USING MOOC AND GAMIFICATION HYBRID LEARNING MODELS IN RURAL PUBLIC SCHOOLS IN THAILAND

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ABSTRACT

This study investigates the effectiveness and knowledge retention of elearning models that could solve education problems in rural areas by considering two different examples: massive online open courses (MOOCs) and gamification hybrid learning. The study also proposes suitable and effective features that could influence student abilities in the context of language and science learning in rural areas. Data were collected from 283 students using field testing methods at rural schools in Thailand's Chaiyaphum province. One hundred and sixty students (13–16 years old) in secondary-school grades 7–10 were randomly selected for MOOC-based hybrid learning, and 123 students participated in gamification hybrid learning. The methodology featured two distinct steps. First, content and pattern examinations were conducted to verify the validity, reliability, and consistency of the content. Second, the sample group was tested to indicate and compare the efficiency of the models and the knowledge retention it then produced. Given the approach's quantitative nature, dependent sample t-tests were conducted to indicate differences in pretest and posttest mean scores, with Cohen's d effect size testing used to analyze subsequent effects. The results reveal that both MOOCs and gamification hybrid learning models are effective and suited to solving rural education problems. Both models improved student learning retention compared to traditional elearning models. Nonetheless, focus groups, peer tutoring, forum discussions, and group activities also significantly influenced learning. The study's findings could also benefit course instructors and program designers to help them create appropriate content using a well-designed framework, which could increase accountability and effectiveness and support class demand.

Keywords: *MOOC hybrid learning, educational gamification, elearning effectiveness, blended learning*

INTRODUCTION

Education is fundamental to developing sustainable social and economic growth and is critical to future success. The Human Development Index growth is substantially influenced by increased public spending on education (UNDP, 2020). However, almost one in five students worldwide do obtain a basic education (OECD, 2018a). According to Global Education Monitoring (2020), more than 63 million children do not have the opportunity to go to school, and 20% of those aged 15 to 24 have not completed primary school and lack employable skills. Thus, education accessibility is as relevant as learning outcomes and education quality.

In Thailand, students in rural areas are low achieving and attend rural and low-income schools where they are less likely to obtain a high-quality education (TDRI, 2018). Additionally, there is an inadequate number of qualified teachers in rural areas, and they often teach subjects that are not their area of expertise. A practical way of improving this problem with the education system would be to reduce the number of low-performing students (Cascio, 2016). Accordingly, the Thai government established its Information and Communication Technology (ICT) master plan, which aimed to use ICT to develop the country's capacity to nurture self-sufficiency and global competitiveness and build a knowledge-based society and economy. This plan integrates modern tools with traditional learning to improve the equity, quality, and standards of Thai education (TDRI, 2019).

Traditional approaches to teaching have been reformed to include elearning, which utilizes the internet to improve the quality and reliability of knowledge transmission, especially in developing countries such as Thailand, Indonesia, and Myanmar (Ngampornchai & Adams, 2016; The & Usagawa, 2018). However, elearning still faces substantial implementation problems (Thomas, 2018; Thongsri et al., 2019), including computer literacy and access to appropriate elearning equipment (Wongwuttiwat et al., 2020). Additionally, students often lack self-motivation, fall behind, get discouraged, and give up (Kew et al., 2018). These obstacles are especially apparent in rural schools, where students are isolated from opportunity. However, various new models have emerged, including massive online open courses (MOOCs) and educational gamification hybrid learning, which aim to support numerous participants and are accessed online (Bozkurt et al., 2015; Han & Shin, 2016). In conjunction, new flipped learning and blended learning approaches have emerged to deliver new material outside of the classroom setting, such as through videos, which enables classroom time to be dedicated to absorbing knowledge through discussion (Dumford & Miller, 2018; Han & Shin, 2016). Although these approaches have been effectively implemented to solve the education inequality problem (Alghamdi et al., 2020; Vicki, 2014), the new elearning platforms have mainly been created for developed countries and built around their learning styles (Ngampornchai & Adams, 2016; Wongwuttiwat et al., 2020)

Accordingly, this study investigates the effectiveness of MOOCs and gamification hybrid learning models in the context of the rural areas of Thailand and aims to describe the features and factors that affect learning ability by focusing on language and science subjects. Flipped classrooms, MOOCs, active learning, and gamification are all considered relevant for inclusion in a research design aimed at rural low-achieving students.

LITERATURE REVIEW

Elearning and Education in Thailand

According to the Programme for International Student Assessment 2018 result, no country can declare that all of its students have reached a baseline level of ability in science, reading, or mathematics (OECD, 2018b), with even developed countries still having low-performing students. Meanwhile, although Thailand has dedicated a substantial part of its budget to education––3.6% of its GDP––it has been ranked lower than Singapore, which spends only 3% of its GDP on education (TDRI, 2019; Vanpetch & Sattayathamrongthian, 2020). Notably, Thailand has also been ranked eighth of the 11 ASEAN member countries in terms of economic performance (Schwab, 2019).

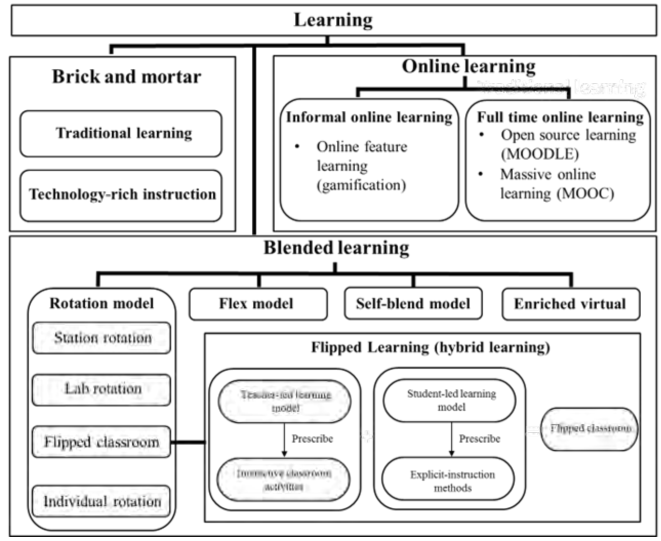
Most rural Thai schools have fewer than 600 students, most of whom are from low-income families, which meets the country's definition of rural and low-income schools. Effectiveness and accountability are needed to improve the quality of rural education in Thailand (Jones & Pimdee, 2017; Santiboon & Ekakul, 2017) However, small rural Thai schools lack both ICT and teachers (Puncreobutr, 2017; Sondergaard, 2015). Thus, although elearning could efficiently solve education problems in Thailand, such models still face various difficulties. Alghamdi et al. (2020), Jones and Pimdee (2017), and Santiboon & Ekakul (2017), have all revealed that 70% of the schools were missing elearning infrastructure and ICT, indicating they had inadequate elearning software, hardware, and professionals. Additionally, rural students have less access to high-speed internet.

