Developing Thai-language open educational resources: Problems and policy recommendations

การพัฒนาสื่อการเรียนรู้แบบเปิดในภาษาไทย : ปัญหาและข้อเสนอแนะเชิงนโยบาย

Received: *January 25, 2019*
Revised: *March 13, 2019*
Accepted: *October 30, 2019*

Jaruwan Ngamman
จารุวรรณ งามแม้น
Faculty of Social Sciences and Humanities, Mahidol University
คณะสังคมศาสตร์และมนุษยศาสตร์ มหาวิทยาลัยมหิดล
jngamman@gmail.com

Abstract

This paper provides guidelines for developing Thai-language Open Education Resources (OER) in Mathematics and Science for Basic Education in Thailand and analyzes key challenges faced during this process. In-depth interviews were conducted with the heads of relevant agencies to determine the status of current policies and programs. To better understand the needs of educators, questionnaires were used to obtain the views of one segment of the educational community: homeschool parents. The research sample consisted of 112 homeschool families across Thailand. The general characteristics of the sample were analyzed using descriptive statistics. The results suggest that the existing resources are inadequate and that more should be done to ensure their quality and availability. The findings also point to a number of major impediments to OER development, most notably problems with telecommunication infrastructure. Policy recommendations are also discussed.

Keywords: OER, lifelong–learning, homeschooling, digital content, Thai language, broadband internet network

บทคัดย่อ

บทความวิจัยนี้เป็นงานวิจัยเชิงพรรณนา มีวัตถุประสงค์เพื่อวิเคราะห์ถึงปัญหาและอุปสรรครวมทั้งเสนอแนะแนวทางเชิงนโยบายเพื่อการพัฒนาสื่อการเรียนรู้แบบเปิดภาษาไทยในวิชาคณิตศาสตร์และวิทยาศาสตร์สำหรับผู้เรียนในระดับการศึกษาขั้นพื้นฐานซึ่งพัฒนาหรือให้การสนับสนุนจากหน่วยงานภาครัฐและเอกชน โดยเก็บรวบรวมข้อมูลจากการสัมภาษณ์เชิงลึกกับผู้บริหารระดับนโยบายที่เกี่ยวข้องและจากแบบสอบถาม จำนวน 112 ชุด จากผู้จัดการศึกษาโดยครอบครัวทั่วประเทศที่ได้มาจากการสุ่มตัวอย่างแบบเจาะจงเป็นเครื่องมือในการเก็บรวบรวมข้อมูลและสถิติที่ใช้ในการวิเคราะห์ข้อมูล ผลของการวิจัยพบว่าสื่อการเรียนการสอนในภาษาไทยที่มีคุณภาพในทั้งสองวิชายังมีไม่เพียงพอ และผู้รับผิดชอบที่เกี่ยวข้องต้องดำเนินการปรับปรุงอีกหลายด้านเพื่อเป็นหลักประกันให้กับทั้งคุณภาพและการเข้าถึงของสื่อการเรียนรู้ดังกล่าว จากการวิจัยครั้งนี้มีข้อเสนอแนะเพื่อการพัฒนาที่ยั่งยืนต่อทุกภาคส่วน โดยเฉพาะเรื่องการพัฒนาโครงข่ายโทรคมนาคมพื้นฐานเพื่อรองรับการพัฒนาและการให้บริการสื่อการเรียนรู้ในรูปแบบดิจิทัลในประเทศไทยอย่างมีประสิทธิภาพ

คำสำคัญ : สื่อการเรียนรู้แบบเปิด, การเรียนรู้ตลอดชีวิต, โฮมสคูล, สื่อการเรียนรู้ดิจิทัล, ภาษาไทย, โครงข่ายบรอดแบนอินเทอร์เน็ต

1. Introduction

For decades, advances in information and communications technology (ICT) have been transforming education globally. As a result, today's learning environments now extend well beyond traditional teacher-centered classrooms. With internet and smart phone capabilities, learners and teachers can access a growing body of educational resources anywhere, anytime. The growth of online educational resources (OER) has also given rise to a range of new pedagogies and allowed for the possibility for ever-more personalized learning plans (Shu-Hsianga et al., 2015; Janthon et al., 2015; Hersh & Mouroutsou, 2015).

It is widely acknowledged that online learning materials can help to address existing shortcomings in public schooling. This is particularly true in a country like Thailand, where despite two decades of educational reform measures and steadily increasing expenditure on educational improvement, a large number of problems remain to be solved (Haruthaithanasan, 2018; Morse et al., 2001; Wongwanich et al., 2015).

A number of factors still impede local OER development, however. Principal among them is language. Anyone familiar with the Internet can attest to the fact that it is already rich with quality educational resources. Unfortunately for Thai-speakers, most of the better material is in English and other foreign languages. Educators have been working for years to overcome this language barrier, thus far with limited success (Intarat et al., 2017; Vungthong, et al., 2017). The Ministry of Education has been working to develop such materials since 2002 (Baldo, 2007). After 16 years, however, the country still has a paucity of digital OER and widespread access issues remain (Intarat et al., 2017; Baldo, 2007).

To promote development of Thai-language OER, reforms are needed on a number of fronts, from ICT infrastructure to human resource development (Mattavarat, Viseshsiri, & Siribanpitak, 2017; Shu-Hsiang et al; 2015). Such measures would clearly be in accordance with Thailand's digital economy policy, the country's road map for educational reform (2015-2021) and the national ICT master plan. The development of Thai-language OER would also assure that poorer children in regions experiencing political unrest, such as Thailand's southern provinces, would have equal access to a quality education.

