Research Article

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The Application of Quizizz with Flipped Classroom Teaching Method in Large Pharmacology Class

Thidarat Phetmanee[1,*] and Nalinee Pradubyat[1]

[1]Department of Pharmacology, College of Pharmacy, Rangsit University, Muang, Pathum Thani 12000, Thailand

*Corresponding author: E-mail: thidarat.w@rsu.ac.th

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Abstract: Pharmacology is a fundamental course in the pharmacy curriculum. In the course, students are expected to apply the principles of pharmacodynamics and pharmacokinetics, along with understanding the concepts of drug interactions and adverse drug reactions for later topics in the course. Every year, a significant number of third-year students enroll, making the teaching environment challenging due to its size and limiting student-instructor interactions. To address this, we integrated the gamification tool, Quizizz, with the flipped classroom approach to enhance student engagement. Our study aimed to gauge student satisfaction with this hybrid method. In this study, we focused on topics including the principles of pharmacology and pharmacogenomics, pharmacodynamics, pharmacokinetic processes, and concepts of drug interactions and adverse reactions over two four-hour classes. The teaching method employed the combination of Quizizz and the flipped classroom approach. In each session, the researchers introduced the topic based on pre-class materials. Students answered questions from assigned exercises using Quizizz. The online questionnaire collected general information, gauged student satisfaction with the integration of Quizizz and the flipped classroom method and sought suggestions from the participants. Data was collected from 148 students in post-classroom session. Overall, students reported high satisfaction levels, though some found the session duration lengthy. The use of Quizizz was particularly well-received, and students appreciated the teaching content. Notably, students from diverse educational backgrounds expressed similar satisfaction levels, suggesting the method's broad applicability. In conclusion, our study underscores the effectiveness of combining Quizizz with the flipped classroom model, especially in large classroom settings.

Keywords: Flipped classroom, Large classroom, Gamification tool, Quizizz, Student satisfaction, Pharmacology

INTRODUCTION

Pharmacology serves as a fundamental subject in the pharmacy curriculum. It elucidates about how drugs work on the body, termed as pharmacodynamics, and how the body reacts to drugs, referred to as pharmacokinetics. As the prerequisite to study advanced topics in pharmacy, students must first study this fundamental knowledge. Understanding the principles of pharmacodynamics and pharmacokinetics, alongside the concepts of drug interactions and adverse drug reactions, is paramount. Students should apply this knowledge to subsequent topics that discuss the effects of drugs on various physiological systems. Therefore, the desired outcome of these lessons is to equip students to apply this knowledge to subsequent topics in the

pharmacology course. The teaching approaches should be tailored to instruct students on how to apply this knowledge effectively.

The flipped classroom method is a dynamic approach to active learning, integrating both asynchronous and synchronous styles. In the asynchronous phase, students engage in self-directed learning using provided materials before class. Subsequently, in-class interaction, with the instructor characterize synchronous learning (1-3). This method stands on four pillars: a flexible learning environment, a student-centered approach, content curated with intent by the instructor, and a professional educator who offers real-time feedback. The process unfolds in three stages: pre-class individual instruction, interactive classroom activities emphasizing content application, and feedback-driven evaluations (4). This approach not only motivates learners from within but also fosters skills beyond mere memorization, like analysis and application. The flipped classroom enhances deep understanding, helping students connect new information with what they already know (5). However, it demands instructors to adapt and learn new techniques, especially in leveraging digital tools for today's tech-savvy learners. While promising, the method does come with challenges, including the time commitment for both educators and students (5).

Education in expansive classroom settings introduces unique pedagogical challenges. The vastness of such environments complicates the teaching-learning dynamic. This complexity arises from catering to a diverse group of students, each with their own knowledge base, skills, and learning styles. Moreover, the expansive setting often results in limited interaction between educators and students (6).

