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Harnessing the Use of Open Learning Exchange to Support Basic Education in Science and Mathematics in the Philippines

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This paper presents the open learning initiatives of the Science Education Institute of the Department of Science and Technology to overcome certain barriers, such as enabling access, cost of replication, timely feedback, monitoring and continuous improvement of learning modules. Using an open-education model, like MIT's (Massachusetts Institute of Technology) OCW (open courseware), a Web-based system was developed to improve the capacity and capability building in primary science and mathematics education in the Philippines, by developing freely accessible, interactive teaching and learning resources. Finally, the paper presents the current status of the project, and discusses the system's potential to deliver better value for money, particularly with the economies of scale, when distribution and monitoring of quality learning modules became nationwide in scope.

Keywords: science and mathematics education in the Philippines, Philippines open learning initiative, ICT (information and communications technology) in education

Introduction

Once one of the best in Asia, the education system of the Philippines is perceived to be lagging behind other countries specifically in the Southeast Asian region, such as Thailand, Malaysia, and Singapore among in terms of quality and access to resources.

In 2003, results of the TIMSS (Trends in International Mathematics And Science Study) conducted by the IEA (International Association for the Evaluation of Educational Achievement), the Philippines ranked the 23rd out of the 25 countries in Grade 4 and the 42nd among 45 countries in Grade 8 (second year high school) for science. For mathematics, the country ranked the 23rd in Grade 4 and the 41st in Grade 8 (second year high school), putting the country in the bottom group along with countries like Chile, Morocco, Tunisia, and South Africa (Mullis, Martin, Gonzalez, & Chrostowski, 2004).

Several reasons were given as causes of the unsatisfactory achievement of Filipino students, particularly in science and mathematics subjects. Among these are lack of qualified science and mathematics teachers and their beliefs about teaching the subjects, the science and mathematics curriculum, large classes resulting to overcrowded classroom, limited or lack of school resources like basic equipment, science laboratory, textbooks,

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enhancement materials, and student opportunities for learning among others.

Through the years, the government has been looking for new solutions and innovations that will uplift and improve the quality of education system and deliver basic education more effectively. Recognizing the opportunities and potential benefits of integrating ICT (information and communications technology) into the education systems, several national policies have been formulated in an attempt to address those issues.

The first of these national policies is the MTPDP (Medium Term Development Plan of the Philippines) 2004-2010, which envisions ICT as a development tool: "ICT will be harnessed 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" (National Economic Development Authority, 2004).

The 2002 BEC (Basic Education Curriculum) likewise recognizes the need to harness ICTs in "the acquisition of life skills, a reflective understanding and internalization of principles and values, and the development of the person's multiple intelligences". BEC 2002 is conceived as an interactive curriculum that promotes integrated teaching and interdisciplinary, contextual, and authentic learning. The use of ICTs in all learning areas is encouraged as a means for promoting greater interactivity, widening access to knowledge that will enrich learning, and for developing "skills in accessing, processing, and applying information, and in solving mathematical problems and conducting experiments" (BEC, 2002).

The Philippine EFA (education for all) 2015 also identified the strategies to achieve the MTPDP targets on basic education and one of these is on "Progressive Curricular Reforms" which states that,

> Teaching-learning processes will be made more learner-centered; indigenization of learning materials will be encouraged and teaching-learning approaches will be aligned with science and mathematics curricula to advance the subjects' quality. A vital part of the restructured curriculum is the use of ICT in every learning area. (Philippine EFA, 2015)

The National Framework Plan for ICTs in Basic Education (2005-2010) meanwhile set the goals and strategies to use ICTs to: broaden access to basic education, improve the quality of learning, improve the quality of teaching, and improve educational planning and management (The National Framework Plan for ICTs in Basic Education, 2005-2010).

Guided by its vision that "By 2020 and beyond, SEI (Science Education Institute) shall have developed the Philippines' human resource capability in science and technology required to produce demand-driven outputs that meet global standards" (Science Education Institute Annual Report, 2011), it is in this context that the DOST (Department of Science and Technology) through the SEI in continuing effort to support the upgrading and improvement of science and mathematics education in the country and to assist in addressing the challenges in Philippine education spearheaded ICT projects that would strengthen the capabilities in science and technology of its stakeholders. Among these are the open-learning initiatives: the MITC (mobile information technology classroom), e-training for science and mathematics teachers and the development of computer-aided instructions for science and mathematics.