This paper centers upon policy support for the development of Thai-language OER. It is particularly concerned with how resources can be developed and delivered to support instruction in two subject areas that are usually taken as a measure of global educational quality and local educational shortcomings: primary school instruction in Mathematics and Science. As noted above, test scores indicate that Thai students consistently perform poorly

in both: recent data from the Trends in International Mathematics and Science Study (TIMSS) and the Programme for International Student Assessment (PISA) indicate that Thai students lag far behind their counterparts in the region and the world (Fry, 2013; Thinwiangthong & Inprasitha, 2014; Putjorn et al., 2016; Khun-Inkeeree, Omar-Fauzee, & Othman, 2017; Khamkhong, 2017).

This paper aims to help identify and devise strategies for the development of Thai-language OER that can improve student learning both within and outside the classroom. A central argument here is that the development of Thai-language OER is not only of critical importance for public schooling but also for alternative education, distance learning, adult education, lifelong learning and homeschooling.

Although a comprehensive assessment of the nation's OER needs is beyond the scope of this study, an effort has been made to assess the needs of learners in informal education. More specifically, a survey has been conducted of Thai homeschool parents, one of the more visible and accessible groups involved in informal education. The primary focus of the survey are the 250 home-school families presently registered at Roong-Aroon School in Bangkok, Children's Village School in Kanchanaburi province and those who registered under the supervision of Primary Educational Service Area (PESA) in five regions: the South, the Northeast, the North, the Central Region and Bangkok.

In addition to assessing the OER needs of homeschool families, this paper offers an overview analysis of existing public and private OER policies and programs in Thailand. The aim in this latter effort is to develop guidelines for developing Thai-language OER in order to support learning both inside and outside of the classroom. Information was obtained from 8 key informants at different locations that each of them is working separately at the Ministry of Digital Economy and Society, Office of the Basic Education Commission (OBEC), the Institute for the Promotion of Teaching Science and Technology (IPST), the TOT Public Company Limited, Digital Economy Promotion Agency (DEPA) and Aksorn Education Public Company Limited.

1.1 Objectives

1.1.1 To analyze key challenges faced during the development of Thai-language OER in Mathematics and Science for Basic Education in Thailand.

1.1.2 To propose guidelines for future developments of Thai-language OER.

2. Educational Policy and ICT Planning

In the 1990s, Thailand like other countries in Southeast Asia concentrated on expanding access to education (Hallinger & Bryant, 2013). In 2012, the Thai government declared educational improvement a national priority. Plans include the utilization of ICT to facilitate educational access and promote a knowledge-based economy (Sriprasertpap et al., 2015).

Although educational planning is increasingly linked with ICT, the level of ICT infrastructure in Thai public schools is not yet sufficient to support the implementation of advanced ICT projects. To address the issue, the Thai government plans to spend some US$22 billion between 2010-2020 (Wonglimpiyarat, 2014). Much of the total will be spent on the expansion of broadband internet access. Along with hardware expenditure, some of the money will also be directed towards the development of learning applications and content.

3. Mathematics and Science Instruction

Mathematics and science are compulsory subjects for all primary and secondary school students in Thailand. Both subjects play an important role in the development of the human mind. Mathematics can help students think logically and develop problem-solving skills (Junpeng, 2012). Science, in turn, is relevant to every aspect of human life. It enables people to develop creative, analytical and critical thinking skills. The scientific method encourages children to acquire essential investigative skills for seeking knowledge and helps them to develop decision-making skills based on evidence (Udompong et al., 2014). Over the past few decades, Thailand has had disturbing rates of underachievement in mathematics among students of all ages (Khun-Inkeeree et al., 2017).

4. Barriers to the Use of Existing English-Language OER

Although most governments now acknowledge the importance of OER development, many are still in the initial stages of implementing development policies (Kanwar et al., 2018). Thailand is one such country. An early initiative to develop digital content in Thai language for primary school students was terminated by the government some two years back. The effort was a part of a "One Tablet per Child" program pursued by the Ministry of Education's OBEC. Launched in 2011, the program eventually resulted in hundreds of thousands of tablet computers being handed out to schoolchildren around the country (Viriyapong & Harfield, 2013).

As often happens in Thailand, private initiatives have emerged to capitalize on governmental shortcomings. Recently, the Thai publishing company *Aksorn* launched *Twig,* an online site with digital educational resources for mathematics and science instruction at the primary level. The company has been working with Twig World, a UK base firm that specializes in educational videos, since 2014. The joint venture currently offers videos with Thai voice-overs and subtitles. Access is limited to paid subscribers however.

Linguistic and cultural diversity continues to be a challenge within the OER movement, which is predominantly in English (Kanwar et al., 2018). Quality English-language OER may be readily available and free for download but local children are usually unable to make use of the material (Hatakka, 2009). English has been taught in Thailand for nearly a century, but the limited English abilities of Thai teachers, parents and guardians makes it difficult to fully utilize English-language OER (Srikote, 2013). Most students still cannot communicate and understand the language. The problem must be overcome before Thais can fully access the current global knowledge system (Fry & Bi, 2013).

To date, translation into local languages has been fairly limited, leaving much of the best content unavailable to children whose native language is Thai. The development of Thai-language learning material is arguably a better option.

5. Related Research

Numerous studies have been done on the educational utility of OER in the part 15 years. Most concern matters of policy and practice, the benefits and challenges associated with using OER for distance learning and the technicalities of sharing, remixing and reproducing content (Perryman et al., 2014).