The advent of gamification has ushered in innovative strategies to augment student engagement and retention in classroom activities. With the rise of digital tools has yielded a plethora of online resources designed to foster a positive learning environment and enhance student outcomes. These tools often provide instant feedback, aiding students in their learning journey (7). Gamification provides a safe space for students to make mistakes and take risks, without facing the severe repercussions they would encounter for similar actions in a professional setting (6, 8). Quizizz, developed by Quizizz Inc., is a prominent tool in the educational gamification landscape. Quizizz is generally considered to be technically reliable, with a user-friendly interface and minimal reported technical issues. Quizizz protects student educational records in accordance with U.S. regulations, specifically the Children's Online Privacy Protection Act (COPPA) and the Family Educational Rights and Privacy Act (FERPA) (9). Several studies have indicated that the application effectively captures the attention of learners. (10, 11). Post-response to Quizizz, students receive immediate feedback and can view their performance on a competitive leaderboard. These gamified elements inspire a sense of competition, pushing students to continually improve (12).

In the College of Pharmacy at Rangsit University, the PHA 351 Pharmacology of Pharmacy course is a core component of the pharmacy curriculum. Every year, around 160-180 students in their third year of the professional program enroll in this course. The researcher takes on the task of teaching the foundational module, delving into principles of pharmacodynamics and pharmacokinetics, as well as the concept of drug interactions and adverse reactions. However, the large number of students results in the teaching environment complications, leading to limited interaction between the instructor and students. While the flipped classroom methodology aligns well with the intended learning outcomes for this subject, the researchers contend additional techniques are necessary to address the challenges posed by such a large class size. The aim of this study was to design a teaching approach that merges the flipped classroom method with Quizizz, specifically crafted for large-scale pharmacology classes. Additionally, we sought to gauge student satisfaction with this combined teaching method.

METHODS

Study Design and Setting

This research was conducted in August 2023 and used a quantitative descriptive design. The precipitants were pharmacy students who registered PHA 351 Pharmacology for Pharmacy I, the first semester of academic year 2023, College of Pharmacy, Rangsit University. The study protocol has been approved by the ethics committee of the RSU Ethics Review Board (RSU-ERB) of Rangsit University, Thailand (reference DPE. No. RSUERB2023-010).

Subjects

Out of the participants, 163 students fit the inclusion criteria. We determined the sample size using Taro Yamane's formula, aiming for a 95% confidence level. These students were in their third year of the professional program.

Intervention

For the course's initial module, the researchers designed a lesson plan based on the ADDIE model. This module encompasses topics like the principles of pharmacology and pharmacogenomics, pharmacodynamics, pharmacokinetic processes, and the concepts of drug interactions and adverse reactions. These subjects were spread over two four-hour class sessions.

For pre-class instruction, students were tasked with a week of self-study using teaching materials. They had the choice of engaging with pre-recorded interactive videos via Edpuzzle or delving into reading materials, depending on their preference. These materials focused on foundational knowledge that would be crucial for in-class activities. The students could study depending on their own pace and on their own schedule. Additionally, the students also were notified of lesson plans and in-class activities.

For the in-class session, the content was organized into four segments including session 1 (Principle of Pharmacology and Pharmacogenomics); session 2 (Pharmacodynamics); session 3 (Pharmacokinetic Processes and Parameters); and session 4 (Concept of drug interactions and adverse drug reactions). In each session, the researchers provided a brief overview of the topic and then assigned the exercise and the questions of case studies based on the pre-class materials. Students were allowed to use their materials while answering questions. Then they participated Quizizz to answer the questions. The researchers could instantly view their answers, provide corrections, and offer immediate feedback. Each session concluded with the researchers summarizing the key concepts covered. Each session was structured into 2 - 3 segments, with each segment lasting approximately 30 - 45 minutes. During each activity segment, students comprehended the questions and attempted to answer them. Subsequently, they participated in Quizizz to provide their responses. The researcher also scheduled short breaks every hour, lasting between 5-10 minutes.

Data Collection and Analysis

We utilized an online questionnaire for our research. Ensuring anonymity and confidentiality, this survey was divided into three main sections. The first gathered general information through two questions. The second, with 20 questions on a 5-point Likert scale, gauged satisfaction levels with the combined use of Quizizz and the flipped classroom approach. This section consisted of three sub-topics: the teaching process, the use of Quizizz in the teaching method, and the teaching content. It also included an overarching question about overall satisfaction. The third section welcomed open-ended suggestions from students. Responses on the Likert scale ranged from 'very dissatisfied' (1) to 'very satisfied' (5). Average scores from each question helped gauge students' overall perception of the combined teaching method. The scores of satisfaction with the teaching process were divided into dissatisfied (less than 24), neutral (24-31), and satisfied (more than 31). For satisfaction with using Quizizz in the teaching method, the scores were divided into dissatisfied (less than 21), neutral (21-27), and satisfied (more than 27). For

satisfaction with teaching content, the scores were divided into dissatisfied (less than 12), neutral (12-15), and satisfied (more than 15). Data were analyzed using descriptive analysis, displayed in mean, standard deviation, and percentage.

