a body of evidence that students become active learners when ICT is embedded in the lessons (music, photos, graphics, social networks, etc) and for them it is not considered to be a primary goal but a given feature of the technology. Teachers considered the primacy of making student being active participants in the learning process mainly because it is the core purpose of their profession.

Table 22
Mean ranking of student's goals in the use of ICT

	Mean Ranking	Std Dev
1. Prepare students for future jobs	2.41	2.06
2. Improve student achievement	2.61	1.76
3. Develop student independence and responsibility for own learning	2.98	1.88
4. Make learning more interesting	3.04	2.01

5. Individualize student learning experiences	3.52	2.15
6. Promote active learning	3.56	2.06
7. Encourage more cooperative and project-based learning	3.71	2.12

Rank comparison of Teachers and Students Goals

Teachers showed varying appreciation on the goals in using ICT. For instance, students' most important goal in the use of ICT is in preparation for future job/employment (ranked 1) compared to rank 6 by teachers. Whereas, teachers top most goal is to make learning more interesting, the student ranked it as only as their 4th. The same observation was noted in the goal about promoting active learning whereby teachers ranked it as their 2nd compared to students 6th (Table 23).

However, they have almost similar goal pertaining to improving academic achievement and developing independence and responsibility for learning.

There is slight variations from the two group as noted in their ranking pertaining to cooperative and project-based learning and individualized learning experiences.

Table 23
Comparative Mean ranking of Teachers and Student's goals in the use of ICT

	Rank	
	Teacher	Student
>Make learning more interesting	1	4
>Promote active learning	2	6
>Improve student achievement	3	2

>Develop student independence and responsibility for own learning	4	3
>Encourage more cooperative and project-based learning	5	7
>Prepare students for future jobs . . .	6	1
>Individualize student learning experiences	7	5

Analysis of variance of Goals

The result of a One-Way Anova computation of the mean ranking scores of both teachers and students (group) with the dependent variables (goals)showed that there were statistical significant differences between the two group in all the goals ($p<.05$).

- Prepare students for future job $F(1,1294)= 226.898$, $p=.000$
- Improve student achievement $F(1,1286)= 27.497$, $p=.000$
- Make learning more interesting $F(1,1303)= 38.894$, $p=.000$
- Develop student independence and responsibility for own learning $F(1,1278)= 30.343$, $p=.000$
- Promote active learning $F(1,1290)= 39.713$, $p=.000$
- Encourage more cooperative and project-based learning $F(1,1281)= 5.393$, $p=.020$
- Individualize student learning experiences $F(1,275)=121.220$, $p=.000$

PERCEPTIONS, BELIEFS AND ATTITUDES

Teachers

The respondents were asked to rate 23 statements using a 5-point Likert scale about their beliefs and perceptions about ICT in education. These statements various affects of ICT integration comprising of availability of resources, curriculum, time, pedagogical approach, incentives, ease of use, and technical skills. Table 24 shows the percentage of respondents who agreed or disagreed to the statements. To emphasize and simplify the presentation and the discrimination responses, the percentage of *strongly agree* and *agree* were totaled into one, and the same with that of *strongly disagree* and *disagree*.

The result revealed that most teachers (82%) desire to have their own laptop. It implied that the availability of computer to use anytime in the classroom, lesson preparation, and management is crucial. What is apparent is the lack of computers to use in the school as indicated by the teachers (63%). While computers are made available, teachers raised issues regarding computer reservation and technical support to carry the computers (desktop) and to set-up along with multimedia devices. With respect to multimedia devices, 46 percent agree that this is not always available.

What is interesting from the result was that, most teachers agree (76%) that it is easier to teach with computers with only 7 percent disagreeing. It implies that teachers can perform better and productive with and from the technology.