The National Information Technology policy framework, or IT issue III, dictated that the Thai government would establish a plan to develop a knowledge-based society (Office of the Board of Investment, 2019). This framework featured six major strategies: increase ICT human resources; improve governance frameworks for national ICT at the central, regional, and local levels; build basic infrastructure, including a high-speed ICT network, to minimize the gap between a rural and metropolitan society; implement ICT management governance; develop a knowledge-based society to support manufacturing and empower businesses to create economic value and industrial competitiveness; train skilled ICT workforce to encourage Thailand's sustainable growth. This plan also indicates the need for elearning in Thailand including providing opportunities for Thai people to access high-speed internet, use ICT for elearning, and improve their quality of life and their environment efficiently and equally (TDRI, 2019).

Elearning Model

Pedagogical models are mainly divided into two forms: teacher-led and student-led. First, instructors are involved in all parts of the class to deliver the lecture contents. Students participate in teacher-organized learning activities such as lectures, group discussions, and projects (Martinez & Jagannathan, 2008). Another is the student-led education model. Teachers are less involved in the classroom, and students have more freedom and flexibility to learn the teacher's planned contents. Demonstrated in Figure 1, the educational models are divided into three parts. The first part is traditional teaching. Brick-and-mortar learning is an educational structure that focuses on face-to-face and teacher-led teaching. Instructions are based on lectures and assignments. The second is online learning. This is a student-led model-based educational structure in which students can learn content online at home or in school. Additionally, students can use online technologies outside of their educational programs. For instance, they receive full-time learning content from MOOCs through Moodle and additional exercises from educational gamification (Goodwin & Miller, 2013). The third is blended learning. This is an educational program where students learn part of the content online and part at school. Students have the freedom to control their place and pace (Staker & Horn, 2012). This approach combines traditional teaching with online learning, which allows teachers to act as facilitators and supporters of the learning process (Meltem, 2015).

Figure 1. Educational Models



In addition, blended learning can be divided into four models. First, the Rotation model is a program that revolves around a given subject. Students can rotate their class schedule, location, or content through learning activities and group projects. However, there are four subrotations: station, lab, individual, and flipped. The activities of each method vary from class to class based on the teacher's perspective. In the research model that utilizes flipped rotations, students receive new content outside of the classroom (teacher-led learning model) and use classroom time to participate the active learning through debates, discussion, and problem-solving (students-led learning model). This model corresponds to the concept that class time should be available to encourage students to learn through interactive teaching techniques and active learning, rather than a brick-and-mortar learning approach (Christensen et al., 2013).

The second model, the Flex model, has the core learning content available online. Even if teachers are available in the class, students freely learn new content online. Teachers provide face-to-face support through active learning such as group discussions and peer tutoring (Staker & Horn, 2012).

Third, the Self-blended or a-la-carte model provides students with opportunities to attend more classes than the school offers. Students learn additional content through online learning while attending traditional classrooms. Online courses are available at either home or school. For instance, students can take online mathematic courses and study other subjects in the classroom (Christensen et al., 2013).

Fourth, the Enriched virtual model enriches the whole school experience within a single curriculum. Students divide their time between traditional and online learning. They learn the main content in the classroom and complete their homework online. On the other hand, online learning becomes the primary tool when students are located remotely. (Bailey et al., 2013).

Moreover, several new approaches have emerged to solve education problems, with MOOCs representing one of the most popular. MOOCs support numerous learners and provide open access via the internet, with examples including Udacity and Coursera (Bozkurt et al., 2015). Meanwhile, educational gamification utilizes game design techniques and game mechanics to motivate and encourage people to utilize problem-solving skills to achieve their goals (Huotari & Hamari, 2012).

Developing from the connectivist distributed learning model and becoming widespread in 2012 (Wang et al., 2017; Zawacki-Richter et al., 2018), MOOCs can be divided into two platform types: xMOOCs are content-based and hosted on an LMS and cMOOCs are connectivist platforms developed by scholars using open-access websites. However, MOOCs still have some problems, including managing massive assessment and evaluation, standardizing design, motivating students, and ensuring user satisfaction. These problems are reflected in the low completion rate of MOOCs, with Henderikx et al. (2017) revealing that the typical completion rate for MOOCs is below 10%, hovering around 7.5%, meaning MOOCs alone cannot encourage students to complete a course.

Meanwhile, gamification is an effective new approach that delivers meaningful educational experiences to students. It provides students with powerful tools that drive behavioral changes, especially when combined with spaced repetition (Barata et al., 2014). Gamification also increases knowledge retention compared to traditional learning approaches (Kapp, 2012). Research conducted by Talent LMS (Andriotis, 2014) and the University of Colorado (Enders, 2013) has indicated that 14% of participants scored higher on skill-based-knowledge assessments, 9% increased their knowledge retention, and 11% demonstrated a higher aptitude for factual knowledge-based assessment. Gamification not only encourages students to acquire effective skills and knowledge but also improves long-term knowledge retention (Marcos, 2016). However, gamification faces certain obstacles, especially when it is not used appropriately (Groh, 2012). It is only efficient when used in conjunction with specific behaviors to achieve individual learning goals. Notably, game mechanics can motivate individual users according to their personalities (Jang et al., 2015; Jia et al., 2016). However, inadequate game design has also been observed as a major reason for problems with gamification (Dichev & Dicheva, 2017).

Flipped and Active Learning

Flipped learning first exposes students to content outside of the classroom, usually in the form of lecture videos. Then, the students do more challenging work during class time, including problem-solving and discussions (Berrett, 2014). Referring to Bloom's taxonomy, students conduct lower-level cognitive functions––knowledge acquisition and understanding––outside of the classroom and conduct higher-level cognitive functioning—such as synthesis and evaluation—inside the classroom, where they are guided by their teachers and classmates (Ahmed & Asiksoy, 2018). Flipped learning can improve efficiency and outcomes through data analytics and interactive learning (Amirtha & Shalini, 2015; Bishop & Verleger, 2013; Staker & Horn, 2012).

