

Exploring the successfulness of a blended online training program to promote math teachers to create online lessons

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Abstract: *This study aimed to explore the success of a blended online training program to promote math teachers to create online lessons. The sample consisted of 224 junior high school math teachers from 42 educational districts in Thailand using purposive sampling. The training consists of 3 phases, starting from designing the lessons that meet online learning requirements following the instructions from the manuals and resources provided on the website. The next step is introductory and preliminary feedback regarding the Pedagogy, Content, and Knowledge (PCK) given via live streaming and Technological Knowledge (TK) given via videoconference. In the third phase, participants joined the on-site workshops for additional training. In the end, qualified lessons have been published on the Massive Open Online Course (MOOC) platform created for this project. Gathering information related to PCK and TK showed that teachers created online lessons using different techniques. The lessons are accurately presented and are engaging. Moreover, interviews and satisfaction questionnaires revealed that the produced online lessons are useful in real-world situations, such as teaching and learning during the COVID-19 epidemic. However, the lessons produced did not cover all the topics specified in the Basic Education Core Curriculum in mathematics.*

1. Introduction

Since 2013, the International College, Suan Sunandha Rajabhat University (SSRUIC) has produced graduates in mathematics education under the philosophy "Integrating Technology in Learning Mathematics." The curriculum was designed to provide graduate students with broad areas of knowledge in the teaching profession in mathematics education, including the application of new technologies appropriate to teaching and learning in the mathematics classroom. Our mission in academic service focuses on providing beneficial knowledge to answer questions or guide the society in community and local organizations by using the outcomes of research utilized in beneficial ways to correspond with society and community for sustainable peace and growth. In 2018, the college provided academic service to increase students' achievement in taking the Ordinary National Educational Test (O-NET) by training junior high school teachers in three subjects: Mathematics, Science, and English (see [1]). In 2019, our team conducted a study that analyzed the O-NET results to develop a Massive Online Open Course (MOOC) for corrections of misconceptions and mathematical errors of junior high school students (see [2]).

In 2020, the college proposed a new project for training junior high school teachers in mathematics, science, and English. It focused on promoting teachers to create online lessons. We believed that improving teachers' skills in utilizing technologies would also improve teaching quality and encourage lifelong learning. The college planned to conduct on-site workshops in several areas during October 2019. Due to the COVID-19 pandemic, schools and educational institutions were forced to close. The "Work from Home" and "Online Learning" policies had been enforced across the country. Many planned training programs were halted, postponed, or allowed with strict conditions such as social distancing, face masks, and the maximum number of participants.

As suggested in [3], using a combination of face-to-face instruction and online learning (defined as a “blended learning model”) can provide a suitable learning environment. Therefore, the project organizer decided to organize a program using blended online training to comply with the social distancing regulations and to minimize the risk to all participants.

1.1 Technological Pedagogical Content Knowledge (TPCK)

The teachers’ essential competencies refer to knowing and understanding what to teach, helping students learn, engaging the community, and becoming better teachers. According to [4], teachers should not only know and understand what to teach. However, they should also deepen and broaden knowledge, such as understanding education trends and updating knowledge on local and global aspects.

From the literature reviews, there are different approaches to support the teacher’s professional development in deepening knowledge of the subject, knowledge of pedagogy (teaching strategies), and the ability to integrate technology in teaching and learning.

The idea of pedagogical content knowledge (PCK) was introduced by [5] concerning the blending of content and pedagogy into the teaching process. It was presented that teachers have to master subject content and choose appropriate teaching and learning to develop the learners’ growth.

The idea of the TPCK framework [6] was built on the idea of PCK [5] combined with technological knowledge (TK). The idea for applying TPCK or TPACK (Technological Pedagogical And Content Knowledge) was suggested in [7]. It was mentioned that teachers should determine what content and standards need to be taught/learned. They also need to choose the appropriate instructional methods that complement the content to be taught/learned and match the technology and other tools to have the best fit for teaching and learning.

For this study, PCK covers Grade 7 to Grade 9 mathematics identify in the Basic Education Core Curriculum 2008 (Revision 2018) in Mathematics, which is divided into “Basic Mathematics” and “Additional Mathematics”. There are three strands in common: number and algebra, measurement and geometry, statistics, and probability. Additional Mathematics has calculus as the fourth strand. TK refers to the technology used to assist in the creation of online lessons.

1.2 Blended learning

Blended learning indicates the pedagogical approach by combining more than one learning strategy. A more common definition of blended learning refers to the combination of face-to-face and online sessions.