Another issue of concern is about the curriculum. A large number of teachers think that 'it is easy to use ICT if the curriculum is flexible' (71%). A look at the statement that 'prescribed textbooks are the guides and the content has to be taught as mandated' describes the rigid nature of the current curriculum. Yet, a large percentage of teachers believe that student learning is more important than the curriculum (70%). The teachers are almost divided on whether the present curriculum addresses ICT integration, with 36 percent agreeing and 33 disagreeing. Again, they are equivocal about the statement that 'there is no curriculum material related to ICT with 36 percent agreeing compared to 35 disagreeing. On the opinion that 'teachers do not have time to integrate ICT because there is so much to cover in the prescribed curriculum', 51 percent agreed against 19 percent who did not. While many factors can be attributed to lack of time, interpretation leads to the observation that as of the present, the learning objectives must be followed and the use of ICT is optional or recommended as matter of curriculum policy.

The large percentage of teachers who concurred to the statement that 'teachers are not well trained to use ICT' (59%) showed the urgency to build and upgrade the capacity of teachers considering the rapid developments of ICT tools. That is why teachers also admitted (56%) that their students know more about computers and internet than they do against a few who believe on the contrary (14%). If this is the case, the teachers may find their authority weakened with a more technology-confident students. This gap in computer skills provide a telling example of the underfunding trainings for teachers. On the type of trainings they received, the

respondents indicated that most of these are 'focused on ICT skills rather than integration'. The study showed that most of these trainings are on how to operate the hardware and software such basic computer operations, word processing, spreadsheet, and operating system). This is evidenced in the statistics of this study that about 80 percent do not know when and how to use these tools in their instructional.

Quite interesting is that the teachers believe they can be still be productive and effective without ICT (52% agreed, 21% disagreed). One probable explanation to this is they can make do with what is available in the school until the hardware and infrastructure become available. Majority of the teachers agree (76%) that it is easier to teach with computers (with only 7 percent disagreeing). This only means that teachers are aware of the advantages of ICT or have experienced actually using ICT in class.

The statement that 'PowerPoint' presentation is just a modern substitute for the blackboard', elicited 55% affirmation against 21% disagreeing. What this means is that powerpoint, in particular, is a mere presentation medium just like the blackboard. Perhaps it could be interpreted to be the lack of knowledge on its potential to incorporate other media (audio, video, animations and graphic) to engage learners. On the other hand when asked if 'the computer does not change teaching-learning pedagogies', almost half of the respondent (45%) disagreed., while more a quarter (27%) agreed. It can be interpreted that teachers believe that computer, in general, has the potential to transform the learning environment.

With reference to teachers' instructional approach, they did not agree that 'students prefer the lecture type in teaching' (45% disagree; 30% agree). This can be interpreted as marginal preference to interactive, constructivist approach (learner-centered) over that of lecture, instructivist (teacher-centered) mode of teaching. Aside from the indicating that students know more about computers and internet, the teachers is of the opinion that 'students usually do their research using computer at home' (70% agree; 12% disagree). This result either showed lack of facilities and time in school to do learning tasks or an expansion of the learning environments from the school to the home.

Table 24

Percentage of Teachers' Agreement and Disagreement to ICT-integration Statements

	Percent	
	Agree	Disagree
1. Student learning is more important than the curriculum.	69.31	12.38
2. The present curriculum does not address ICT integration.	33.42	35.95
3. Teachers are not well trained to use ICT	58.85	17.71
4. Computers are not always available	63.21	16.79
5. Multimedia is always available	28.29	46.40
6. It is better if we have our own laptop	82.38	7.44
7. Making the lectures in computer is taking so much time.	29.57	45.11
8. It is easier to teach using computers.	76.06	5.24
9. There is no curriculum material related to ICT	36.13	34.61
10.The computer does not change teaching-learning pedagogies.	26.74	45.24
11. PowerPoint is just a modern substitute for blackboard.	54.48	21.39
12. Students prefer the lecture type in teaching.	23.56	42.61
13. It is difficult to manage students in an ICT-mediated class	22.67	44.84
14. Students usually do the research using computer at home	69.27	11.84
15. Teachers do not have much time to integrate ICT because there is so much to cover in the prescribed curriculum.	50.77	19.07
16. It is easy to use ICT if the curriculum is flexible.	70.69	7.20