Furthermore, incorporating active learning encourages students to complete activities (student-centered learning) that promote analysis, evaluation, and synthesis of class content. Learners can share their work with their classmates and provide comments to their peers (Paton et al., 2018). Both MOOCs and gamification-based hybrid learning models can be integrated because students can access them from anywhere at any time. Meanwhile, active learning activities encourage students to participate in group work and use the knowledge acquired to complete their assignments. These models also comprise the various learning tenets of problem-based learning, peer-assisted learning, and peer tutoring. Elsewhere, collaborative learning is an efficient method that encourages students to support each other by working in teams to achieve an objective (Musdi et al., 2019; Shapiro et al., 2017). It can be used in conjunction with peer tutoring, supporting students to find suitable companions and utilizing forum-type discussions and peer-to-peer exchanges to increase in-depth understanding (Huisman et al., 2018).

Learning Retention

It has been found that learners do not retain the material received in class for a long time after examination (Bahrick, 1979), with learners forgetting about 20%, 63%, and 73% of the material after, respectively, one day, one week, and one month (Allen et al., 1969; Bahrick, 1979; Singh et al., 1994). The amount of knowledge retention depends on various factors, including learning method, material type, learner's prior knowledge, learner's age, learner's motivation, learner's satisfaction, and practice time (Thalheimer, 2010). However, well-designed learning methods and increased practice time can significantly alter results, potentially enabling knowledge to be retained for up to 50 years (Bahrick, 1984). There are different types of knowledge retention, including cognitive, recall, recognition, and comprehension, with Glasnapp et al. (1978) suggesting that knowledge is retained with significantly less efficiency by recall.

METHODOLOGY

This study investigated the suitable features and effectiveness of MOOCs and gamification hybrid learning models in rural schools by considering two different subjects: science (MOOCs hybrid learning) and language (gamification hybrid learning). The specific subjects––chemistry for science and German for language––were chosen to assess student abilities because the two subjects had never been studied by these student groups. Meanwhile, focus groups, peer tutoring, forum discussions, and group activities were considered appropriate in-class tools for students in rural areas. To analyze the data, a dependent sample *t*-test was conducted to ensure the scores differed statistically. To indicate the efficiency of the features and model, a dependent sample *t*-test was conducted to indicate pretest and posttest mean score differences. Additionally, Cohen's *d* was utilized to interpret the effect sizes of mean scores by measuring both the sizes of differences and the associations. Cohen's *d* indicates that the difference is negligible––but statistically significant––if the mean difference is below 0.2, with $d = 0.5$ indicating a medium mean score difference, $d = 0.8$ indicating a large mean score difference, and $d \geq 1.3$ indicating a very large mean score difference (Ferguson, 2009). Thus, the quantitative analysis involved two steps. First, MOOC and gamification hybrid learning model effectiveness were evaluated by testing hypothesis H1 (below) using dependent sample *t*-tests:

H1*: Pretest and posttest scores are significantly different.*

H1.1*: MOOC hybrid learning pretest and posttest scores are significantly different.*

H1.2*: Gamification hybrid learning pretest and posttest scores are significantly different.*

Then, hypotheses H2–H5 were tested to define the effectiveness of various model features, including MOOC videos (pretest and in-video quiz mean score difference), gamified learning (pretest and in-game test mean score difference), retention rate (online quiz or in-game test and flash quiz mean score difference), focus group (flash quiz and JiTT [Just in Time Teaching] mean score difference), and group activities (JiTT and posttest mean score difference).

Figure 2. Comparison of Model Features

Pretest	Pretest scores	Online quiz, Game test	Flash quiz scores	JiTT test
Effectiveness of features	MOOCs video and Game learning	Learning retention	Focus group	Discussion and group activity
Posttest	In-video quiz or Game test	Flash quiz scores	JiTT test	Individual test (Posttest)

H2*: Pretest and in-video quiz or game test scores are significantly different.*

H2.1*: Pretest and in-video quiz scores are significantly different for MOOC hybrid learning.*

H2.2*: Pretest and game test scores are significantly different for gamification hybrid learning.*

H3*: Online quiz or game test and flash quiz scores are significantly different.*

H3.1*: Online quiz and flash quiz scores are significantly different for MOOC hybrid learning.*

H3.2: Game test and flash quiz scores are significantly different for gamification hybrid learning.

H4: Flash quiz and JiTT test scores are significantly different.

H4.1: Flash quiz and JiTT test scores are significantly different for MOOC hybrid learning.

H4.2: Flash quiz and JiTT test scores are significantly different for gamification hybrid learning.

H5: JiTT test and posttest scores are significantly different.

H5.1: JiTT test and posttest scores are significantly different for MOOC hybrid learning.

H5.2: JiTT test and posttest scores are significantly different for gamification hybrid learning.

The final part of the study involved comparing the suitability and effectiveness of the two hybrid learning models for each group of students by considering model and feature effectiveness. Dependent variable *t*-tests were conducted to identify pretest and posttest mean score differences, with mean score differences in terms of percentage change indicating their efficiency.

Participants

The data collection utilized a field-testing approach in a rural school, splitting the sample population into two groups: MOOC participants and gamification participants. In total, 283 students participated, including 160 MOOC students and 123 gamification participants. Participants were 13–16 years old (grades 7–10) and attended a rural school in Thailand's Chaiyaphum province. Among the 160 MOOC participants, there were 43 students in grade 7, 40 students in grade 8, 38 students in grade 9, and 39 students in grade 10. Meanwhile, 76 (47.5%) were female and 84 (52.5%) were male. The students who had achieved a high GPA (3.00–4.00) accounted for 34.37% of the group, with 33.1% having a medium GPA (2.00–3.00), and 32.5% having a low GPA (below 2.00). Among the 123 gamification participants, 63 were male and 60 were female, and there were 38 students in grade 7, 40 students in grade 8, and 45 students in grade 9. Forty-one students were high achieving (GPA 3.00–4.00), 42 students were medium achieving (GPA 2.00–3.00), and 40 students were low achieving (GPA below 2.00).

Each group of students was separated into three groups: control, elearning, and elearning and motivation. The control group received the main content through traditional instruction before sharing their thoughts and acquiring in-depth understanding through group activities and focus groups. The elearning group was taught the main content using either MOOCs or gamification before collaborating through group activities and focus groups. The elearning and motivation group were also taught the main content through either MOOCs or gamification before joining group activities and focus groups, as well as being incentivized by toys, snacks, and stationery also with adjunct scores from Science and German language subject. Each group was also controlled for academic achievement according to their GPA level.

