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

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Abstract

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 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.

Background

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 both in terms of quality and access to resources.

In 2003, results of the Trends in International Mathematics and Science Study (TIMSS) conducted by the International Association for the Evaluation of Educational Achievement (IEA), the Philippines ranked twenty-third out of the twenty-five countries in Grade 4 and forty-second among forty five countries in Grade 8 (second year high school) for science [1]. For mathematics, the country ranked twenty-third in Grade 4 and forty-first in Grade 8 (second year high school), putting the country in the bottom group along with countries like Chile, Morocco, Tunisia and South Africa [2].

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, enhancement materials and student opportunities for learning among others.

Through the years, the government have 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 Information

and Communications Technology (ICT) 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 Medium Term Development Plan of the Philippines (MTPDP) 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"[3].

The 2002 Basic Education Curriculum (BEC) 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"[4]. 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"[5].

The Philippine Education for All (EFA) 2015 also identified the strategies to achieve the MTPDP targets on basic education and one of these is on *"Progressive Curricular Reforms"* which states *"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"[6].*

The National Framework Plan for ICTs in Basic Education (2005-2010) meanwhile sets the goals and strategies to use ICTs to broaden access to basic education, improve the quality of learning, teaching, planning and management of education [7].

Guided by its vision that "By 2020 and beyond, SEI shall have developed the Philippines' human resource capability in science and technology required to produce demand-driven outputs that meet global standards"[8], it is in this context that the Department of Science and Technology (DOST) through the Science Education Institute (SEI) spearheaded ICT projects that would strengthen the capabilities in science and technology of its stakeholders. Among these are the open learning initiatives: the 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, SEI continuously initiates projects that are inclined towards the adoption of an open learning exchange that would assist in promoting ICT-awareness 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 Open Educational Resources (OER) 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"[9]. 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 [10].

- **The Mobile Information Technology Classroom (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 projector, television, VHS player, public address system and science and mathematics lessons in VHS and CD-ROMs. 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 9 regions from Luzon, Visayas and Mindanao and 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 Teacher Education Institutions (TEIs) 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 Learning Management Systems (LMS) Virtual Class (VClass) and Blackboard. The UP Open University (UPOU) conducted the training of trainers for VClass as well as the conduct of the monitoring and evaluation of the program in 2006, while University of Sto. Tomas (UST) provided the training and hosting for the Blackboard LMS in 2008.

- **Development of Computer-Aided Instructions for Science and Mathematics**
  In 2004, the Science Education Institute collaborated with the Advanced Science and Technology Institute (ASTI) 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" (Figure 1) project was initiated and produced one hundred one (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.

  The modules, developed using Macromedia Flash, Adobe Photoshop and other open source applications like the GNU Image Manipulation Program (GIMP) and 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.
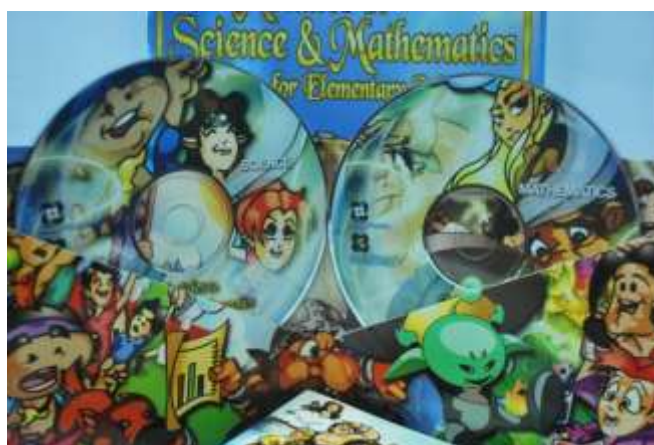

Figure 1. The Modules in Science and Mathematics for Elementary Schools

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. Ten thousand additional copies of the package was made 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:

- **Cost of replication**
  To date about 8,000 copies of the courseware were 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 [11] a copy, however, is very high that which costs the government roughly around eight hundred thousand (P800,000.00) 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 and 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 for continuous improvement**
  In 2009, the courseware development group of SEI and ASTI developed and launched a website to serve as a repository of the modules and to 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 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:

A. 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 are more towards the younger generation, with the 15 - 24 year olds making up 40% of the Internet population in Philippines [12].

In a paper by Cajilig that seeks to investigate on the adoption patterns of Metro Manila public secondary school teachers, while information and communication technology (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 [13].

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 [14].

The Massachusettes Institute of Technology MIT OpenCourseWare (OCW) is a web-based publication of virtually all MIT course content. OCW is open and available to the world and is a permanent MIT activity [15]. It is this model that the DOST 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 (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. An option to download the modules in bulk e.g. by subject and by grade level is also available.

- **Reports Generation**

  Currently, there are twelve reports that could be generated from the website including those which shows 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 Google Analytics to efficiently track information not captured in the registration. Google Analytics is an enterprise-class web analytics solution that gives rich insights into website traffic and marketing effectiveness.

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 become 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 Google Analytics.

B.   Upcoming Features

1. 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 thirteen 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, the courseware portal page.

2. Courseware Mobile Application (CMApp)
Web applications and social media will drive dynamics in flourishing smartphone market in Philippines. IDC (A premier global market intelligence firm which research 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 [16].

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 OS [17].

To keep up with the technological trends and popularity of the so-called downloadable "Apps" (application), a mobile version (Figure 3) of the courseware will be developed to run on smart phones and tablet PCs. 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 is not only fun, it is also made easy, portable and most of all it is ubiquitous.

Figure 3. Courseware Mobile Application (CMApp)

3. 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"[18]. According to Alexa Traffic Rank, Facebook is the number 1 site in Philippines [19].

Facts about Facebook statistics in the Philippines according to Socialbakers.com, shows that as of December 2011 the country ranked 8th among all countries with 27,035,600 Facebook users which is 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, 52% are female[20]. It ranked 3rd in Asia, behind Indonesia and India [21].

Figure 4. Courseware Reloaded on Facebook

"Courseware Reloaded" will serve as an alternate site for users to download the modules. 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 will also be uploaded to the site along with other modules currently being digitized by ASTI. 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. 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 computer aided instruction (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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