17. The prescribed textbooks are the guides and the content has to be taught as mandated.	49.34	18.04
18. Teachers can be as productive and effective even without ICT.	51.67	20.57
19. Students know more about computers, internet, than teachers.	55.89	14.25
20. There are few software available to augment pedagogy.	47.52	15.40
21. Majority of professional development focused on ICT skills rather than integration.	54.66	9.33
22. Giving incentives and recognition is important to support innovative teachers.	68.72	6.92
23. Most teachers commonly use computers for administrative and planning functions rather than pedagogical purpose.	58.27	12.07

Students

Table 25 shows that a large of percentage of students (91%) believed that knowing how to use computers help them in their studies. Their affirmation to the efficacy of computers supports the view that ICT is needed to facilitate and improve their learning. Meanwhile, almost all students agreed that doing well in school is important(92%)and that they plan to continue studying after high school(90%). However, they were ambivalent about the statement 'going to college to me is not critical' (34% agreed - 34%disagreed).

Most students indicated that 'there should be more computers and internet access in the school'(78%). For them, the internet is better for school research (72%) and as they also believed that 'books are becoming obsolete because of internet'. Consistent with this is the students perception that there is more information in the internet than in the library(40%);however, 20 percent did not agree. This only indicate that student search and inquire information more on on-line than the traditional sources. They likewise expressed that using internet is better that watching movies(49%).

As to the delivery mode of instruction, students are ambivalent about the statement 'online lesson is more enjoyable that the usual classroom teaching' (31% agreed, 32% disagreed).
With respect to location, the students indicated preference to study at home using on-line lessons (34%) while 26% percent did not agree.

Almost half of the students believed that teachers should be using more technology in the classroom (46%) as against 21 percent who did not agree. When asked if teachers are falling behind in technology, 35 percent of the students agreed, while 26% disagreed. A relatively small number of student (21%) said that teachers have time to use the computers in the classroom whereas 42% indicated that teacher do not have time. Meanwhile, while they showed strong reliance on ICT applications and tools, they still believed that a good teacher is not a substitute for technology(46%).

A large number of students (84%) have the common notion that they should be given more responsibility for their learning. And that they shared the view that it is not good studying without time constraint(57%). Based on these confirmations, it can be inferred that students are ready to assume the role of learners who are independent and accountable.

Table 25
Percentage of Students' Agreement and Disagreement to ICT-integration Statements

	Agree	Disagree
1. Doing well in school is important to me	92.12	4.66
2. I plan to continue studying after high school	89.92	5.20
3. Going to college to me is NOT critical.	33.94	34.04
4. Knowing how to use computers help me in my studies.	90.98	4.36
5. There should be more computers and internet access in the school.	77.65	5.30
6. Spending time using internet is better than watching movie	49.32	11.65
7. It is better to use the internet for school research	72.30	7.26
8. Online lessons is more enjoyable than the usual classroom teaching	30.97	31.91
9. It is faster to gain friends using the internet	43.51	23.33
10 Each student should use social networking software (facebook,multiply, friendster)	50.57	14.32
11. It is preferable to study at home using on-line lessons	34.27	26.04
12. Books are becoming obsolete because of internet	51.77	19.23
13. Teachers should be using more technology in the classroom.	50.00	11.88
14. There is more information in the internet than in our library	40.37	20.29
15. Generally, teachers are falling behind in technology	25.53	33.19
16. Computers are only used for PowerPoint in the classroom	25.73	44.87
17. Teachers has no time to use computer in the classroom	20.86	42.24
18. Good teacher is no substitute for technology	44.51	22.78
19. Students should be given more responsibility in their learning	84.41	5.96
20. It not good studying without time constraint	56.83	10.90

EXECUTIVE SUMMARY OF THE FOCUS GROUP DISCUSSION

The purpose of the focus group discussion was to gain information from the ICT coordinators from the various divisions in Metro Manila and the regional office about ICT integration. Discussions centered on the preliminary findings of the study on ICT adoption and the participants' recommendations and actions taken in their respective areas.

Key findings

Machines

The ICT coordinators acknowledged the lack of computers as a major problem. They mentioned that schools are not allowed to purchase computers and they are constrained by a very limited budget of P10,000/per annum (approx. US$232). The acquisition process for computers and peripherals is centralized in the Department of Education main office which standardize the hardware and configurations for all schools and purchase these equipment by bulk thru competitive bidding process, and distributes them to the individual schools. However, this procurement cycle takes many months or a year and by this time some specifications may have been rendered outdated.