Before the questionnaire was distributed to students, it was reviewed by experts from the learning field to evaluate the validity using the Index of Item Objective Congruence (IOC). The values of IOC from the experts' evaluation ranged between 0.67 - 1.00 which were in accordance with the acceptable criterion. Furthermore, the reliability was also tested in a pilot study that was conducted among 30 pharmacy students who attended pharmacology classes in the academic year 2022. The Cronbach's alpha coefficient was 0.97 which indicated that the instrument was reliable and could be used for data collection.

RESULTS

General Information

We gathered data from 148 students, exceeding the sample size determined by Taro Yamane's formula at a 95% confidence level. Details about the students' general information are presented in Table 1.

Table 1. General information of students (n = 148)

General information	Number (Percentage)
Admission Year	
2018	1 (0.68)
2019	12 (8.11)
2020	39 (26.35)
2021	96 (64.86)
Major	
Industrial Pharmacy	73 (49.32)
Pharmaceutical Care	75 (50.68)
Total	148 (100)

Satisfaction with the Teaching Process

Table 2 displays the results concerning satisfaction with the teaching process. Overall, students expressed contentment with how the course was conducted. They particularly appreciated the opportunity to ask questions and voice their opinions, as reflected in the highest average score of 4.73. This indicates a strong desire among students for interactive sessions and for their feedback to be heard. The lowest mean value (4.11) was for the overall duration of teaching of all sessions. Given that the course was structured into two four-hour sessions in just one day, students might have felt drained from the extended learning period. Even though the researcher scheduled short breaks every hour, the overall duration could still be taxing.

Table 2. Student responses to satisfaction with the teaching process

Survey Items	Mean	SD
Clarification of the teaching method before studying	4.58	0.63
Clarity of the objectives of the lesson	4.68	0.51
Introductory activity before the lesson (using mentimeter)	4.69	0.56
Overall duration for teaching of all sessions	4.11	1.07
Duration for teaching of each session	4.32	0.90
Providing opportunities for students to ask questions, express opinions, and listening to feedback from students	4.73	0.46
Summarizing the lesson	4.70	0.54
Methods of assessment	4.69	0.58

Satisfaction with the Use of Quizizz in the Teaching Method

Table 3 presents the students' satisfaction levels regarding the use of Quizizz in the teaching method. Overall, students expressed strong satisfaction, with scores ranging between 4.72 and 4.78. The standout score of 4.78 highlighted Quizizz's effectiveness in motivating student participation. This suggests that Quizizz

significantly boosts student engagement and responsiveness during classroom activities.

Table 3. Student responses to satisfaction with the use of Quizizz in the teaching method

Survey Items	Mean	SD
Creating an engaging classroom environment	4.77	0.48
Motivating students to participate in teaching and learning	4.78	0.45
Helping students to understand the lesson better	4.72	0.52
How to use an application (easy and not complicated)	4.74	0.51
Knowing the results immediately after answering a question during a lesson	4.75	0.48
Teacher-student interaction	4.77	0.47
Receiving feedback from the teacher after answering a question	4.74	0.51

Satisfaction with the Teaching Content

Table 4 outlines the students' satisfaction regarding the teaching content, with scores indicating strong contentment, ranging between 4.66 and 4.68. The peak score of 4.68 emphasized the alignment of the content with its objectives, the clarity of both visual and textual communication, and the relevance of session-specific case studies and questions. This suggests that the course material was not only in sync with the lesson's goals but was also presented in a manner that facilitated comprehension. Notably, the lesson's questions played a pivotal role in aiding students to grasp the content and apply their knowledge to case studies.