Cultural barriers and localization issues have been considered as well (Cannell et al., 2015). Most scholars agree on the critical importance of OER language (Richter & McPherson, 2012; Yamada et al., 2014; Mtebe & Raisamo, 2014). While OER can potentially improve access, reduce educational inequality, and decrease educational costs, much of the existing material has been developed in English for children in the United States and Europe. It has been suggested that this is the principal impediment to the broader adoption of OER (Ivins, 2011; Cobo, 2013). Not surprisingly, scholars have been looking at ways to overcome barriers by remixing and reproducing OER for local learners (Amiel, 2013; Murphy & Wolfenden, 2013; Buckler et al., 2014). Localization strategies discussed include the changing of language, content, imagery, religious, cultural and geographical references (Murphy et al; 2013). Clearly, adapting

OER for local learners remains one of the greatest challenges of the open education movement (Kanwar et al., 2018).

In Thailand, a few OER initiatives have been developed by both the public and private sector. To date these have tended to focus on the development of prototypes and distribution systems (Yamada et al., 2014).

6. Methodology

This paper utilizes a descriptive research method. It is focused upon policy planning for the development of Thai-language OER. It is particularly interested in resources which can be used to support instruction in two subject areas that are usually taken as a measure of both global educational quality and Thailand' s educational shortcomings: Grades 1-12 mathematics and science curriculum.

A needs analysis questionnaire was used as a data collection. The questionnaire was informed by data in the literature review and related educational theories pertaining to ICT in education, connectivism, parental involvement/ homeschooling theories and lifelong/ e-learning. Descriptive and inferential statistics were used to interpret the results.

One of the more visible categories of distant learners, homeschoolers, were the survey target. They are representative of other learners who have turned away from classroom curriculums and standard textbooks in order to make use of other alternative educational methods and materials. They also constitute a potential group of users for Thai and English OER, particularly digital math/science educational materials. Analyzed in conjunction with the literature review and related educational theory, the survey data gave the author the ability to better assess the need for Thai language OER in math and science subjects. The needs analysis survey also helped to identify specific problems experienced by home school parents. It considered how parents perceive currently available math and science curriculums and sought their advice on how such material can be improved. Questionnaires were distributed to 250 homeschool families nationwide. Some 112 surveys were returned, accounting for about 45 percent of the total. Survey data was analyzed using Statistical Package Software to determine frequency, mean, standard deviation and percentage to assess the needs of homeschool parents for Thai language OER in Mathematics and Science. For quantification purposes the following point values were assigned to needs assessment responses:

4.21-5.00 Highest;

3.41-4.20 High;

2.61-3.40 Moderate;

1.81-2.60 Low;

1.00-1.80 Lowest.

The collected sample data was used to measure the needs of the sampled population. Therefore, the analysis was focused on descriptive statistics.

In-depth interviews were arranged and used as a method to collect qualitative data from related government agencies and private digital content providers. A set of interview guidelines were designed to collect data about plans and programs for local OER development. The population and criteria of selection for qualitative data is comprised of eight key informants who were selected by purposive sampling from six organizations: five government agencies and a private company. Content analysis was employed to analyze the results from government agencies, a private organization and homeschool parents to develop guidelines for developing Thai-language OER in Math/Science for basic education in Thailand.

7. Results

Interview findings suggested that relevant state and private sector agencies recognize the importance of developing local learning materials and continue to invest in project development. However, the interview findings also suggest that there has been little progress in developing OER materials relevant to the national curriculum for basic education. Impediments cited include: A lack of coordination within and between relevant agencies; manpower and budgeting issues; inconsistent policies; limited uptake of ICT in classroom setting; and ICT network infrastructure issues.

7.1 Current development plans and program of the government agencies and private sector

Thailand has made significant investments in ICT education over the past few decades, setting up master plans to use ICT as a tool to improve teaching and learning, especially at the basic education level. Both state and private stakeholders fully recognize the potential of ICT to support today's education. They also readily acknowledge that students need access to appropriate digital teaching and assessment resources and that an investment must be made in the development of Thai-language digital learning resources.

Implementation has made little progress, however. A One Tablet Per Child program, launched by the government of former Prime Minister Yingluck Shinawatra (2011-14), was terminated by the current government and a related project to develop Thai-language OER for tablets was ended. The program was supposed to be replaced by a hardware-oriented 'smart classroom' project but this has not happened.

7.2 Digital Economy Promotion Agency (DEPA)

State agencies responsible for the development of educational materials have continued to plan and invest in line with NESDB and ICT master plans. Planning and investment entered a new phase in April 2016, when the government announced a new Digital 4.0 scheme, a plan to promote a digital value-based economy. The aim is to achieve social and economic development through the support of digital technology. Toward that end, the government established a Ministry for Digital Economy and Society (MDES) in late 2016. It also announced a new 20-year National Digital Economy master plan.

The plan has a number of promising initiatives. Its first phase calls for the improvement of basic ICT infrastructure and education in order to promote innovation. This includes digital content development. In 2016, the national Software Industry Promotion Agency (SIPA) was given an expanded brief, renamed the Digital Economy Promotion Agency (DEPA), and placed under MDES to promote and support its development (MDES, 2017 ACT). DEPA also revised the current master plan and set a goal to make Thailand a regional center for digital content production. They plan to promote the development of local digital animation and digital gaming industries as well. To drive content development, an internal fund has been established to provide financial support to local market players looking to do business overseas. A digital startup program is also being set up to aid new comers. This includes a co-creation space to promote cooperation and an exchange of ideas among involving parties.

In the education sector, DEPA is currently pursuing an "education in the digital age" scheme to help vocational educators better integrate ICT into their classrooms. The hope is to produce graduates with better reasoning, and problem solving skills so that Thailand can move up the value-added ladder to reach a knowledge-based economy.