The ICT coordinators commented that their schools were given second-hand donated computers but after several uses these machines can no longer be used or repaired. The common perception is that schools become a "dumping ground" for computers which cannot be repaired or parts that are no longer available or available but expensive. While they say that "beggars should not be choosy", they proposed that there should be appropriate guideline for second-hand donated computers which will avoid the pitfalls of frequent machine failures and short-term serviceability.

Manpower

The participants reported that teachers only attend training few times and it is not regular. It was observed that teachers who were given computer trainings, more often, do not apply them in the classroom and merely used it for service records and promotions. They

suggested that there should be a "return of investment" from the training by echoing it to other teachers or having an ICT project.

It was also mentioned that the age of the teacher is a vital factor in the attitude towards the use of computers. Some older teachers/administrators do not know how to use technology and in effect consider its use a low-priority. Participants enjoined administrators to motivate their teachers and advocate ICT use.

One issue which surfaced during the group discussion was on the lack of time of teachers to use computers or to plan. This problem is attributable to the lack of computers since most of these are used by students in the computer laboratories.

The participants also observed that there are teachers who can develop quality e-learning materials but they are not tapped. They suggested that these teachers can be pooled to develop the local materials instead of hiring external consultants.

Material

The participants raised the issue on the lack and cost of software. It was also noted that there was no agreed standard software to be used for certain subjects. One coordinator noticed that even technology teachers are using different software even if they teach the same subject. They suggested standardization of software be it proprietary or open-source, provided it serve the learning needs of the students. One participant reported that they use both Linux and Microsoft in their school (Dept. of Education officially prefers the use of the

latter). Until now, there is a unresolved issue on the standardization of all public school software whether to adopt a proprietary software or the FOSS (free-open source software).

Another issue is the lack of inventory of software existing in the schools some of which are not used.

Management

The group believed that a strong leadership is needed to push the adoption of ICT in the schools. It was reported that the ICT for Education (ICT4E) Strategic Plan crafted before the present government administration was discontinued because of political change. The Director for Planning and National Capital Region ICT coordinator lamented that the plan should have been continued and improved to fit the needs of the times. She also advocated that any formulations of plans and policies should have the participation of people from the field and other stakeholders. "Mahirap gumawa ng policy na hindi naka-hands-on", (It is difficult to make policy if you're not hands-on), she further stated. She added that the shelved ICT4E plan was developed in consultation with teachers, parents, and students and it was a very good plan.

It was mentioned that if there is a strong support from the Dept. of Education to the grassroots (i.e., schools) ICT will boom. They all agreed that school principal have a big influence in the infusion of ICT in teaching and learning process. However, the group admitted that there is no monitoring and evaluation as far as ICT integration is concerned. Another participant

recommended monitoring teacher ICT usage by installing the appropriate system in the computer and posting of a computer laboratory policy.

FGD ACTION PLANS AND PROPOSED POLICIES

To improve the use ICT in the schools, the coordinators and principals resolved to take the following actions/policies:

- Create a task force for innovative learning before the start of the school year – June 2012.
- Pooling of manpower to produce learning materials which are locally made.
- Set-up an educational portal where learning tools and content can be uploaded and downloaded
- Use other technology not limited to computers
- Inventory and pooling of software from various schools
- Use of available ICT resources to its utmost advantage
- Showcase e-learning products
- Enhance teachers creativity
- Generate item-bank for student examinations

Chapter 5

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This chapter summarizes the various findings and observations about Integration of Information and Communication Technology (ICT) in Public Secondary Schools in Metro Manila, Philippines. The summary will proceed according to the major causal domains in ICT integration such as : machine, manpower, material, method, and milieu. The study purports not to generalize its conclusion and recommendation as to be applied to the overall issues in technology adoption but to give an understanding and insights both in quantitative and qualitative terms. The recommendations proposed areas for improvement from the analysis of the problems and some action steps that took into cognizance the views and opinions of educational leaders, administrators and ICT coordinators, and the classroom teachers.