The DOST-SEI Initiatives

In leveraging ICT in education, the SEI continuously initiates projects that are inclined towards the adoption of an open learning exchange that would assist in promoting ICT-awareness and usage through hands-on computer and other interactive learning activities and expose elementary and high school students and

teachers to state of the art education technology as an alternative method of learning and instruction.

These initiatives provide OER (open educational resources) in different forms. OER refers to:

> The open provision of educational resources enabled by information and communication technologies, for consultation, use and adaptation by a community of users for non-commercial purposes. It includes open content, as well as software tools and standards. (Education With Online Learning and Open Educational Resources, 2008)

The term includes free (no charge) and open (for modification) resources, such as digital content, open source software, and intellectual property licenses. OER takes many forms, including formal courses; course-related materials, such as syllabi, lectures, lesson plans, and assignments; textbooks; or collections of digital media, such as libraries of images and videos. The principles of OER are founded on the academic traditions of freely and openly sharing and extending knowledge (OECD Giving Knowledge for Free: The Emergence of Open Educational Resources, 2007).

The MITC

The MITC which started rolling in 2000, is a specially designed 32-seater air-conditioned bus loaded with ICT facilities that include laptop computers, LCD (liquid crystal display) projector, and television, VHS (video home system) player, public address system and science and mathematics lessons in VHS and CD-ROMs (compact disk read-only memory). It is targeted to minimize the digital divide and provide service to disadvantaged communities and schools without ICT facilities, promote science literacy through ICT and provide learning experiences to students. The MITC was deployed in nine regions from Luzon, Visayas and Mindanao up to date had served around 309,941 students in 4,998 schools. It is managed by science and mathematics teachers who have been trained to use its facilities and integrate the learning materials of MITC into the school curriculum.

E-training for Science and Mathematics Teachers

The e-training for science and mathematics is a 10-month online training designed to upgrade the competence and confidence of public science and mathematics teachers who are non-major but are actually teaching these subjects in the elementary and secondary levels through the effective use of ICT. Thirteen selected TEIs (Teacher Education Institutions) served as the nationwide training venues where participants held and took their orientation and final examinations respectively. Faculties from the TEIs specializing in science and mathematics education served as the participants' online trainers using LMS (learning management systems) VClass (virtual class) and blackboard. The UPOU (UP Open University) conducted the training of trainers for VClass as well as the conduct of the monitoring and evaluation of the program in 2006, while UST (University of Sto. Tomas) provided the training and hosting for the blackboard LMS in 2008.

Development of CAIs (Computer-Aided Instructions) for Science and Mathematics

In 2004, the Science Education Institute collaborated with the ASTI (Advanced Science and Technology Institute) also an agency of the DOST and a frontrunner in ICT, to enable schools to take advantage of ICT in conducting classroom lectures and to assist Filipino students to be more competitive by exposing them to computer-based technologies. The "modules in science and mathematics for elementary schools" (see Figure 1) project was initiated and produced 101 interactive multi-media modules in science and mathematics. The project aims to optimize, streamline, and standardize educational lesson presentation in science and mathematics through the use of cost-effective and high-quality solutions, with the aim of developing

competitive elementary students who can maximize and enhance learning through the use of ICT as well as equip teachers with supplemental tools to assist them not only in teaching, but also in motivating their students to learn and participate in class discussions.

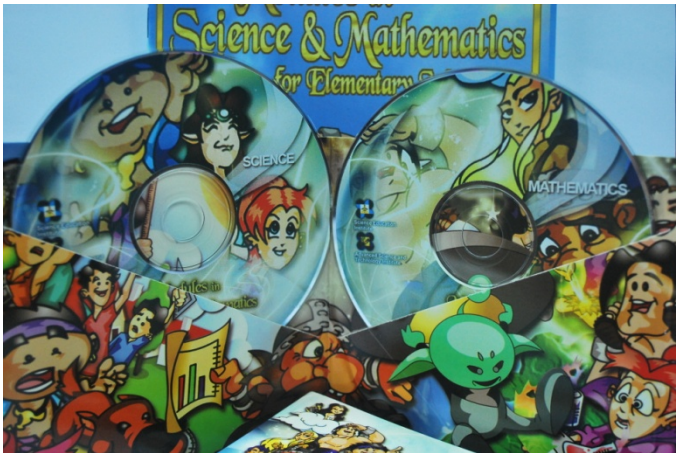

Figure 1. The modules in science and mathematics for elementary schools.