Little is being done with respect to e-learning content development, however. When asked about plans to promote digital content in secondary and higher education, officials explained that their ability to do so was hindered by traditional teaching pedagogies. As noted by one DEPA official, however, quality Thai- language OER remains in short supply and

government financial support alone was unlikely bring it into being. *"We have enough money; we don't have enough people producing content," t*he interviewee explained. What was needed, in his view point, was stakeholder participation and without it, existing development goals were not likely to be reached.

7.3 Institute for the Promotion of Teaching Science and Technology (IPST)

In recent years, IPST has made significant investments in Thai-language OER for science, technology, engineering and mathematics (STEM) subjects. It supports SciMath.org and the *Learning Space* platform for basic education in Thailand.

IPST's Assistant to the President explained why the development and improvement of basic Thai-language math and science OER is the main function of the agency. He noted that online curricula and learning materials "*benefit everybody, helping teachers and students,"* In rural areas, it improved learning outcomes. It also provided resources for home school parents and their children. Thai parents living outside of Thailand could also find free Thai math and science curriculum to use with their children.

In an effort to improve material, IPST is currently improving its *Learning Space* platform, an upgraded version of its original *SciMath.org* web site. The new platform is meant to be an interactive digital learning center for students, educators, parents and the public.

7.4 Office of Basic Education Commission (OBEC)

OBEC is responsible for managing primary and secondary education in the country. The commission is currently developing its own OER for math, science and other cores subjects including Thai, social studies and English. According to the Director, a high priority continues to be given to the development of Thai-language OER but progress is limited by factors beyond OBEC's control such budgetary concerns and network capacity. Concerned by this latter problem, the Director remarked that internet access is *"one of the limitations that we can't solve … internet connectivity affects whether or not schools are able to download [online material] … and more than half of [OBEC] schools have bad internet connections."*

With respect to Thai-language OER, OBEC is also in the middle of developing an "OBEC Content Center", a digital repository for students and educators around the country to create and use digital content. Like IPST's Learning Space, the OBEC content platform will provide users with e-book, PDFs, ePubs, video clips, image files, audio files, and useful educational research. The plan is to create a platform not only for formal but also informal and vocational education to support the government's life-long learning policy. Content development remains

a problem, however. As note by the Director, *OBEC "creates platforms ... the content must be produced by the teachers and students themselves. We can't do everything,"*

7.5 Aksorn Education Plc

Aksorn Education Public Company Limited has been working together with UK-based Twig World, a digital media firm that offers education content to schools through subscription websites. Their joint venture company, Aksorn Inspire, was established to provide local subscribers with basic math/science OER in Thai and English.

Their digital content development plans are currently on hold, however. The primary market for OER are state schools nationwide but these are forbidden from buying online content by the Thai government. Asked for his views on the matter, the executed said, *"I think it is reasonable to say that one of the flaws in the Thai system ... are regulations limiting the distribution of [digital content] to schools,"*

Unable to sell materials to public schools, the company has had difficulty finding customers. To survive, it has been selling an offline version of its learning packages using DVD technology. The company is currently focused on the development of non-digital curriculum materials grades 1-12. It is also working with a private school partner to integrate the company learning materials into their curricula. In essence, the company provides teachers with a classroom tool kit, a full package of lesson plans and teaching materials.

7.6 TOT Public Company

TOT is the state's national network service provider. It is responsible for upgrading national telecommunications infrastructure and has installed a high-speed fiber optic cable network, Pracharat Internet, in 24,700 villages by the end of 2017.

TOT's immediate aim is to establish the Pracharat Internet project as assigned by the Ministry of Digital for Economy and Society. On the paper, this involves a nation-wide rollout of broadband in order to turn Thailand into a regional connectivity hub. In reality, TOT has been given a 15 billion baht contract to install the first phase of a free public-access 20Mbps broadband internet to every village in Thailand. The early phases will not be really be high-speed. As one officer explained: *"It's Internet for home use. We are setting up Wi-Fi transmission boxes in communities where there are no private operators. The stations have a limited (200 meter) coverage area so people will have to be in range and its speed depends on how many people are using it... if one guy is watching a YouTube video, the next guy may find it a little slow."* The siting of wireless and fixed-line access points was likely to be another problem.

According to the project plan, these were only installed at specific locations in each village, such as chief district's house. Schools and learning centers have yet to be included.

8. Survey

The demographic information collected from survey respondents is interesting in several respects. Among other things, it indicates that those who participated in the survey had considerable experience in home schooling. Most had been homeschooling their children for at least six years. It also indicated that respondents have similar backgrounds: the majority were middle-aged entrepreneurs with high monthly incomes. The survey results also show that respondents share a common perspective. They are favorable disposed towards the use of technology in education. They believe that Mathematics and Science are important subjects for primary education. They also believe that Thai-language OER are important in Math/Science education, that Thai primary school students would benefit from using such materials, and that such materials would improve teaching quality and increase learner motivation.

The data on perceptions and use of Thai-language Math/Science OER is less straight forward. It indicates that many parents already make use of digital devices when teaching their children and do try to provide them with Math/Science learning materials. It also suggests that survey respondents were not entirely satisfied with state curricula materials and existing education resources, whether online or in other forms. Areas for improvement were indicated when participants were asked about OER design. The majority felt that materials should be user-friendly, support personalized learning and be available in Thai-language. The majority also indicated that telecommunications infrastructure should be improved to improve internet access and reduce costs.

In the final section of the survey, the parents were asked about the need for OER development. The response was strongly in favor of governmental action to improve the current situation by: speeding up existing programs, establishing clear policies and guidelines, working together in partnership with private organizations and improving internet access to support online learning.