Figure 3. Categorization of Students Participating in the MOOCs Hybrid Learning Model

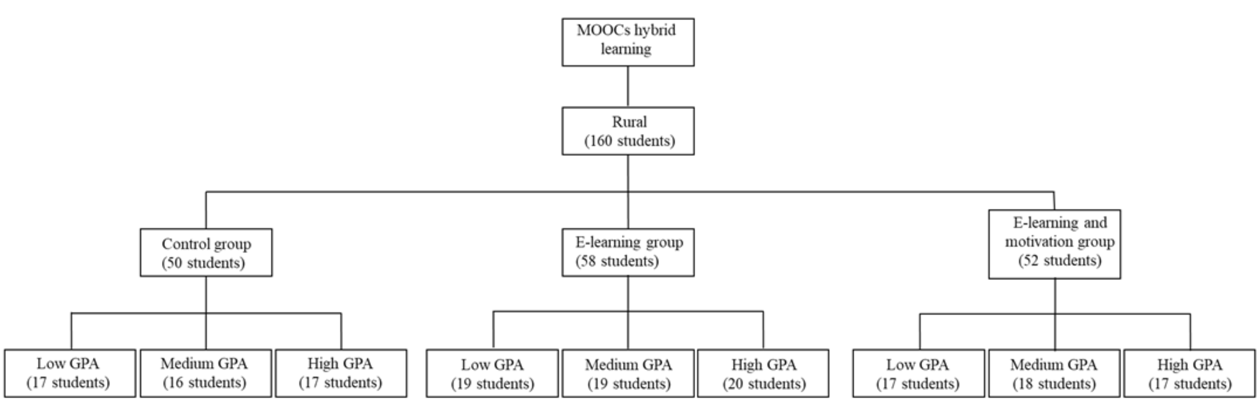
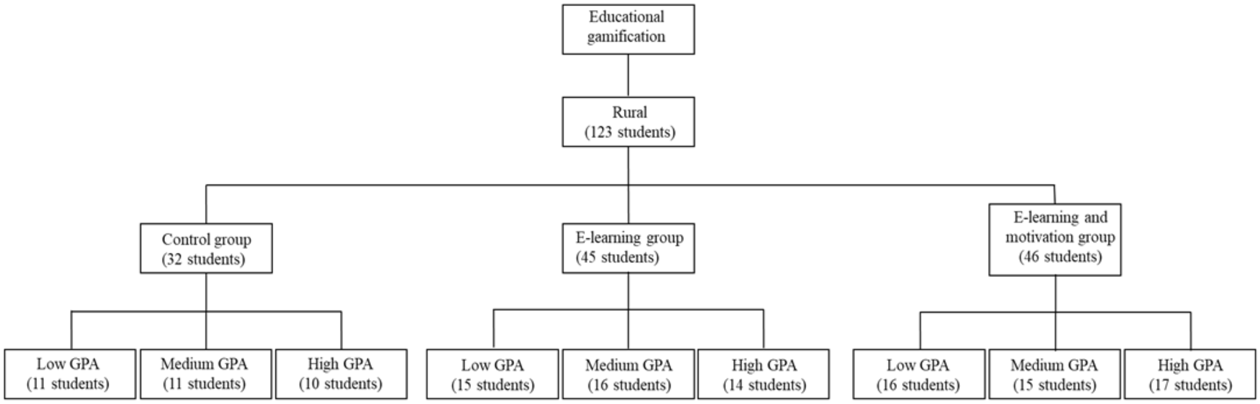


Figure 4. Categorization of Students Participating in the Gamification Hybrid Learning Model



Research Framework and Instruments

Given the requirements of data collection, the major analytical processes were separated into two steps. First, content and model pattern testing was conducted, with Figure 5 demonstrating the process for recognizing the effectiveness of both MOOC and gamification content. Meanwhile, a pilot test indicated reliability, trust, and content efficiency, which followed the students' learning and collaborating on various exercises through model processes. Accordingly, the effectiveness of each feature of the MOOC and gamification hybrid learning models was demonstrated.

Figure 5. Content Development and Evaluation

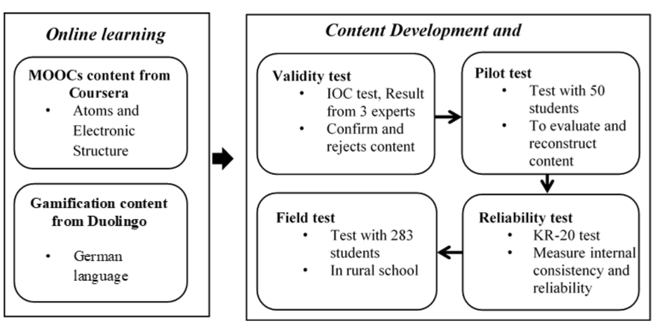
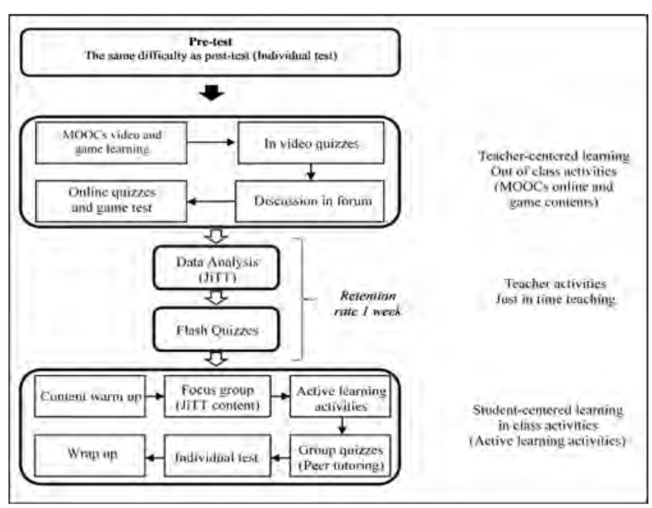


Figure 5 indicates that content validation was the first step. The MOOC content was adopted from Coursera's chemistry course (atoms and electronic structure), which had been developed by the University of Kentucky. This course comprised video lectures and practice problems corresponding to each video lecture (Coursera, 2015). Meanwhile, gamification content was adopted from Duolingo (Duolingo, 2016) and comprised eight German lessons at the basic and intermediate levels. Interactive game activities were integrated into classes, with students spending 10 to 15 minutes on each lesson.

Meanwhile, testing of validity utilized the Item Objective Congruence (IOC) index (Rovinelli & Hambleton, 1997), with results adopted from three experts in related academic fields and outcomes confirming or rejecting exam sets. Where results were confirmed, an exam set would be taken to the pilot test stage, in which 50 students participated. Meanwhile, the Kuder-Richardson Formula 20 (KR-20) test measured internal consistency and reliability (Kuder & Richardson, 1937), enabling reconstruction and evaluation of question sets based on test results. Following the pilot test and the KR-20 test, pretesting was performed.