SUMMARY OF FINDINGS

I. Machine

Undoubtedly, the most important issue that beset the use of ICT in the schools is the lack of sufficient computers and peripherals. The overall average ratio of students' population against the number of computers of the schools was found to be at a low of **1:63**. Only 30 percent of the schools have a ratio of from 1:1 to 1:30. Most of the schools (53%) have reported an average ratio of 1:2 in the computer laboratory. However, not all schools offer computer education at all year level. Besides computers, the supporting IT devices like LCD projectors, printers, scanners, etc. are exceedingly low. As an example, there is one LCD projector per 1,418

students, and a single printer per 1,607 students. Some schools (18%) lack LCD projector. Both teachers and students have ranked 'insufficient computer hardware' as their number one problem. The research studies of Tinio(2002) and Cajilig(2009) also revealed that "insufficient number of computers" as the biggest obstacle of public high school teachers in the use of ICT for teaching and learning.

Majority of the schools (59%) have computer maintenance and repair support using variety of approaches like using external service maintenance provider, in-house servicing(ICT coordinator/teachers), or combination of both. Lately, the DepEd enjoined schools to use technical-vocational schools to service their repair needs. While schools may have trained teachers or technicians to troubleshoot and repair computers, there is no money to buy the needed parts. The common complaint by school administrators is the lack of budget for computer maintenance and repairs. It is apparent from the study that machine failures, breakdowns, and response time for repair become a frustrating experience in the use of ICT, thus become a de-motivator for the teachers and students. Even with a good start-up computer deployment inventory, the number computers in the schools are bound to decline if these are not properly maintained and repaired; plus, the natural course of the equipment's obsolescence.

II. Manpower

A disproportionate amount of attention and financial resources have been poured for the acquisition of computers than the equally important aspect of training teacher to use these tools. The study showed that "not enough knowledge and training" is the second major

obstacle ranked by teachers in the realization of ICT adoption in the classroom. The study revealed that a small majority (53%) of teachers received ICT-related trainings and while the others (47%) did not. Most of the trainings attended were limited on *basic operations, and productivity tools* (word processing, electronic spreadsheet). A bigger percentage of teachers have no training on database, multimedia/graphic design, operating system, simple programming, and ICT integration. Last training attended, on the average, is two years. Those that were trained do not practice it in their classrooms nor re-echo the same to their respective schools. Some administrators observed that age has a bearing on the interest to learn ICT and younger teachers are more inclined to adopt ICT in their classroom.

In terms of ICT proficiency, most teachers are in the middle level in the area of operating computer, writing document and communicating via email. Below the intermediate level are skills related to internet sending/searching, calculating using spreadsheet including making presentations. Teachers only registered signified higher proficiency level in "calculating with spreadsheet" while the students showed higher skill in writing document, writing simple programs, communicating via email, creating web pages, designing presentations, and networking administration. It is not surprising therefore that majority of the teachers (56%) agreed to the statement that : "Students know more about computers and internet than teachers. The imbalance of computer skills poses a challenge to build the confidence of teachers to use ICT to teach effectively by infusing more resources for capacity building.

III. Method

The amount of time and frequency of use by teachers gave a clear picture of the current state of actual use of ICT in the classroom. Most of the teachers (42%) only use the computers "a few times a year" , almost a quarter (23%) "weekly or more", and almost a quarter (24%) – "never" used ICT for teaching. Understandably, technology and livelihood teachers use it more often, monthly on the average, than the other subject areas. Science teachers usage is between monthly to few times a year while English teachers usage is slightly more frequent per year but not monthly. ICT usage for mathematics, considered to be a good area for IT intervention, is only used " a few times" per year. It is observed that most of the computer time and facilities are devoted to the teaching of computer literacy which is a separate subject course for students under the Technology and Livelihood Education (TLE) and some other special courses in ICT.