9. Guidelines for developing Thai-language OER in Mathematics and Science for homeschooling in Thailand

Comprehensive data analysis shows a high need for Thai-language OER in Mathematics and Science (the mean being 4.39 and 4.33 for each respectively). If we take homeschoolers to be representative of that broader community of learners in informal education, and a subset of all learners in Thailand, we can see that there is a growing need for quality Thai-language OER in the kingdom. The interviews, in turn, suggest that those tasked with addressing this need are still struggling to do so. To facilitate their efforts, the following guidelines are offered.

9.1 Efforts should be made to promote intra-governmental coordination. The finding show that at present IPST and OBEC are developing separate web-based educational resources. Existing online learning platforms should be reorganized into a single repository. The central platform should have design functions to allow the users to search digital learning materials by subject and grade level. It should also provide tools and guidelines for users who want to assist in the development of digital OER.

9.2 Talented private-sector content developers should also be recognized and brought on board as partners. The interview results shown that government agencies tasked with the development of OER are overburdened. Efforts should be made to promote and support local OER development using the government's *Digital Startup* policy. In addition, non-governmental stakeholders should be encouraged to establish initiatives to develop high-quality digital learning resources.

9.3 Efforts should be made to identify, license and localize high-quality foreign-language OER. Reviewed literatures and in-depth interview with state informants of this present study has suggested that creative math/science OER is readily available in English and a number of other foreign languages. In partnership with state universities and the private sector, the government should set up a grant program for localizing such materials through translation.

9.4 Online Community Network Development Initiative: The creation of an online community network for Thai-language OER sharing similar to Khan Academy and Wikipedia is worth considering. This was suggested by an IPST executive who has expertise in Math/Science national curriculum development. It could be initiated from any quarter by to ensure sustainability, it should be subsidized by the government.

9.5 Expand and maintain Internet infrastructure to provide universal access. Telecom infrastructure remains a major barrier to the provision of OER. Instead of relying upon

private network operators to further develop the country's fiber optic network, the government should fund TOT to expand infrastructure access, especially in remote areas.

10. Discussion

This section contains a discussion of research findings. In addresses the paper's two main objectives: (1) analyzing key challenges faced during the development of Thai-language OER in Mathematics and Science for Basic Education in Thailand (2) and framing guidelines for future developments of Thai-language OER. Findings are discussed below as follow:

10.1 Analysis: Problem and Obstacles

Extensive government planning and investment have thus far failed to produce much in the way of Thai-language OER. During the interviews, state officials readily acknowledged the fact and pointed to a number of obstacles that have hindered efforts to develop high-quality materials and improve public access.

As noted above, DEPA officials felt that there was a need to motivate key stakeholders involved in classroom learning. Educators and school administrators showed little enthusiasm for participating in the development of digital learning resources and those who did showed little interest in centralizing their resources. Traditional teacher-centered learning was still the prevailing model. Institutional culture and occupational concerns seemingly left little room for the adoption of new resources and pedagogies to improve the quality of classroom learning. As a result, despite a growing demand for digital content, with a projected market value to reach Bt26.8 billion by the end of 2018, the country was still not able to produce its own material.

Inter-governmental contracts have been another problem. For transparency purposes, agencies receiving funds are obliged to strictly adhere to government purchasing criteria. As a result, those looking for partners often enter into contractual agreements with other state agencies, even when these partners are not necessarily as capable as private-sector firms. Thus it was that IPST contracted with Srinakarinwirot University to develop digital content on its behalf while OBEC signed a similar agreement with Chiangmai University. In both instances, the work contracted failed to meet national curriculum standards and had to be corrected.

Budget shortfalls have also been an issue. In recent years, the Bureau of the Budget has cut available funding by 10-20 percent. Funding for digital content development is part of a broader budget outlay for classroom materials. This includes printed textbooks and other

necessities. As a result, the development of new learning resources seemingly comes at the expense of existing classroom needs.

In addition to the obstacles noted above, OER development has also been hindered by manpower shortages and coordination issues. The IPST project, for example, requires computer technicians and academic specialists to work as a team. The production and requisite proofing of mathematical and scientific content is a time-consuming activity that invariably slows the whole process down. Roughly half of IPST's 300 employees are academics but they are still overstretched. As one executive lamented, his organization has been tasked with "multiple duties". In addition to working on printed and digital curricula, they also manage the International Olympiads project, a special project for the country.

OBEC addresses manpower issues by relying upon external partners to develop content but faces a number of other problems. Learning materials acquired by the Commission must be modified to fit with the national curriculum. To establish a central database for the country, they must also be systematically organized. According to OBEC's Innovation Director, quality remains an issue. Much of the material is not fully interactive and, from the standpoint of students, not very interesting. Teachers also need guidance on how to integrate OER into their pedagogy and many are still not sure how to integrate ICT into their classrooms.

As a result, OBEC is working to ensure that teachers around the country receive training and understand the benefits of ICT. This is not easily done. School administrator are often unwilling to have their teachers pulled out of classrooms: *"even the tiniest of changes tend to make principals complain."* There is also no simple universal training program. Finally those responsible for the provision of training are frequently over-burdened with other work duties.