Figure 6 presents the framework combining three groups of activities. The first group involved out-of-class activities or teacher-centered activities

Figure 6. MOOCs and Gamification Hybrid Learning Model Used in Research



(depending on the group). Before learning the material, pretesting was conducted to measure the students' background knowledge. Students (other than those in the control group) then learned the chemistry content from Coursera and German language content from Duolingo. The teacher would explain the content, and in-video quizzes would test preliminary understanding. Students then participated in forum discussions to confirm their in-depth understanding of the content. After students have understood and learned all the material, online quizzes, and gamified tests were applied to test their knowledge.

During the second group of activities, teaching activities were conducted, including Just in Time Teaching (JiTT), where teachers would use learning scores to identify the concepts each student was struggling with and identify the low-achieving group. After one week, learners answered flash quiz questions of the same difficulty level as the original online quiz questions to indicate learning retention.

The final group of activities was student-centered learning. The teacher would review all the material as a warm-up activity before separating students into groups based on their learning abilities and the content they had not understood, which had been identified using the JiTT method. The instructors would teach different content to the different groups according to their needs. Then, students join three active-learning activities. First, individual activities supported students in solving problems in class; these featured an opportunity for discussion with the teacher. Second, pair activities enabled students to discuss the content with their peers. Third, group activities involved fishbowl discussions, in which some students sit in a small circle and participate in a peer discussion while the remaining students sit in a larger circle observing the discussion, taking notes, and making comments before discussing the interaction (Barkley et al., 2005). Finally, group quizzes measured peer tutoring before individual posttesting evaluated individual understanding, enabling comparison with the pretest scores to analyze learning differences between groups.

RESULTS

According to H1, pretest and posttest scores are significantly different at the 0.01 level for both MOOC (*t*-value = −56.74) and gamification hybrid learning (*t*-value = −34.12). Meanwhile, Cohen's *d* interprets effect sizes, revealing that both MOOC (*d* = 1.62) and gamification hybrid learning (*d* = 3.97) produced large differences between pretest and posttest mean scores.

Table 1. Results of the t-test for Pretest and Posttest Mean Score Differences

Group	pretest mean score			posttest mean score			*t*-value
	N	*M*	SD	*N*	*M*	SD	
MOOCs hybrid learning	160	2.01	0.83	160	7.30	0.94	-56.74**
Gamification hybrid learning	123	2.15	0.79	123	5.64	0.95	-34.12**

*p<0.05, ***p<0.01, M*=Mean, *SD*=standard deviation

The posttest mean score for the MOOC control group (Mean = 6.40, SD = 0.75) was greater than the pretest mean score (Mean = 1.78, SD = 0.76). Cohen's *d* was 6.1, indicating a very large mean score difference. For the MOOC elearning group, the posttest mean score (Mean = 7.41, SD = 0.76) was greater than the pretest mean score (Mean = 2.05, SD = 0.89), indicating a very large mean score difference (*d* = 6.9). For the MOOC elearning and motivation group, the posttest mean score (Mean = 8.03, SD = 0.76) was greater than the pretest mean score (Mean = 2.05, SD = 0.89), indicating a very large mean score difference (*d* = 7.2).

For the gamification control group, the posttest mean score (Mean = 5.43, SD = 0.94) was greater

Table 2. Pretest and Posttest Mean Score Differences for MOOC Hybrid Learning Group

Group	pretest mean score			posttest mean score			Mean score difference		
	N	M_1	SD_1	*N*	M_2	SD_2	M_2-M_1 [95% CI]	*t*-value	*d*
Control	50	1.78	0.76	50	6.40	0.75	4.62 [4.29, 4.94]	-28.19**	6.1
Elearning	58	2.18	0.80	58	7.41	0.70	5.22 [5.03, 5.41]	-54.76**	6.9
Elearning and Motivation	52	2.05	0.89	52	8.03	0.76	5.98 [5.63, 6.32]	-35.10**	7.2

*p<0.05, ***p<0.01, M*=Mean, *SD*=standard deviation, *CI*=Confidence interval; *d*=Cohen's *d* effect size

Table 3. Pretest and Posttest Scores Differences for Gamification Hybrid Learning Group

Group	pretest scores			Posttest scores			Mean score difference		
	N	M_1	SD_1	N	M_2	SD_2	M_2-M_1[95% CI]	*t*-value	*d*
Control	42	2.02	0.77	42	5.43	0.94	3.41 [3.04, 3.77]	-19.91**	3.9
Elearning	42	2.15	0.74	42	5.48	0.96	3.33 [2.97, 3.69]	-18.96**	3.8
Elearning and Motivation	39	2.33	0.89	39	5.89	0.85	3.56 [3.20, 3.92]	-19.88**	4.0

*$p<0.05$, **$p<0.01$, *M*=Mean, *SD*=standard deviation, *CI*=Confidence interval; *d*=Cohen's *d* effect size

Table 4. Pretest and in-video Quiz Mean Score Differences for MOOC Hybrid Learning Group

Group	pretest mean score			in-video quiz mean score			Mean score difference		
	N	M_1	SD_1	*N*	M_2	SD_2	M_2-M_1[95% CI]	*t*-value	*d*
Control	50	1.78	0.76	50	2.78	0.76	1.00 [0.76, 1.23]	-8.48**	1.3
Elearning	58	2.28	0.80	58	3.58	0.81	1.30 [1.02, 1.57]	-11.05**	1.6
Elearning and Motivation	52	2.08	0.89	52	3.94	0.84	1.86[1.49, 2.22]	-10.50**	2.1

*$p<0.05$, **$p<0.01$, *M*=Mean, *SD*=standard deviation, *CI*=Confidence interval; *d*=Cohen's *d* effect size

than the pretest mean score (Mean = 2.02, SD = 0.77), indicating a very large mean score difference (*d* = 3.9). For the gamification elearning group, the posttest mean score (Mean = 5.48, SD = 0.96) was greater than the pretest mean score (Mean = 2.15, SD = 0.74), again indicating a very large mean score difference (*d* = 3.8). For the gamification elearning and motivation group, the posttest mean score (Mean = 5.89, SD = 0.85) was greater than the pretest mean score (Mean = 2.33, SD = 0.89), with Cohen's *d* having a size of 4.00, demonstrating a very large mean score difference.