The modules, developed using Macromedia Flash (then), Adobe Photoshop, and other open source applications like the GIMP (GNU Image Manipulation Program) which feature local Filipino characters and situations to establish branding for DOST's initiatives, were packaged in CD-ROM. Initially, 1,500 copies were distributed for free during its launching in November 2006 to select elementary schools, public offices, guests, and educational institutions among others.

Among these initiatives, the e-training for teachers project was first to be concluded. The MITC continues to reach and serve as many stakeholders as possible with the remaining four of out five units deployed in Bicol, Cebu, Davao, and Siargao provinces.

The courseware on science and mathematics for elementary schools, on the other hand, gained an overwhelming response from its stakeholders which prompted the SEI to replicate 10 thousand (10,000) copies of the package in December 2007 to accommodate requests especially from the Philippine legislators to distribute those to schools under their respective congressional district. Thus, this paper will focus initially on the problems and barriers for the said initiative.

Problems/Barriers

In bringing better value for money, particularly with the economies of scale, when distribution and monitoring of quality learning modules became nationwide in scope, some problems need to be addressed in order to maximize the potentials of these open educational resources. These are as the follows.

Cost of Replication

To data about 8,000 copies of the courseware was distributed for free to various recipients including elementary schools, public offices, some foreign guests, science centrums, non-government organizations, and lawmakers. The cost of replication to provide each 38,351 public elementary school (DepEd Factsheet as of Nov. 16, 2011, 2011), a copy, however, is very high that which costs the government roughly around 800,000.00 for 10,000 copies replicated in 2007. The multi-million peso budget to spend for replication could instead be used to develop and produce new sets of modules in science and mathematics.

Distribution and Promotion Mechanism

Since the acquisition of courseware is per-request on a limited basis, distribution of copies to target recipients particularly elementary schools is not maximized, thus, losing some opportunities for learners and teachers to take full advantage of this free supplemental modules in science and mathematics. Promotional activities and materials, such as participation to various exhibitions and distribution of bookmarks and flyers were seem not enough to promote the courseware, not to mention the costs for the implementation and production of such.

Lack of Comprehensive Monitoring System on Courseware Website Users for Timely Feedback and Evaluation of Content for the Continuous Improvement of Modules

In 2009, the courseware development group of SEI and ASTI developed and launched a Website to serve as a repository of the modules and enable target clients to download and practically acquire a copy of those for free anytime, anywhere.

The thrust of the project now is to utilize technology-driven mode of education as to open and distance e-learning, to widen access to quality learning materials, effective learning and the development of more efficient and cost-effective education tools and services. The current Website, however, has only limited features as to: (1) could only generate data on the number of downloads or hits and the number of most downloaded modules per subject area, lesson and grade thus, lacking efficient reports of generation mechanism; (2) feedback rate is low; (3) demographics of user/visitor are unknown; (4) unavailable administrator on-site management functionality; and (5) search feature is not available.

Reforms/Solutions

To address the problems on cost, distribution, promotion and monitoring of site users and modules downloads the following mechanisms were innovated.

Courseware Website Improvement—The Courseware Project

Filipinos spend an average of 18.6 hours on Internet usage compared to the Asian average of 16.4 hours. The age distribution of Filipinos Internet users is more towards the younger generation, with the 15-24 years old, making up 40% of the Internet population in Philippines (ComScore Media Matrix Demographic Report, 2010).

In a paper by Cajilig that seeks to investigate on the adoption patterns of Metro Manila public secondary school teachers while ICT is being integrated into their teaching, evidence shows that the majority of the teachers had highly favorable attitudes toward the use of new technologies in instruction. This disposition was brought about, among other things, by the influence of authority and/or the status individuals normally attach to technology innovation (Cajilig, 2009).

ICTs are also transformational tools which, when used appropriately, can promote the shift to a learner-centered environment. ICTs, such as videos, television, and multimedia computer software that combine text, sound, and colorful, moving images can be used to provide challenging and authentic content that will engage the student in the learning process (Tinio, 2002).

The MIT's (Massachusetts Institute of Technology) OCW (open courseware) is a Web-based publication of virtually all MIT's course content. OCW is open and available to the world and is a permanent MIT's activity (Massachusetts Institute of Technology Open Courseware, 2001). It is this model that the DOST's

Courseware Project drew inspiration to harness the potentials of ICT to improve and uplift the state of science and mathematics education in the country.