Majority of teachers (56%) do not use the computers in the classroom for pedagogy. Of those who use ICT, a few teachers (29%) averaged 1 to 5 hours per week. Usage drops significantly to 6 percent for 6-10 hours weekly, and to a mere 3 percent above 20 hours per week. In lesson preparation and class management, a bigger number of teachers use ICT (66 and 67 percent respectively). Forty-five percent of teachers prepares lesson using the computers for an average 1-5 hours per week. Usage for class management is higher (50%) for an average of 1-5 hours per week. The study showed that usage dips significantly beyond 5 hours of usage per week. This validated the issue on the "lack of time to use the

computers" ranked 7th by the teachers which bring to fore its connection to issues on hardware, software, and knowledge.

Less than half (46%) of the teachers reported that they learn how to use computers by collaborating with other teachers. The resource persons are normally the technology teachers or ICT coordinators who help them with their work on ICT. Given that a teacher belongs to certain department, assistance is naturally sought within the unit. Some schools conduct monthly meetings where ICT and pedagogical issues are raised from the various disciplines. However, the schools have yet to formalize a program on peer coaching or mentoring where a culture of learning collaboration can be fostered.

IV. Material

Teachers generally use text processors (56%), presentation software (46%), browsers (46%), and spreadsheet (36%). A smaller percentage use educational games (23%), drill and practice(23%), simulation(12%), statistical/mathematical (12%), and tutorial(10%). This explains the trend in software use since most teachers receive trainings on productivity tools (text processor, spreadsheet, and presentation software). Again, the problem on "lack of digital/software material" was prominently raised since productivity tools would not directly address the pedagogical needs of teachers as compared to educational software titles that are tailored for the subject. Understandably, teachers have a common perception that computers are generally used for administrative and planning support rather than pedagogical purpose. For lack of sufficient guide and

models on when and how to use a given software or tool for a specific lesson, teachers adoption may stall.

Policy pertinent to the use proprietary platform and software against open source software have been the subject of debate. Some schools have adopted a Linux based platforms because this have been distributed by institutions like the Department of Science and Technology under its iSchool project. However, Department of Education's prescribes the use of proprietary platform because they argued that it is cost-effective to train teachers by 33% than open source. For now, the majority of schools use Microsoft products given the large number of teachers who were trained and use it as compared to Ubuntu or Edubuntu (Linux). The use of Linux and other open source productivity tools, as an alternative, is promising to be a viable option for schools. The primary reason is that schools do not have to spend for licensing. Secondly, it is particularly suited for a thin-client environment which connects old computers to a Linux-based server. Thirdly, the source codes are available and can be modified by its community of users.

V. Millieu

A large percentage of students (66%) have reported that they have a least one computer at home. Of this percentage, a larger number of students (78%) are using them for learning. The average amount time spent is 10 hours per week. This is consistent with what the teachers believe that students do their homework using computer at home and they know more about computers and internet than them. Compared to the time they use computers at home, students only averaged about 4 hours per week in the school (or 45 minutes/day).

Both teachers and students believe that the curriculum is loaded and there are too many subjects to learn. Teachers thought that they have no time to integrate because there is so much to cover in the curriculum. A large number (70%) also affirmed the statement that : "It is easy to use ICT if the curriculum is flexible." Since computer education is treated as a separate subject in the curriculum, teachers tend to treat ICT as distinct and special subject which would not fit in their normal practice. A small majority of teachers (52%) thought that they will still be productive and effective even without ICT. With the recent implementation of the K-12 basic education program, it is expected that it will decongest loaded curriculum and to give more quality time for teachers to integrate ICT to improve learning outcomes.

The Public-Private Partnership program of the Department of Education with the private sector, with a mutual objective of improving the quality of education through ICT, have been notable. Given the limited financial resources of the government, these dynamic private organizations have reduced the hardware backlog, installed/expanded connectivity, and provided training and technical support to various schools. Some of these achievements are as follows :

- **Intel Teach to the Future** have trained since 2001, 25,000 pre-service faculty students and more than 50,000 in-service teachers on how to incorporate ICT into their lesson by producing local unit plans and products enhanced by ICT.

- **GILAS** (Gearing-Up Internet Literacy and Access to Students) a conglomerate of private and non-profit institutions have provided 3,306 schools with

internet connectivity. This represents 46% of the total public high schools. About 4 million students were given access to internet and 13,506 teachers were given various trainings. Moreover, computer packages were provided to schools without computers (including free internet connection, LAN, printer, servers).