According to [8], blended learning is categorized into three modes consisting of skill-driven learning (combined self-paced learning with instructor support to develop specific knowledge and skills), attitude-driven learning (mixes various events and delivery media to develop specific behaviors), and competency-driven learning (blends performance support tools with knowledge management resources and mentoring to develop workplace competencies).

The proportion of content delivered using each method can be decided for each course, such as 30% online and 70% offline, as suggested in [9]. Typical online content consists of discussions, videos, and eBooks, while workshops and crucial discussions often take place in face-to-face meetings. Lessons can be made 100% online if they support self-regulated learning. Due to the high technology adoption rate in instruction, educational institutions have brought the online components to create courses to support students’ learning or provide the necessary training for teachers to efficiently utilize the online components (see [10]).

Blended learning can create effective training, save time and money for the institute, make training more engagement and convenient for trainees, and offer professional development focus on TPCK

and the chance to innovate. Designing a blended online course requires a systematic but flexible strategy to improve educational practice. The process can have several steps, such as planning, designing, implementing, and evaluating. Some useful guidelines were suggested by [11] that may help to design a blended online course as follows:

- 1) Lecture materials should have file size and format compatible with most of the devices. The time for releasing content should also be considered.
- 2) Audio and video content should include interactive questioning and encourage students to share ideas.
- 3) All materials are subject to copyright provisions.
- 4) Activities should be designed based on Bloom's taxonomy hierarchical classification for different objectives.
- 5) Intimately tie an online assessment to assess students' achievement.

1.3 Multimedia for blended online learning

The use of multimedia in blended online learning has to be considered to deliver content effectively. The study done by [12] aimed to upgrade teacher qualification using e-training. The process included training through computer networking, training plan (curriculum-wide and individual units). Materials included presentations, online videos/audios, online lectures, online worksheets, writing examples, learning resources with hyperlinks, email, and web forums. It was found that participants gained high achievements after participating. Moreover, the trainees, online instructors, and e-training coordinators were satisfied with the training. They also had positive attitudes toward information technology.

Several media types can be used to support blended learning. The case study of [13] involved more than forty courses in leading healthcare organizations and sales professionals through distance learning with more than 10,000 students across the United States and Puerto Rico. It showed that media types used included print-based text, audio CD, and browser-enabled multimedia files. It was reported that the variety of teaching media was driven by the growth of technology and consumers' demands for alternatives to online learning solutions.

According to the planned workshop of the SSRUIC to train junior high school teachers to create online lessons mentioned previously, the organizer planned to implement several online tools to facilitate online training during the outbreak. Those tools include a video conferencing system, live streaming via social network group, online videos, chat room, and web pages. Although the on-site training had become possible later on, limitations such as maximum training hours and social distancing were still enforced. And online solutions were still required to effectively distribute content across multiple sections and gather submissions for evaluation.

1.4 Objectives

Due to several obstacles mentioned above, we tried to investigate if the blended online training was an effective solution. The objectives are listed as follows:

- 1) To explore the quality of online lessons created by the participants.
- 2) To examine the participants' satisfaction regarding the proposed blending online training program.

2. Methodology

This study was designed as a one-shot case study. Details are described as follows:

2.1 Participants

Participants were purposively selected by the supervisors of each educational district in Thailand (total 42 districts). This selection process was implemented as teachers could not join voluntarily without the official invitation and proper permission. We also relied on the guidance from supervisors to select participants based on their availability.

There were 224 junior high school math teachers participating in the workshop. But participants might not attend all activities and not all teachers submit their lessons (described in Section 3).

2.2 Instruments

The proposed blended online training program was referred to as a “treatment” of this quasi-experimental study. Several tools and materials were included as follows:

Learning resources (ICT) – Materials included an online lesson production manual that describes several techniques that teachers can use to record lesson videos such as slideshow recording, screen recording, and smartphone setup. The manual also includes instructions for video editing, video publishing, creating online quizzes, and creating web pages. Tutorial videos are also provided.

PCK handbook (Math) – This handbook includes several instructional design techniques to produce attractive online math lessons while maintaining the correctness of the content.

Communication platforms – Several platforms were used to communicate during the workshop, as the on-site workshop was unavailable at first. We used videoconference, instant messaging, social network groups, and content distribution via web pages and file collection via online forms.