Meanwhile, H2 was designed to measure the effectiveness of MOOC and gamification learning content. Confirming H2.1, MOOC pretest and in-video quiz scores were significantly different (*t*-value = −16.48), with Cohen's *d* being 1.62, representing a very large mean score difference. Confirming H2.2, gamification pretest and game test scores were significantly different (*t*-value = −15.27), with Cohen's *d* being 1.5, representing a considerable effect size. For the MOOC control group, the in-video quiz mean score (Mean = 2.78, SD = 0.76) was greater than the pretest mean score (Mean = 1.78, SD = 0.76), representing a very large mean score difference (*d* = 1.3). For the MOOC elearning group, the in-video quiz mean score (Mean = 3.58, SD = 0.81) was greater than the pretest mean score (Mean = 2.08, SD = 0.89), again representing a very large mean score difference (*d* = 1.6). For the MOOC elearning and motivation group, the in-video quiz mean score (Mean = 3.94, SD = 0.84) was greater than the pretest mean score (Mean = 2.08, SD = 0.89), representing a very large mean score difference (*d* = 2.1).

For the gamification control group, the game test mean score (Mean = 3.20, SD = 1.05) was greater than the pretest mean score (Mean = 2.02, SD = 0.77), representing a very large mean score difference (*d* = 1.2). For the gamification elearning group, the game test mean score (Mean = 3.23, SD = 0.77) was greater than the pretest mean score (Mean = 2.15, SD = 0.74), again representing a very large mean score difference (d = 1.4). For

Table 5. Pretest and Game Test Mean Score Differences for Gamification Hybrid Learning Group

Group	pretest mean score			game test mean score			Mean score difference		
	N	M_1	SD_1	*N*	M_2	SD_2	M_2-M_1[95% CI]	*t*-value	*d*
Control	42	2.02	0.77	42	3.20	1.05	1.20 [0.88, 1.52]	-7.77**	1.2
Elearning	42	2.15	0.74	42	3.23	0.77	1.07 [0.79, 1.35]	-7.91**	1.4
Elearning and Motivation	39	2.33	0.89	39	3.87	0.73	1.53 [1.27, 1.80]	-11.68**	1.8

*$p<0.05$, **$p<0.01$, *M*=Mean, *SD*=standard deviation, *CI*=Confidence interval; *d*=Cohen's *d* effect size

the elearning and motivation group, the game test mean score (Mean = 3.87, SD = 0.73) was greater than the pretest mean score (Mean = 2.333, SD = 0.89), representing a very large mean score difference (*d* = 1.8).

Next, H3 measured the effectiveness of MOOCs and gamification for learning retention. Confirming H3.1, MOOC online quiz and flash quiz mean scores were significantly different (*t*-value = −18.72), with Cohen's *d* being 1.42, representing a very large mean score difference. Confirming assumption H3.2 (gamification), game test and flash quiz mean scores were significantly different (*t*-value = 10.80), with Cohen's *d* being 0.78, representing a very large mean score difference (*d* = 0.78). For the MOOC control group, the flash quiz mean score (Mean = 2.74, SD = 0.63) was lower than the online quiz mean score (Mean = 4.50, SD = 0.83), representing a very large mean score difference (*d* = 2.3). For the MOOC elearning group, the flash quiz mean score (Mean = 3.92, SD = 0.89) was lower than the online quiz mean score (Mean = 5.42, SD = 0.73), again representing a very large mean score difference (*d* = 1.8). For the MOOC elearning and motivation group, the flash quiz mean score (Mean = 4.72, SD = 0.80) was lower than the online quiz mean score (Mean = 5.78, SD = 0.81), indicating a very large mean score difference (*d* = 1.3).

For the gamification control group, the flash quiz mean score (Mean = 2.41, SD = 1.01) was lower than the game test mean score (Mean = 3.20, SD = 1.05), indicating a medium mean score difference (*d* = 0.7). For the gamification elearning group, the flash quiz mean score (Mean = 2.15, SD = 0.93) was lower than the game test mean score (Mean = 3.23, SD = 0.77), again representing a medium mean score difference (*d* = 1.2). For the gamification elearning and motivation group, the flash quiz mean score (Mean = 3.25, SD = 1.01) was lower than the game test mean score (Mean = 3.87, SD = 0.73), again representing a medium mean score difference (*d* = 0.7).

Next, H4 measured the effectiveness of focus groups in the MOOC and gamification contexts. Confirming H4.1, MOOC flash quiz and JiTT test mean scores were significantly different (*t*-value = −21.79), with Cohen's *d* indicating a very large mean score difference (*d* = 1.53). Confirming H4.2, gamification flash quiz and JiTT test mean scores were significantly different (*t*-value = 10.80), with Cohen's *d* indicating a very large mean score difference.

For the MOOC control group, the JiTT test mean score (Mean = 4.52, SD = 0.73) was greater than the flash quiz mean score (Mean = 2.74, SD = 0.63), representing a very large mean score difference (*d* = 2.6). For the MOOC elearning group,

Table 6. Online Quiz and Flash Quiz Mean Score Differences for MOOC Hybrid Learning Group

Group	online quiz mean score			flash quiz mean score			Mean score difference		
	N	M_1	SD_1	***N***	M_2	SD_2	M_2-M_1 [95% *CI*]	***t*-value**	***d***
Control	50	4.50	0.83	50	2.74	0.63	-1.76 [-2.03,-1.48]	12.96**	2.3
Elearning	58	5.42	0.73	58	3.92	0.89	-1.50 [-1.77,-1.22]	12.99**	1.8
Elearning and Motivation	52	5.78	0.81	52	4.72	0.80	-1.06 [-1.32,-0.79]	7.78**	1.3

*p<0.05, ***p<0.01,* *M*=Mean, *S*=standard deviation, *CI*=Confidence interval; *d*=Cohen's *d* effect size

Table 7. Game Test and Flash Quiz Mean Score Differences for Gamification Hybrid Learning Group

Group	game test mean score			flash quiz mean score			Mean score difference		
	N	M_1	SD_1	***N***	M_2	SD_2	M_2-M_1 [95% *CI*]	***t*-value**	***d***
Control	42	3.20	1.05	42	2.41	1.01	-0.82 [-1.02,-0.61]	7.13**	0.7
Elearning	42	3.23	0.77	42	2.15	0.93	-1.07 [-1.38,-0.76]	6.98**	1.2
Elearning and Motivation	39	3.87	0.73	39	3.25	1.01	-0.61 [-0.86,-0.36]	4.91**	0.7

*p<0.05, **p<0.01, M=Mean, SD=standard deviation, CI=Confidence interval; d=Cohen's d effect size

Table 8. Flash Quiz and JiTT Test Score Differences for MOOC Hybrid Learning Group