- **Microsoft's Partners-In-Learning (PiL)** provided trainings and workshops for school leaders and teachers. About 43,000 teachers through direct training and 3 million through cascade model of training, were the beneficiaries of said program. PiL established regional IT Training Centers. The learning grant provided by Microsoft is worth US$25 million. In addition, the program provided free licensed copy of Windows operating system for donated computers. The second phase will end in 2013.

- **Personal Computer for Public Schools (PCPS)** is a joint undertaking by the Department of Trade and Industry and the Government of Japan which provides for hardware and training for public high schools teachers and students. The program, Phase I-III, provided 3,714 public high schools with 47,100 computer packages from a total grant of P1.8 billion funding support from the Government of Japan thus reducing the computer backlog from 75 percent to 37 percent as of year 2010.

IV. Management

The schools ranked the local government units (LGU) as their number one source of support for their ICT program

(M=1.56), Department of Education as second (M=1.67), and non-government organization (NGO) as third (M=2.13). The succeeding order of supporters as follows : alumni association, industry, Congress, foreign-aid and parent-teachers association. Schools have limited budget allocations for internet subscription of Php48,000 (US$1,109) per year as prescribed by the Department of Education. The budget for general maintenance and operating expense per school is P25,000 per month (US$581). There is no specific budget allocations for computer repairs and maintenance. According to the ICT coordinators, they are only allowed to purchase equipment to a maximum of Php10,000 (approx.US$232). Acquisition of computers is centralized in the Department of Education.

To gauge the implementation and effectiveness of ICT, monitoring and evaluation is necessary. In this study, the "lack of monitoring and evaluation" was considered not as important by teachers compared to their concern about hardware, software, and training. This is understandably, considering that most teachers do not really apply ICT in their pedagogical practice. A large number of teachers (80%) stated that they do not have a monitoring and evaluation to measure the ICT's use and effectiveness. The average frequency of evaluation is yearly and this is not specific to ICT use but on teaching performance in general.

ATTITUDES AND BELIEFS

The following are the statements which elicited a high degree of agreement concerning teachers and students beliefs, perceptions, and attitudes on ICT in education:

Teachers

- Students' learning is more important than the curriculum (69%)
- Computers and multimedia are not always available (63%)
- It is better if we have our own laptop (83%)
- It is easier to teach using computers (76%)
- PowerPoint is just a modern substitute for blackboard (55%)
- Students usually do research at home (69%)
- Students know more about computer and internet than teachers (56%)
- It is easy to use ICT if the curriculum is flexible (71%)
- No time to integrate because there is so much to cover in the curriculum (51%)
- Teachers can be as productive/effective even without ICT (52%)
- Most professional developments focused on ICT skills rather than integration (55%)
- Giving incentives and recognition is important to support innovative teachers (69%)
- Most teachers commonly use computers for administrative and planning functions (58%)
- Teachers are not well trained to use ICT (59%)
- There are few software to augment pedagogy (48%)

Students

- Doing well in school is important to me (92%).
- I plan to continue studying after high school (90%)

- Knowing how to use computer help me in my studies. (91%)
- Students should be given more responsibility for their learning. (85%)
- There should be more computer and internet access in the school.(78%)
- It is better to use the internet for school research (72%)
- It is not good studying without time constraint. (57%)
- Each student should have a social networking account. (51%)
- Books are becoming obsolete because of internet (52%)
- Teachers should be using more internet in the classrooms. (51%)

GOALS IN ICT USE

The teachers and students have ranked the goals in the use of ICT according to the degree of importance , as follows :

Teachers' Ranking

1. Make learning more interesting
2. Promote active learning
3. Improve student achievement
4. Develop student independence and responsibility
5. Encourage more cooperative learning and project-based learning
6. Prepare for students for future job
7. Individualize student learning experience

Students' Ranking

1. Prepare students for future jobs
2. Improve student achievement
3. Develop student independence and responsibility for own learning
4. Make learning more interesting
5. Individualize student learning experiences
6. Promote active learning
7. Encourage more cooperative and project-based learning

Teacher considered the primacy of making lesson interesting through ICT mainly because it will engage the students and make become active partner in the learning process. In the same context, teachers also believe that ICT will be an effective tool to improve student achievement. Students likewise believe the value of learning and using ICT tool for future job. They also acknowledge that with ICT tools, they will be able to improve their academic achievement in school. The ranking of the goals showed the receptiveness of students to have "independence and responsibility for own learning."