To refurbish and enhance the current Website, a prototype courseware portal Webpage (see Figure 2) was developed which features the following major functionalities.

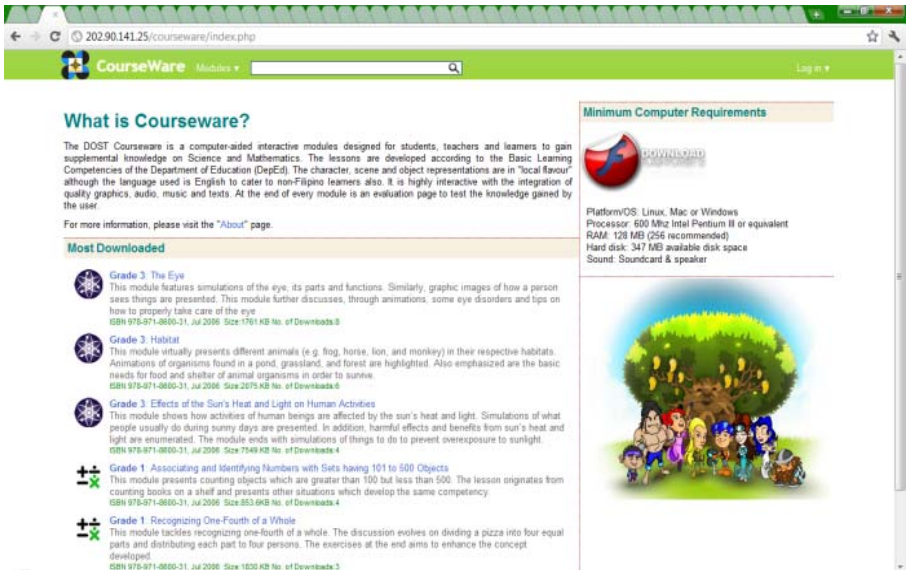

Figure 2. The courseware portal project.

User Download Access and Registration

To access and download the modules for free, user must register through a registration form to provide information on age, gender, school, school type, geographical location, profession, organization, etc.. Once registered, a user can now login to the courseware site and may also have the option to edit profile, change password, delete account, and send message to site administrator. For unregistered users, download link is disabled or unavailable, thus only the information about the module can be viewed on click of the module title such as ISBN (International Standard Book Number), file size along with the number of times the said module was downloaded. An option to download the modules in bulk by subject and by grade level is also available.

Reports Generation

Currently, there are 12 reports that could be generated from the Website including those which show the number and specific modules downloaded, registered user demographics (gender, age group, year level, school and type, geographical location, etc.). This feature, however, is for site administrators only.

Feedback Gathering

There are two ways by which to manage or view feedback. First, option is through the site administrator's feedback functionality where users could send their comments privately. Print mechanism for this feature is available at the reports module. The second is through the comments box attached to each module similar to "threads" to allow interaction and collaboration among users by allowing them to freely post comments on the thread for each module.

User Administration/Module Administration

The administrator can view information and total number of registered users as well as delete user records. Additional site administrators may also be added if needed. Upload of modules is made flexible by the modules

upload functionality wherein resource materials can be categorized and a user-input form is provided to specify module details.

Search Mechanism

Search mechanism feature is available both for administrator, registered and non-registered users. The search returns for keyword found in the titles and description of the module.

User Tracking and Website Traffic Monitoring Mechanism

Aside from the registration mechanism, the site will also use the GA (Google analytics) to efficiently track information not captured in the registration. GA is an enterprise-class Web analytics solution that gives rich insights into Website traffic and marketing effectiveness. It is extremely comprehensive, quick-to-setup, easy-to-use, and free traffic analytics service from Google. It is a powerful tool that can help Webmasters better understand Website traffic, visitors' online behavior, measure performance of individual pages, identify low performing Webpage, and generate detailed statistics about the visitors to a Website and more.

Because the modules are made available online, it is not necessary to replicate the modules in CD-ROMs, since the same copy can now be downloaded for free from the Website, sparing the government from spending millions of pesos for replication alone.

As Internet usage among Filipinos becomes significantly higher, distribution of modules online can be the most practical strategy for the government to reach more stakeholders, and at the same time, gives them more opportunity to learn science and mathematics and harness ICT, as the modules become available and accessible ubiquitously.

Monitoring of site user, modules downloads, feedback gathering and management, and essential administrative functionalities are made more efficient through the registration mechanism alongside the use of GA.