Group	flash quiz mean score			JiTT test mean score			Mean score difference		
	N	M_1	SD_1	*N*	M_2	SD_2	M_2-M_1 [95% CI]	*t*-value	*d*
Control	50	2.74	0.63	50	4.52	0.73	1.78 [1.53, 2.02]	-14.56**	2.6
Elearning	58	3.92	0.89	58	5.74	0.86	1.82 [1.31, 1.92]	-15.05**	2.6
Elearning and Motivation	52	4.72	0.80	52	6.61	0.78	1.89 [1.15, 1.60]	-15.69**	2.7

*$p<0.05$, **$p<0.01$, *M*=Mean, *SD*=standard deviation, *CI*=Confidence interval; *d*=Cohen's *d* effect size

the JiTT test mean score (Mean = 5.74, SD = 0.86) was greater than the flash quiz mean score (Mean = 3.92, SD = 0.89), again representing a very large mean score difference (*d* = 2.6). For the MOOC elearning and motivation group, the JiTT test mean score (Mean = 6.61, SD = 0.78) was greater than the flash quiz mean score (Mean = 4.72, SD = 0.80), again representing a very large mean score difference (*d* = 2.7).

For the gamification control group, the JiTT test mean score (Mean = 4.25, SD = 1.04) was greater than the flash quiz mean score (Mean = 2.41, SD = 1.01), representing a very large mean score difference (*d* = 1.7). For the gamification elearning group, the JiTT test mean score (Mean = 4.15, SD = 1.11) was greater than the flash quiz mean score (Mean = 2.15, SD = 0.93), again representing a very large mean score difference (*d* = 1.9). For the gamification elearning and motivation group, the JiTT test mean score (Mean = 5.48, SD = 0.99) was greater than the flash quiz mean score (Mean = 3.25, SD = 1.01), again representing a very large mean score difference (*d* = 1.8).

Next, H5 measured the effectiveness of group activities for the MOOC and gamification hybrid learning models. Confirming H5.1, MOOC JiTT test and posttest mean scores were significantly different (*t*-value = −22.07), with Cohen's *d* indicating a very large mean score difference (*d* = 1.9). Confirming H5.2, gamification JiTT test and posttest mean scores were significantly different (*t*-value = −10.92), with Cohen's *d* indicating a large mean score difference (*d* = 1.05).

For the MOOC control group, the posttest mean score (Mean = 6.40, SD = 0.75) was greater than the JiTT test mean score (Mean = 4.52, SD = 0.73), representing a very large mean score difference (*d* = 2.5). For the MOOC elearning group, the posttest mean score (Mean = 7.46, SD = 0.67) was greater than the JiTT test mean score (Mean = 5.54, SD = 0.86), indicating a very large mean score difference (*d* = 2.4). For the MOOC elearning and motivation group, the posttest mean score (Mean = 8.04, SD = 0.78) was greater than the JiTT test mean score (Mean = 6.10, SD = 0.78), again representing a very large mean score difference (*d* = 2.4).

For the gamification control group, the posttest mean score (Mean = 5.33, SD = 0.92) was greater than the JiTT test mean score (Mean = 4.25, SD = 1.04), representing a medium mean score difference (*d* = 1.0). For the gamification elearning group, the posttest mean score (Mean = 5.35, SD = 0.90) was greater than the JiTT test mean score (Mean = 4.15, SD = 1.11), representing a medium mean score difference (*d* = 1.1). For the gamification elearning and motivation group, the posttest mean score (Mean = 5.35, SD = 0.84) was greater than the JiTT test mean score (Mean = 4.14, SD = 0.99), again indicating a medium mean score difference (*d* = 1.1).

This section's final results measure the

Table 9. Flash Quiz and JiTT Test Mean Score Differences for Gamification Hybrid Learning Group

Group	flash quiz mean score			JiTT test mean score			Mean score difference		
	N	M_1	SD_1	*N*	M_2	SD_2	M_2-M_1 [95% CI]	*t*-value	*d*
Control	42	2.41	1.01	42	4.25	1.04	1.84 [1.53, 2.15]	-10.78**	1.7
Elearning	42	2.15	0.93	42	4.15	1.11	2.00 [1.58, 2.41]	-9.83**	1.9
Elearning and Motivation	39	3.25	1.01	39	5.48	0.99	2.23 [0.85, 1.66]	-10.27**	1.8

*$p<0.05$, **$p<0.01$, *M*=Mean, *SD*=standard deviation, *CI*=Confidence interval; *d*=Cohen's *d* effect size

Table 10. JiTT Test and Posttest Mean Score Differences for MOOC Hybrid Learning Group

Group	JiTT test mean score			posttest mean score			Mean score difference		
	N	M_1	SD_1	*N*	M_2	SD_2	M_2-M_1[95% CI]	*t*-value	*d*
Control	50	4.52	0.73	50	6.40	0.75	1.88 [1.55, 2.20]	-11.69**	2.5
Elearning	58	5.54	0.86	58	7.46	0.67	1.92 [1.62, 2.21]	-13.51**	2.4
Elearning and Motivation	52	6.1	0.78	52	8.04	0.78	1.94 [1.62, 2.25]	-13.81**	2.4

*p<0.05, ***p<0.01*, *M*=Mean, *SD*=standard deviation, *CI*=Confidence interval; *d*=Cohen's *d* effect size

Table 11. JiTT Test and Posttest Mean Score Differences for Gamification Hybrid Learning Group

Group	JiTT test score			posttest scores			Means difference		
	N	M_1	SD_1	*N*	M_2	SD_2	M_2-M_1[95% CI]	*t*-value	*d*
Control	42	4.25	1.04	42	5.33	0.92	1.07 [0.75, 1.39]	-7.13**	1.0
Elearning	42	4.15	1.11	42	5.35	0.90	1.20 [0.83, 1.57]	-6.41**	1.1
Elearning and Motivation	39	4.14	0.99	39	5.35	0.84	1.21 [0.52, 1.16]	-7.35**	1.1

*p<0.05, ***p<0.01*, *M*=Mean, *SD*=standard deviation, *CI*=Confidence interval; *d*=Cohen's *d* effect size

effectiveness of MOOCs and gamification according to the three different academic achievement levels (low, medium, and high). To test each model's effectiveness, dependent variable *t*-tests were used to indicate pretest and posttest mean score differences, with percentage change and mean score differences utilized to compare effectiveness.

Table 12 reveals the effectiveness of both MOOC and gamification hybrid learning models. The MOOC elearning and motivation group produced a higher mean score than both the control and elearning groups for every achievement level. This indicates that MOOCs are most efficient when combining elearning and motivation. Meanwhile, the gamification elearning and motivation group also produced a higher mean score than both the control and elearning groups for every achievement level.