RECOMMENDATIONS AND STRATEGIES

In the light of results and findings found in the study, the following are recommended to improve the current status of ICT adoption for the National Capital Region public secondary high schools :

- Develop/review ICT for Education Master Plan that will provide clear plan of action with a shared single vision to achieve key priority education outcomes. The planning team should include all possible mixtures of representations from various

stakeholders (most importantly, expertise from seasoned teachers who have used ICT in their practice). The plan should continue to be implemented despite shifts in political leadership.

- Increase financial investment at the national level for ICT infrastructure, professional development, and digital resources.
- Set-up and configure ICT based on factors such : teaching and learning needs, technology maturity of teachers/students, population, among others.
- Standardize the year level where computer education subject is being offered to avoid digital divide among schools. There should be equitable distribution of ICT time and resources across all learning areas not only on technology subject.
- Strengthen participation of the private sector and non-government agencies in providing computers, training, internet connectivity, technical support, etc. to schools.
- Build-up capacity and enhance confidence of teacher by focusing ICT training on specific lesson/course. It is best that they learn practical ICT adoption in their *workplace* with their peers or mentors.
- Develop educational portals to deliver and share content and materials and best practices.
- Provide ample support to innovative teachers or ICT coordinators who can demonstrate exemplary instances of ICT application in the classroom.
- Conduct a continuing measurement and evaluation on the use of ICT as to its effectiveness on improving learning objectives.
- Tap students, with advance ICT skills, who can assist the teachers in the classroom/laboratory machine troubleshooting and repairs.

- Create a more subject-specific application of ICT in the curriculum.
- Rationalize training programs by identifying type, period attended, level of proficiency, and pedagogical needs. This includes post-training follow-up and support.
- Strengthen program to finance teacher's acquisition of laptop by encouraging banks and financing institutions to open special loan at low interest or high discount rate.
- Conduct study on internet usage of schools and monitor performance of service providers.
- Support school initiatives in sourcing funds their own funds to sustain ICT program.
- Study other alternatives on the use of old computers to maximize its usefulness(example, as dumb terminals in a client-server set-up).

CONCLUSION

In general, the study concludes that ICT adoption in the public high schools in Metro Manila have not trickled in the classrooms. The fundamental and recurring issue since ICT was introduced had always been the lack of ample provisions for hardware and connectivity. While there were digital literacy conducted for teachers, they are generally on the productivity tools(text processor, spreadsheet, presentation). Most of these are learning *about* rather than learning *with* the tools. As teachers reported, the use of ICT have been limited to "a few times year" hampered by lack of time, knowledge, equipment, and software. The curriculum policy to teach computer education as a separate subject and later applied to other learning areas have yet to be realized on the latter. ICT resources are concentrated on computer

education, and in effect, little time and resources are given to teachers for their pedagogical needs. A policy shift is needed to address the inequality on the use of sparse ICT resources across all learning areas not only to computer education.

Both teachers and students have shown positive attitudes and beliefs regarding the use of ICT as a tool for teaching and learning. The opportunity to capitalize on the perceived efficacy of ICT tools must be taken advantage. Students know that the ICT will prepare them for their future and teachers believe that it will make a difference in improving learning achievements.

School administrators have strong influence on ICT initiatives. Continues process improvement must be done from planning to implementation. It is imperative that constant measurement and evaluation be done in all aspect of the teaching process enabled by ICT. Teachers will follow given an enabling environment to innovate.

The conclusion of this study brought to the surface new and persistent issues to be addressed. A clear strategic plan, concrete actions, continuous measurement and evaluation, and strong leadership to sustain it is needed if ICT becomes transformative and effective tool for teaching and learning.

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