Rubrics for assessment – The assessment was used to measure the quality of produced online lessons. Rubrics are divided into two aspects; TK and PCK. Criteria on the technological aspect (TK) determined whether the online lesson meets the standards (e.g., short and straight to the point, viewable on mobile devices, compatible, no copyright infringement). Lessons were evaluated in three parts; video production (20 points), online test (5 points), and publication (5 points). Another set of criteria was used to measure the work quality on the PCK aspect (e.g., correctness and attractiveness). There were 18 points for the PCK part and 48 points in total.

Satisfaction questionnaire – A questionnaire consisting of 5-point Likert scale questions was used to measure participants’ satisfaction. Satisfaction levels were defined as follows: 5 = Very satisfied, 4 = Satisfied, 3 = Neutral, 2 = Dissatisfied, and 1 = Strongly dissatisfied. There were 9 questionnaire items in total, excluding the questions regarding personal information, as shown in Table 4.

2.3 Procedure

The designed blended online training workshop was organized in three phases over three months, as described below. All participants were required to attend at least one phase of the workshop, and they needed to submit their lessons to receive a teacher development certificate.

Phase 1 – Participants designed the lessons that meet online learning requirements following the instructions from the manuals and resources provided on the website.

Phase 2 – Content experts provided introductory and preliminary feedback regarding the PCK via live stream in a social network group. IT experts provided supports regarding TK via videoconference. These experts were assessors who evaluated all submitted lessons.

Phase 3 – Participants joined the on-site workshop organized in their districts for additional training. After completing the workshop, participants submitted their online lessons to be evaluated.

The resource materials such as evaluation criteria, ICT manual, PCK handbook, videos, and live stream recordings are provided electronically and always accessible to support some participants who missed any activity.

2.4 Data collection and analysis

To determine the quality of the submitted online lessons (objective 1), all the lessons were evaluated following the criteria mention in Section 2.2. The scores from the specialists in PCK and TK were collected and analyzed for each submitted lesson. There was a total of 48 points, as mentioned in Section 2.2. The passing grade was set to 50% (greater than or equal to 24 points). Note that only 156 teachers (out of 224) successfully submitted their lessons within the due dates. And only these lessons are presented and discussed in the results.

The satisfaction level (objective 2) was calculated using mean and standard deviation. The interpretation of the data was as follows: 1.00 – 2.00 = Less than acceptable, 2.01 – 3.00 = Acceptable, 3.01 – 4.00 = Good, and 4.01 – 5.00 = Very good. The data was analyzed for all 224 participants.

3. Results

3.1 Quality of online lessons

Only 156 participants submitted their online lessons within the first due dates. All submitted online lessons were evaluated by mathematics and IT specialists. The results revealed uneven distribution of the submitted online lessons across three common strands, as shown in Table 1. Qualified lessons were submissions that obtained the evaluation score above the passing grade (greater than or equal to 24 points or 50%). For the TK aspect, common mistakes found included small text sizes, poor text/background contrast, and mismatched animation queues. Mistakes on the PCK approach were inconsistent use of variables and symbols, typos, and mispronounced words. The qualified lessons were published on the website, as shown in Figure 1, while lessons that needed revisions were sent back to the owner with detailed feedback.

Participants used several techniques to create lesson videos, as shown in Table 2. The results show that slideshow recording using PowerPoint is the most preferred method, with more than 78% of participants choosing this technique.

Table 1 Distribution of the qualified online lessons

Strand	No. of submitted lessons	No. of qualified lessons	No. of lessons that needed revision
Number and Algebra	120	56	64
Measurement and Geometry	27	21	6
Statistics and Probability	9	8	1
Total	156	85	71

Table 2 Video production techniques

Technique	No. of submitted lessons
Slideshow recording using PowerPoint	123 (78.85%)
Paper + top-view camera	15 (9.61%)
Tablet capture + stylus	12 (7.69%)
Screen recording using apps or online services	5 (3.21%)
Whiteboard + front-view camera	1 (0.64%)
Total	156 (100%)

3.2 Examples of qualified online lessons

Among 156 submissions, 85 lessons are qualified. Some of the qualified lessons are illustrated in Figure 1. The lesson in Figure 1a shows the subtraction of two negative integers. This lesson was recorded using slideshow with animation. The lesson in Figure 1b shows how to factor the difference of two perfect squares. This lesson was created using the Geometer's Sketchpad and recorded using a screen recording program. The lesson in Figure 1c demonstrates how to draw a 75° angle using a straightedge and compass. This lesson was created using an online geometry application and recorded using a screen recording program. The lesson in Figure 1d shows how to find the sample space and events of a random experiment. This lesson was recorded using slideshow with animation. All qualified lessons are published on the SSRUIC MOOC website, as illustrated in Figure 2.