Table 4. Student responses to satisfaction with the teaching content

Survey Items	Mean	SD
Alignment of the content with its objectives	4.68	0.53
Clarity of both visual and textual communication	4.68	0.53
Linking the content to other related academic knowledge, such as physiology and pathology	4.66	0.57
Case studies and questions of each session	4.68	0.55

Overall Satisfaction

Table 5 shows the proportion of students expressing satisfaction with the integration of Quizizz and the flipped classroom approach. A significant majority expressed contentment across all facets, be it the teaching process, the use of Quizizz in the teaching method, and the teaching content. In particular, 95.95% of students were satisfied with Quizizz in classroom activities. Further, Figure 1 reveals that 69% (or 103 students) were very satisfied with this combined teaching method, reflecting an average satisfaction score of 4.65±0.57.

Table 5. The percentage of students who responded to the satisfaction with the combined use of Quizizz and the flipped classroom approach.

	Satisfaction with the teaching process		Satisfaction with the use of Quizizz in the teaching method		Satisfaction with the teaching content	
	n	%	n	%	n	%
Dissatisfied	1	0.68	1	0.68	0	0.00
Neutral	19	12.84	5	3.38	8	5.41
Satisfied	128	86.49	142	95.95	140	94.59
Total	148	100	148	100	148	100

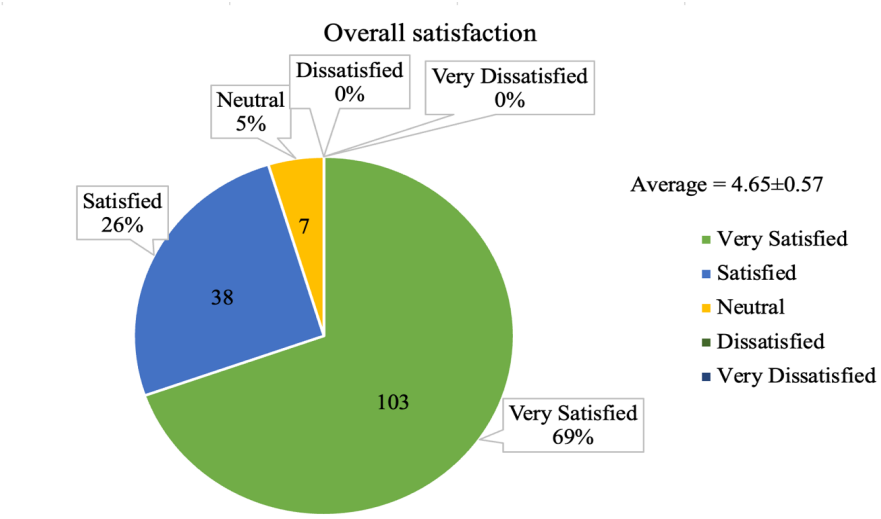

Figure 1. The percentage of students who responded to the overall satisfaction of classroom activities.

Subgroup Analysis of Overall Satisfaction

On-Track Students and Delayed Students

Table 6 displays the overall satisfaction levels of both on-track and delayed students. A significant majority from both groups expressed high satisfaction with the classroom activities, indicating that the contentment levels between the two groups are remarkably similar.

Table 6. The percentage of students who response to the overall satisfaction of classroom activities according to status: on-track students and delayed students

	On-track students		Delayed students	
	n	%	n	%
Very Dissatisfied	0	0.00	0	0.00
Dissatisfied	0	0.00	0	0.00
Neutral	4	4.17	3	5.77
Satisfied	26	27.08	12	23.08
Very Satisfied	66	68.75	37	71.15
Total	96	100	52	100

Industrial Pharmacy and Pharmaceutical Care

Table 7 shows the overall satisfaction levels among industrial pharmacy and pharmaceutical care students. A notable majority from both majors expressed strong satisfaction with the classroom activities, indicating that the two groups share similar levels of contentment.