Upcoming/Future Plans

Courseware re-assembled. Courseware bundle downloading is the grouping or bundling of several files into a single self-extractable file that can be downloaded and saved. Some several self-extracting file programs for Windows are WinRar, WinZip, the builtin IExpress, and the open source software 7Zip are available.

The user will now have an option to download a single file from 13 selections as: all courseware, all science, all mathematics, science for Grades 3-6 and mathematics for Grades 1-6. This option will be made available to the refurbished Website, and the courseware portal page.

CMApp (courseware mobile application). Web applications and social media will drive dynamics in flourishing smartphone market in Philippines. IDC (A premier global market intelligence firm which researches of information technology companies and markets) believes that in 2011, Web applications and social media will shape trends in the smart phone space, driving dynamics in areas, such as pricing, features, and operating systems (Digital Media in Philippines from Digital Media Asia, n.d.).

The usage of Web 2.0 applications through smartphone is rapidly increasing. Filipinos' continuing fascination with useful applications in smartphones will result in bigger demand for smartphone, which is capable of carrying platforms, such as Android and Apple IOS (Internet Operating System) (Digital Media in Philippines from Digital Media Asia, n.d.).

To keep up with the technological trends and popularity of the so-called downloadable "Apps" (application), a mobile version (see Figure 3) of the courseware will be developed to run on smart phones and

tablet PCs (personal computers). The courseware “App” shall lead the user to the courseware Website and will have the option to either view (run) or download the modules for storage or sharing (Bluetooth). Learning science and math are not only fun, it is also made easy, portable and most of all it is ubiquitous.

Figure 3. CMApp (Courseware Mobile Application).

Courseware Reloaded (on Social Networking Site)

The use of social networking Website has become so extensive in the Philippines that the country has been nicknamed as “The Social Networking Capital of the World” (Digital Media in Philippines from Digital Media Asia, n.d.). According to Alexa Traffic Rank, Facebook is the number one site in Philippines (Digital Media in Philippines from Digital Media Asia, n.d.).

Figure 4. Courseware reloaded on Facebook.

Facts about Facebook statistics in the Philippines, according to Socialbakers.com, shows that as of December 2011, the country ranked eighth among all countries with 27,035,600 Facebook users which are 27.06% penetration of Philippines population, and 91.03% penetration of online Filipinos. Age brackets 18-24 (39% or 10,543,884 users) and 25-34 (24%) are the biggest segments of Facebook users in Philippines, while

48% are male, and 52% are female (Philippines Facebook Statistics, n.d.). It ranked the 3rd in Asia, behind Indonesia and India (World Continents Facebook Statistics, n.d.).

"Courseware reloaded" will serve as an alternate site for users to download the modules (see Figure 4). The link going through this site will also be posted in the main Website. The page containing the modules can either be viewed or downloaded. This mechanism will also allow open collaboration among stakeholders, as they post their comments or suggestions for each module's thread.

Current Status/Recommendations

The courseware project will host the 101 modules in elementary science (Grades 3 to 6) and mathematics (Grades 1 to 6). Eventually, modules from first to fourth year of secondary level (high school) will also be uploaded to the site along with other modules currently being digitized by the ASTI (Advanced Science and Technology Institute). Filipino students now have an alternative means for which modules can be readily available and accessible through the Internet without acquiring the actual package in CDs (compact disks). Aside from its DepEd curriculum-based content, the modules which can be downloaded as personal copy to personal computers or laptops and Netbooks can run both in Microsoft Operating Systems and Linux using the downloadable Flash Player.

A study on the impact and to evaluate the effectiveness of these modules as perceived by the end users (teachers and pupils) in public schools in the Metro Manila area is ongoing. It aims to identify the factors and elements that constitute a quality CAI through a tool for evaluating the effectiveness of the CAI modules.

An assessment, however, on the usefulness, effectiveness, and efficiency of the overall functionality of the courseware project will be conducted. Other plans for the courseware shall be implemented after the courseware portal page is institutionalized.

Not only will students benefit in this e-learning facility. The modules also empower teachers to more effectively and efficiently meet the challenges of education in today's increasingly technology-infused schools, recognizing and pursuing opportunities to integrate computer-based technologies into the teaching-learning process. This will also facilitate communication among students and teachers or even beyond the classroom (as an aid to distance-learning), along with experts. It will serve as an effective tool for teachers in motivating their students to learn and participate in class discussions.

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