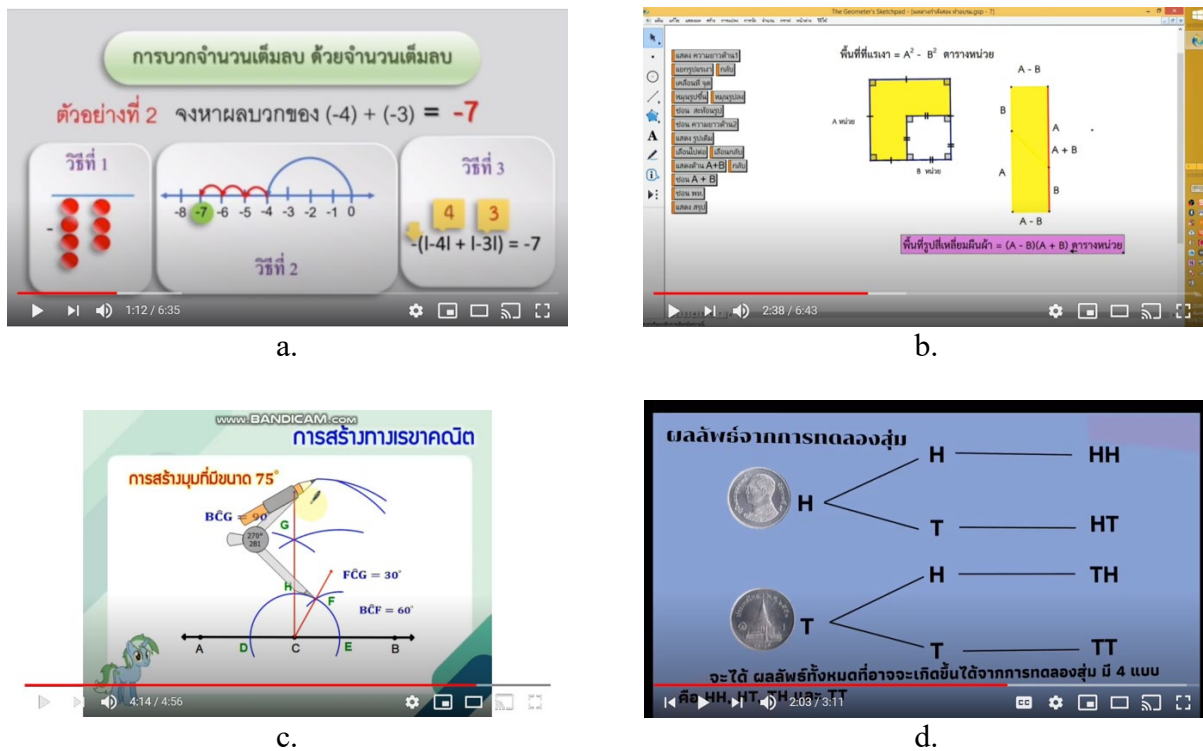


Figure 1 Examples of qualified lessons

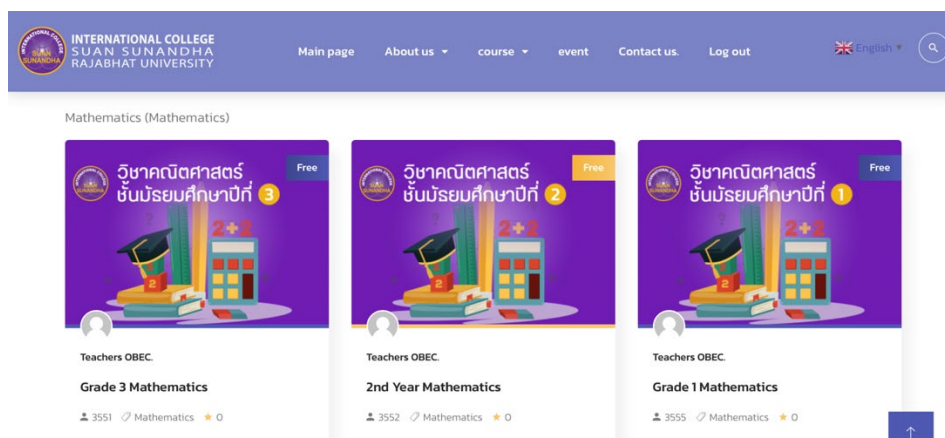


Figure 2 Online learning platform created for this project

3.2 Attendance and satisfaction

A total of 224 participants responded to the questionnaire. They were 67 Grade-7 teachers (29.91%), 72 Grade-8 teachers (32.14%), and 85 Grade-9 teachers (37.95%). Note that teaching levels were considered based on the lessons they submitted. In practice, many teachers teach more than one level. For the analysis, participants were classified into groups according to the activities they attended (3 phases, as mentioned above), as illustrated in Table 3. It was found that the highest proportion of participants (37.5%) attended only on-site workshops. However, there was also a large group of participants who attended all the activities (33.04%).

The average satisfaction in each aspect was shown in Table 4. The aspect with the highest satisfaction level was "Benefits in practicing and revising" in Phase 3. And the aspect with the lowest satisfaction level was "Knowledge gained from online materials" in Phase 1. However, the overall satisfaction level was at 4.16 (Very good), and the standard deviation was 0.68.

Table 3 Distribution of the participants attended in the blended online learning activities

Group	Participated activities			No. of participants
	Phase 1	Phase 2	Phase 3	
Group 1	✓	✓	✓	74 (33.04%)
Group 2	✓	✓	-	3 (1.34%)
Group 3	✓	-	✓	37 (16.52%)
Group 4	-	✓	✓	17 (7.59%)
Group 5	✓	-	-	4 (1.78%)
Group 6	-	✓	-	6 (2.68%)
Group 7	-	-	✓	83 (37.05%)
Total				224 (100%)

Table 4 Participants' satisfaction (N=224)

Aspect	Satisfaction level	
	Mean	SD
Phase 1		
Knowledge gained from online materials	3.97	0.69
Adequacy of the materials provided	4.22	0.65
Benefits in learning and working	4.34	0.64
Phase 2		
Knowledge gained from online sessions	4.06	0.71
Schedule and time management	3.78	0.82
Benefits in creating online lessons	4.08	0.69
Phase 3		
Knowledge gained from the on-site workshop	4.22	0.65
Meet the needs	4.31	0.65
Benefits of practicing and revising	4.46	0.62
Overall	4.16	0.68

4. Conclusion and Discussion

The primary purpose of this blended online training program was to equip mathematics teachers with the required knowledge and skills to face reformation in education. This professional development program employed TPCK activities to support teachers to create online lessons.