Because of these and other problems, digital resource usage remains quite low. IPST spent approximately 60 million baht to develop an online curriculum which thus far has only received 6 million visits, raising the question of whether additional funding should be sought for marketing purposes. OBEC officials joked that the limited usage of their web-based resources was due to a technical problem: potential users lacked the necessary skills to register for access. Asked about promotional efforts, one interviewee joked that he was *"planning to perform backflips while wearing a bikini at Siam Square,"*

As has already been noted, government purchasing regulations are currently the main barrier to private-sector participation. *"It is something that we have to be careful about; national coverage involves lots of money."* The adoption of digital learning in Thailand is seemingly also hindered by the traditional mindset of many school administrators and

instructors. To integrate online learning resource into the classroom, teachers need to change their existing lesson plans, a time-consuming enterprise. Most, by one estimate more than 80%, have yet to do so. As one interviewee remarked, *"It's the biggest barrier … getting teachers to see that they will benefit from investing the time and energy to rethink their pedagogies … and make use of the online resources,"*

Not surprisingly, textbook publishing companies like Aksorn Education continue to focus on the production of non-digital learning materials. Technical problems are arguably the most serious barrier to online learning in Thailand. The full utilization of digital resources, web-based collaboration systems and e-books requires near-universal access to a reliable high-speed network. Thailand falls well short of the mark. Around half of OBEC's 30,000 schools are still not connected to a high speed broadband network, making it impossible to distribute digital curricula to schools nationwide. Broadband penetration remains low due to a limited number of fixed lines and the dominance of cellular services in rural areas. The government hopes to improve access in the near term by leasing network capacity from TOT, a move which is unlikely to help. As has already been noted, TOT's Pracharat Internet project was not designed to bring stable internet connections to schools in remote areas. TOT officials note that their new fiber optic network does not even support widespread public access.

The government plans to expand broadband network coverage to schools in rural areas, but OBEC and TOT officials are quick to point out that this might not be practical. The Digital Economy scheme calls for broadband service to be extended to every village in the kingdom, some 44,352 nationwide, as well as all OBEC and non-OBEC schools. The cost of rolling out this extensive network infrastructure will be huge and it remains to be seen how it will turn out. *"The current administration is committed … but we don't know what problems might come in the future … it could turn out like the tablet project,"* The worry is that it might amount to another project where money is spent on hardware that fails to delivery educational software. OBEC still has no idea what to do with its millions of broken tablet computers.

A number of separate agencies have been tasked with the same job. Despite the obvious overlap in duties, interviewees were immediately unaware of any specific action plans for inter-agency collaboration. Responses suggest that partnerships are hindered by a lack of interaction. Agencies work independently of each other and there is no occasion to jointly discuss their work, let alone plan together.

Online platform development is one area where collaboration should be possible. IPST is in charge of Science and Technology Engineering and Mathematics (STEM) programming and continues to invest in its own web portal to distribute related materials. It also offers training to teachers and students. OBEC has a separate portal, OER and teaching training initiatives. A single portal might reduce expenses and improve content.

Private-public partnerships should also be possible. An OBEC official raised the example of school sponsor (Pracharat) partnerships. This new government scheme encourages private firms to work together with the state to improve education. IPST officials welcomed the initiative and acknowledged that they could not do everything by themselves. Presuming government regulations allowed for it, experienced partners and sub-contractors in the private sector could help boost the quality and quantity of Thai OER. As noted by one of the interviewees, *"we still have hope … although the government is presently not open to the idea."*

10.2 Guidelines for Developing Thai-Language Math/Science OER

In an effort to raise the standard and quality of education, various ICT initiatives have been introduced in the nation's classrooms. For reasons noted above, quality Thai-language OER have yet to be fully developed, despite growing public need and support. The following guidelines may be of value in facilitating the development of Thai-language OER for basic education system:

10.2.1 Efforts should be made to promote intra-governmental coordination. Relevant educational agencies such as IPST and OBEC continue to work independently on web-based educational resources. Existing online learning platforms should be reorganized into an integrated system where stakeholders can collaborate to reach common goals. A lack of coordination can lead to budget overlaps, redundancies and interagency conflicts. A central system platform should have design functions to allow the users to search digital learning materials by subject and grade level. It should also foster knowledge sharing, providing tools or guidelines for users who want to contribute digital OER materials.

10.2.2 Private-sector developers should be brought on board as partners. Thailand currently has a shortage of technically-skilled workers. Students in the education system are ill-prepared for work in the fields of science and technology (Wonglimpiyarat, 2011). To supplement human resource and address issues in related government agencies, efforts should be made to promote local OER development using the government's *Digital Startup*

policy. Non-governmental stakeholders should also be encouraged to develop learning resources.

10.2.3 Efforts should be made to identify, license and localize high- quality foreign-language OER. Creative math/science OER is readily available in English and a number of other foreign languages. In partnership with state universities and the private sector, the government should set up a grant program for localizing such materials through translation. The government currently does not support translation and localization efforts. Some work, mostly in mathematics, is being done by Thai volunteers. Localization strategies are widely used overseas (Ivins, 2011; Cobo, 2013; Murphy & Wolfenden, 2013 & Kanwar, Abeywardena & Mishra, 2018). This could be a short term strategy for producing quality Thai-language content.

10.2.4 Online Community Network Development Initiative. As noted by Sriprasertpap et al. (Sriprasertpap, Langka & Boonlue, 2015) online communities are a tool for learning. The creation of an online community network for Thai-language OER sharing similar to Khan Academy and Wikipedia is worth considering. This was suggested by an IPST executive who has expertise in Math/Science national curriculum development. It could be initiated from any quarter by to ensure sustainability, it should be subsidized by the government.