Table 7. The percentage of students who response to the overall satisfaction of classroom activities according to major: industrial pharmacy and pharmaceutical care

	Industrial Pharmacy		Pharmaceutical Care	
	n	%	n	%
Very Dissatisfied	0	0.00	0	0.00
Dissatisfied	0	0.00	0	0.00
Neutral	3	4.11	4	5.33
Satisfied	17	23.29	21	28.00
Very Satisfied	53	72.60	50	66.67
Total	73	100	75	100

Table 8. The example of written student comments

Positive	Negative
I like this teaching style, teacher. There are also review clips available.	The class was a bit long.
I like this way of learning. It is so much fun.	The duration and the amount of teaching content were too much, making it impossible to fully focus on the lesson.
I like it! It is fun and not boring. I did not even realize I have been studying all day.	The duration of the study takes up the whole day.
I really like the teaching method used today. It made me think more and improved my memorization compared to just passively listening.	Today's class was long. By the afternoon, I couldn't really grasp the lessons anymore.
Even though it was a long session, it was the most fun I have had since I started attending classes.	
This teaching method is fun and very beneficial, but the content is a lot.	

Feedback from Students

Student feedback was compiled, with the majority being positive as detailed in Table 8. However, some students did express concerns, particularly about the extended duration of the sessions.

DISCUSSION

We designed a learning method by integrating Quizizz into the flipped classroom approach to address challenges prevalent in expansive classrooms. We emphasized content deemed foundational for ensuing course topics. For pre-class preparations, we provided both interactive videos and textual materials, enabling students to opt for their favored learning modality. A significant majority students garnered a lucid comprehension of this pedagogical approach a week ahead, affording them sufficient lead time for preliminary studies. On the designed class day, the initial session commence with the elucidation of objectives, followed by the utilization of Mentimeter for an introductory activity, aimed at elevating student engagement. While the predominant sentiment ranged from high to very high satisfaction with the comprehensive teaching process, the length of the sessions garnered a less favorable response. Due to scheduling constraints, these topics were condensed into a single day, leading to moderate satisfaction levels regarding the learning duration. We aim to rectify this in the upcoming academic year.

The results highlight that Quizizz significantly boosts student engagement in the classroom, fostering a positive learning environment. It facilitates seamless and comprehensive interactions between teachers and students. Not only does the application captivate learners' attention during activities, but it also enhances the benefits of the flipped classroom approach compared to traditional methods. Modern educational trends are gravitating towards the use of digital technology, catering especially to the needs of digital-native learners (5). It's noteworthy that students faced no challenges using Quizizz, with most expressing high to very high satisfaction levels.

In larger classrooms, the environment's complexity is often shaped by the diverse attributes of its students. This diversity, stemming from differences in knowledge, skills, and learning styles, becomes more pronounced with increased class sizes (6, 13). In our study, this was evident as students displayed a range of educational backgrounds, resulting in varied learning behaviors. We had both on-track students and delayed students. Delay students are the students who not progressing through their academic

program within the standard timeframe. The teaching approach from this study resonated with both student groups, with both showcasing similar satisfaction levels, predominantly ranging from high to very high. All students were able to effectively engage with and comprehend the lessons. This was consistent even among students from different majors, suggesting that our approach caters to a wide spectrum of educational backgrounds and learning styles. Our study's findings align with previous research suggesting that gamification is an effective teaching approach for large classrooms, especially when faced with the complexities arising from students' varied educational backgrounds (6).

In the flipped classroom paradigm, content selection is pivotal. Instructors need to tailor it to match the learning level and desired learning outcomes, ensuring it connects with prior knowledge to help students relate more easily (5). In this study, we selectively organized the content, focusing only on essential knowledge that would be applicable to subsequent course topics. This is because these sessions form the foundation for every topic in the course. Emphasizing case studies and questions is crucial, as they enable learners to understand and apply the knowledge they've acquired.

In summary, this study demonstrates that integrating Quizizz into the flipped classroom approach is effective for large classrooms. The use of Quizizz significantly boosts student engagement, fostering better collaboration during classroom activities. Additionally, it allows instructors to provide comprehensive feedback, enhancing the students' learning experience. This creates a positive learning environment, which is crucial for promoting effective learning.

This research has its limitations. The course involves multiple instructors, and the teaching method introduced could not be implemented across all topics. Furthermore, we did not formally assess the student's ability to apply the knowledge in subsequent topics.

CONCLUSION

The results suggest that integrating Quizizz with the flipped classroom teaching approach is beneficial for large classes. A majority of students expressed high to very high satisfaction with this method. Moreover, it proved suitable for students with varied educational backgrounds and learning styles.

CONFLICTS OF INTEREST

None

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