In this training program, the organizer let participants choose their preferred topics and production techniques. As shown in Table 1, the strand with the highest number of submissions was the Number and Algebra. This was probably because this chapter will soon be taught in the upcoming semester. This implies that participants were willing to implement the lessons they produced in the actual teaching/learning. The most preferred production method was slideshow recording using PowerPoint, as shown in Table 2. This was corresponded to [14] stating that time and available resources are important factors that influence the use of educational technology.

From Table 3, the teachers who did not attend Phase 1 and/or Phase 2 were allowed to attend Phase 3, which is on-site training. This caused the unequal numbers of participants in the analysis (156 for objective 1 and 224 for objective 2). From the results, it was found that many participants (37.5%) attended only on-site workshops. This can be described based on qualitative feedback saying that teachers already had a huge workload during the pandemic. Although there was no face-to-face session, teachers still needed to manage online classes (e.g., via video conferencing and digital TV channels). However, participants remained focused on producing online lessons as summarized from the satisfaction survey results, as shown in Table 4. However, due to the high workload mentioned above, the produced online lessons did not cover all strands in junior high school mathematics shown in Table 1.

5. Limitation and suggestion

As suggested above, time and existing workload are important factors that obstruct the development of online lessons. Facilities and equipment also play a crucial part since advanced video production techniques require hi-end devices and strong internet. However, the organizer provided alternatives to support teachers with limitations. Teachers were able to participate even though they only had basic equipment. We also emphasized the use of free software and online services.

The teacher training program is important in professional development to enhance the necessary skills to meet the new challenges in education. The rise of new teaching strategies and technology encourages the interaction between teachers and students and shifts the focus of global education from traditional classroom settings to online, on-demand, and autonomous learning.

One important in conducting a multi-phase blended online training program is to keep the evaluation process as a key-driven step to assist the design of the incoming phase. The design-based approach consisting of planning, designing, implementing, and evaluating for each phase can be applied for future works (see [15]).

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