Comparing the effectiveness of the model's features, including main teaching content, focus group, group activities, and retention rate, both the MOOC and gamification hybrid learning models indicate good efficiency when utilizing incentives and motivation for all achievement levels. For the MOOC hybrid learning model, total posttest mean scores increased about 263%; for the gamification model, total posttest mean scores increased about 162%. This indicates that these two models can

Table 12. Learning Effectiveness Comparison between MOOC and Gamification Hybrid Learning Models

Academic achievement	Model comparison					
	MOOC hybrid learning			Gamification hybrid learning		
	Control	Elearning	Elearning and motivation	Control	Elearning	Elearning and motivation
Low	**5.22** (330%) (*1.58, 6.82*)	**5.20** (225%) (*2.31, 7.52*)	**5.71** (263%) (*2.17, 7.88*)	**2.93** (155%) (*1.88, 4.81*)	**3.00** (132%) (*2.26, 5.26*)	**3.40** (170%) (*2.00, 5.40*)
Medium	**4.44** (264%) (*1.68, 6.12*)	**5.15** (233%) (*2.21, 7.36*)	**6.16** (308%) (*2.00, 8.16*)	**2.75** (127%) (*2.15, 4.90*)	**3.37** (149%) (*2.25, 5.62*)	**3.53** (147%) (*2.40, 5.93*)
High	**4.15** (202%) (*2.05, 6.23*)	**5.30** (258%) (*2.05, 7.35*)	**6.05** (302%) (*2.00, 8.05*)	**3.00** (125%) (*2.40, 5.40*)	**3.50** (148%) (*2.35, 5.85*)	**4.00** (181%) (*2.20, 6.20*)

improve learning in rural areas when students are encouraged to focus on elearning tools through the use of incentives. Meanwhile, regarding the main teaching content, both MOOCs and gamification demonstrated efficiency for utilization as major learning contents in a blended learning model, with the MOOC total posttest mean score increasing about 72% and the gamification total posttest mean score increasing about 60%.

Elsewhere, although the MOOC group demonstrated the effectiveness of focus groups for all three achievement levels (total mean score increase of about 43%), the gamification group only demonstrated the effectiveness of focus groups for the low- and medium-achieving groups (total mean score increase of about 64%). Thus, focus groups can be utilized for all students except high-achieving groups, whose substantial learning potentiality enables them to understand the material by themselves. In this context, teachers can act as advisors, providing suggestions for students. Regarding group activities, in the MOOC context, such activities are suitable and effective when utilized with elearning or elearning and motivation for all achievement levels, with a total mean score increase of about 34% observed. In the gamification context, a total mean score increase of about 23% was associated with group activities; however, it only demonstrated effectiveness for medium- and high-achieving students. Finally, regarding learning retention, both MOOC and gamification hybrid learning models can increase learning retention rates when utilized with elearning or elearning and motivation methods for medium- and high-achieving students. After one week, MOOC students had forgotten about 28% of the total content and gamification students had forgotten about 23%.

DISCUSSION AND CONCLUSION

The results indicate that both MOOC and gamification hybrid learning models were efficient for most of the study's sample groups, improving all aspects of the learning process. The results corresponded with findings from previous research by Sanchez-Gordon and Luján-Mora (2017) and Hood et al. (2015), both of which reported that students who were taught using a MOOC model benefited in terms of learning effectiveness. Furthermore, these results also align with those observed by Seixasa et al. (2016) and Butler (2014), both of which revealed that gamification models improve learning outcomes and motivate students to devote time and effort to achieving tasks.

Regarding course content, MOOCs and gamification demonstrated the greatest efficiency when utilized in conjunction with motivation for students of all achievement levels, with the MOOC group producing a more substantial increase in performance. Regarding knowledge retention, both MOOCs and gamification significantly increased retention rates when utilized either alone or in conjunction with motivation for students of all achievement levels. After one week, students had forgotten approximately 15% of all content. To counter this problem, teachers should review material in warm-up sessions to refresh students' memories before each new class begins. Additionally, teachers should integrate focus groups into their teaching model, with the findings demonstrating the efficiency of the approach in the context of both elearning alone and elearning combined with motivation for students of all achievement levels. Notably, Brown et al. (2019), Simkins and Maier (2010), and Sokoloff and Thornton (1997) have demonstrated that a JiTT approach can enable instructors to identify missing material and compensate for its absence. Furthermore, this study's findings indicate that discussion and group activities demonstrably impact learning, with these two social elements persuading students to share their knowledge and ideas with their classmates. This aligns with the findings of Everly (2013) and Zhang et al. (2016), both of which reported that collaboration and social interaction provide positive learning outcomes. Discussion and group activities support an in-depth understanding of learning material, with students performing better if they are able to share with a group and discuss problems together.

Ultimately, while the study demonstrated that MOOCs and gamification hybrid learning models are important learning models and useful educational tools that improve learning processes and increase learning ability, such models are quite complex for instructors. This study's experiments demanded substantial effort from teachers to follow the model structure. This suggests that teachers need more time to understand all of the tools and processes. Moreover, a lack of equipment and infrastructure substantially inhibit this model's application, requiring computers and high-speed internet access. According to Wongwuttiwat et al. (2020), Ngampornchai and Adams (2016), and Sondergaard (2015), each of which considered Thai elearning readiness in rural public secondary schools, rural Thai schools are limited in their capacity to consistently access high-speed internet. They also lack appropriate devices, especially outside of school. However, although only 70.6% of rural schools feature proper infrastructure and devices, most urban Thai schools are ready for elearning.

The COVID-19 pandemic has shut most schools worldwide. More than 1.2 billion students have been affected by school closures. Over 100 million students are out of the classroom and will fall below the proficiency level (UNESCO, 2020). That has dramatically changed the education sector. To support and mobilize learning continuity, online learning is an effective educational tool for improving student abilities and learning retention. MOOC and gamification hybrid learning models should be considered as part of elearning design guidelines, and instructors should modify the features of the model according to the requirements of their classes, utilizing the effective features of the models––focus groups, group discussions, and group activities––to help students reach an in-depth understanding of the course content by enabling them to share diverse perspectives and improve their communication skills. Additionally, MOOCs and gamification can be integrated with other active learning methods, such as station rotation, lab rotation, and individual rotation, to create new models that are suitable and meet the diverse needs of each area. These models will allow teachers to analyze student abilities and identify key attributes and factors that significantly affect learning ability, learning retention, and processes. Thus, MOOC and gamification hybrid learning models ultimately represent a possibility for improving student learning and potentially solving rural education problems.

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