10.2.5 Expand and maintain Internet infrastructure to provide universal access. Telecom infrastructure remains a major barrier to the provision of OER. Optical fiber connections and broadband are concentrated in urban areas, leaving people in other areas to rely upon mobile rather than fixed line access (Sudtasan & Mitomo, 2018). Providing schools with computers without access to internet reduces their educational utility. Instead of relying upon private network operators to further develop the country's fiber optic network, the government should fund TOT to expand infrastructure access, especially in remote areas. For areas that lack adequate Internet connectivity, offline information stores the study noted in the chapter IV could be an alternative solution for the short term strategy (Acharya & Lee, 2018). The government may be considered encouraging offline-based OER materials as a first step and later subsequently upgrade the internet infrastructure to support the widespread access of OER materials.

As illustrated in both quantitative and qualitative data, it can be concluded that there is a strong need for Thai-language Math/Science OER. The country has made investments in digital learning resources, but has not developed high quality or interactive OER materials for all subjects and grades of the basic education curriculum. The quality and availability of existing resources is

limited as is access. Interview and survey results suggest that existing OER should be improved. To do so, a number of challenges must be overcome: legal impediments, poor infrastructure, inadequate human resources and financing issues. There is a need to develop short/long term policies to support the development of Thai-language OER.

11. Conclusion

Interview and survey results suggest that existing OER should be improved. To do so, a number of challenges especially poor infrastructure must be overcome. There is a need to develop short/long term policies to support the development of Thai-language OER. Among other things, there is a need for clear and consistent policies to facilitate the development of Thai-language OER. Digital learning materials have great pedagogical potential. They can support learning in different contexts, providing learners with appropriate resources that allows them to practice essential skills.

While the government is responsible for moving things in the right direction it does not need to do everything on its own**.** Developing Thai-language OER requires the involvement of all stakeholders. Interested parties in formal and informal education, as well as the private sector, should be encouraged to work together to produce creative OER materials for Thai learners.

References

Acharya, B., & Lee, J. (2018). Users' perspective on the adoption of e-learning in developing countries: The case of Nepal with a conjoint-based discrete choice approach. *Telematics and Informatics*, *35*(6), 1733-1734. doi: 10.1016/j.tele.2018.05.002

Amiel, T. (2013). Identifying barriers to the remix of translated open educational resources. *The International Review of Research in Open and Distributed Learning*, *14*(1), 126-144.

Baldo, T. (2007). *Exploring the culture of educational software: is the software culturally neutral? : localization of educational technology for developing Nations* (Doctoral dissertation, Concordia University). Retrieved from https: / / spectrum. library. concordia.ca/975288/

Buckler, A., Perryman, L. A., Seal, T., & Musafir, S. (2014). The role of OER localization in building a knowledge partnership for development: insights from the TESSA and TESS-India teacher education projects. *Open Praxis*, *6*(3), 221-233.

Cannell, P., Macintyre, R., & Hewitt, L. (2015). Widening access and OER: developing new practice. *Widening Participation and Lifelong Learning*, *17*(1) , 64- 72. doi: 10.5456/WPLL.17.1.64

Cobo, C. (2013) . Exploration of open educational resources in non- English speaking communities. *The International Review of Research in Open and Distributed Learning*, *14*(2), 106-128.

Fry, G. W., & Bi, H. (2013). The evolution of educational reform in Thailand: The Thai educational paradox. *Journal of Educational Administration*, *51*(3) , 290- 3 19. doi: 10.1108/09578231311311483

Hallinger, P., & Bryant, D. A. (2013). Synthesis of findings from 15 years of educational reform in Thailand: Lessons on leading educational change in East Asia. *International Journal of Leadership in Education*, *16*(4), 399-418. doi: 10.1080/13603124.2013.770076

Hatakka, M. (2009). Build it and they will come?–Inhibiting factors for reuse of open content in developing countries. *The Electronic Journal of Information Systems in Developing Countries*, *37*(1), 1-16. doi: 10.1002/j.1681-4835.2009.tb00260.x

Haruthaithanasan, T. (2018). Effects of educational reforms in the 2nd decade (2009–2018) on teacher motivation and student achievement among schools in Southern Thailand. *Kasetsart Journal of Social Sciences*, *39*(2), 222-229. doi: 10.1016/j.kjss.2017.06.008

Hersh, M. A., & Mouroutsou, S. (2015). Learning Technology and Disability: Overcoming Barriers to Inclusion: Evidence from a Multi-Country Study. *IFAC-PapersOnLine*, *48*(24), 83-88. doi: 10.1016/j.ifacol.2015.12.061

Intarat, S., Chanchalor, S., & Murphy, E. (2017). ICTs for non-formal education in rural Thailand. *Australasian Journal of Educational Technology*, *33*(4). doi: 10.14742/ajet.3165

Ivins, T. (2011). Localization of open educational resources (OER) in Nepal: Strategies of Himalayan knowledge-workers. Retrieved from http://hdl.lib.byu.edu/1877/etd4349

Janthon, U. A., Songkram, N., & Koraneekij, P. (2015). Work- based blended learning and technological scaffolding system to enhance communication skills for caregivers under local administrative organization, ministry of interior, thailand (Part I) . *Procediasocial and behavioral sciences*, 984-991. doi: 10.1016/j.sbspro.2015.01.722

Junpeng, P. (2012). The development of classroom assessment system in Mathematics for basic education of Thailand. *Procedia-Social and Behavioral Sciences*, 69, 1965 - 1972. Retrieved from https://ednet.kku.ac.th/picture/paper-t05.pdf

Kanwar, A., Abeywardena, I. S., & Mishra, S. (2018). Smart OER: Bridges for Sustainable Education. Retrieved from http://hdl.handle.net/11599/2933

Khamkhong, Y. (2017). *Education in Thailand: Past, Present and ASEAN Integration*. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3032791

Khun-Inkeeree, H., Omar-Fauzee, M. S., & Othman, M. K. H. (2017). The Effect of Students Confidence Level toward Mathematics Performance among Southern Thailand Primary School Children. *International Journal of Academic Research in Progressive Education and Development*, *6*(2), 20-34. doi: 10.6007/IJARPED/v6-i2/2934

Kunzman, R., & Gaither, M. (2013). Homeschooling: A comprehensive survey of the research *Other Education*, *2*(1), 4-59. Retrieved from https://www.othereducation.org/index.php/OE/article/view/10

Mattavarat, S., Viseshsiri, P., & Siribanpitak, P. (2017). Proposed policy for preparation of high-quality primary school teachers in Thailand. *Kasetsart Journal of Social Sciences*, *38*(2), 105-110. doi: 10.1016/j.kjss.2016.04.005

Morse, A., Khaimook, K., Paonil, P., & Suktrisul, S. (2001). eLearning Education for Thai Teachers. *Education*, *2002*(2003), 2004. doi: 10.19173/irrodl.v15i2.1803

Mtebe, J. S., & Raisamo, R. (2014). Investigating perceived barriers to the use of open educational resources in higher education in Tanzania. *The International Review of Research in Open and Distributed Learning*, *15*(2). doi: 10.19173/irrodl.v15i2.1803

Murphy, P., & Wolfenden, F. (2013). Developing a pedagogy of mutuality in a capability approach: Teachers' experiences of using the Open Educational Resources (OER) of the teacher education in sub-Saharan Africa (TESSA) programme. *International Journal of Educational Development*, *33*(3), 263-271. doi: 10.1016/j.ijedudev.2012.09.010

Perryman, L. A., Hemmings-Buckler, A., & Seal, T. (2014). Learning from TESS- India's Approach to OER Localisation Across Multiple Indian States. *Journal of Interactive Media in Education*, *2014*(2), pp.1-11. doi: 10.5334/jime.af

Pruet, P., Ang, C. S., & Farzin, D. (2016). Understanding tablet computer usage among primary school students in underdeveloped areas: Students' technology experience, learning styles and attitudes. *Computers in Human Behavior*, *55*, 1131- 1144. doi: 10.1016/j.chb.2014.09.063

Richter, T., & McPherson, M. (2012). Open educational resources: education for the world? *Distance Education*, *33*(2), 201-219. doi: 10.1080/01587919.2012.692068

Shu-Hsiang, C., Jaitip, N., & Ana, D. J. (2015). From vision to action-A strategic planning process model for open educational resources. *Procedia-Social and Behavioral Sciences*, 174, 3707-3714. doi: 10.1016/j.sbspro.2015.01.1103

Srikote, S. (2013). Learning English through Collaboration: A Case Study at Mahachula longornrajavidyalaya University, Loei Buddhist College. *Procedia-Social and Behavioral Sciences*, 88, 274 - 281. doi: 10.1016/j.sbspro.2013.08.506

Sriprasertpap, K., Langka, W., & Boonlue, S. (2015). The Development of Thai Teacher Information Communication Technology (ICT) Online Community Model in Thailand. *Procedia-Social and Behavioral Sciences*, 197, 1727-1731. doi: 10.1016/j.sbspro.2015.07.227

Sudtasan, T., & Mitomo, H. (2018). The Internet of Things as an accelerator of advancement of broadband networks: A case of Thailand. *Telecommunications Policy*, *42*(4), 293-303. doi: 10.1016/j.telpol.2017.08.008

Thinwiangthong, S., & Inprasitha, M. (2014). Pre-and In-service Teachers' Role to Improve the Teaching and Learning Mathematics. *Procedia-Social and Behavioral Sciences*, 116, 1940-1944. doi: 10.1016/j.sbspro.2014.01.499

Udompong, L., Traiwichitkhun, D., & Wongwanich, S. (2014). Causal model of research competency via scientific literacy of teacher and student. *Procedia-Social and Behavioral Sciences*, 116, 1581-1586. doi: 10.1016/j.sbspro.2014.01.438

Viriyapong, R., & Harfield, A. (2013). Facing the challenges of the One-Tablet-Per - Child policy in Thai primary school education. Education, *4*(9), 176-184. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.403.5381&rep=rep1&type=pdf

Vungthong, S., Djonov, E., & Torr, J. (2017). Images as a resource for supporting vocabulary learning: A multimodal analysis of Thai EFL tablet apps for primary school children. *TESOL Quarterly*, *51*(1), 32-58. doi: 10.1002/tesq.274

Wonglimpiyarat, J. (2011). Government programmes in financing innovations: Comparative innovation system cases of Malaysia and Thailand. *Technology in Society*, *33*(1-2), 156-164. doi: 10.1016/j.techsoc.2011.03.009

Wonglimpiyarat, J. (2014). Incubator policy to support entrepreneurial development, technology transfer and commercialization. *World Journal of Enterpreneurship, Management and Sustainable Development*, *10*(4), 334-351. doi: 10.1108/WJEMSD-03-2014-0008

Wongwanich, S., Piromsombat, C., Khaikleng, P., & Sriklaub, K. (2015). Policy delivery strategies for education reform: A formative research and development. *Procedia-Social and Behavioral Sciences*, *171*, 1365-1372. doi: 10.1016/j.sbspro.2015.01.255

Yamada, T., Jung, I., Lee, T., Fadzil M., Pawlowski, J. M., Pirkkalainen, H., ... Wang, L. (2014). *Open Educational Resources in Lifelong Learning.* [ASEM LLL HUB version]. Retrieved from http: / / asemlllhub. org/ fileadmin/ www. asem. au. dk/ publications/ e-ASEM_OER_2014.pdf