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STUDENTS' ACHIEVEMENT IN A FLIPPED DATABASE MANAGEMENT COURSE: THE IMPACT OF FLOW THEORY GAMIFICATION ELEMENTS

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ABSTRACT

Aim/Purpose The study aimed to investigate the effect of using the gamified flipped classroom instructional method on the students' overall achievement compared to the traditional non-gamified, non-gamified flipped classroom, and traditional gamified instructional methods.

Background Flipped classroom is helpful to address limited class time, implement different pedagogies, and help students better attain their learning outcomes and improve their academic achievement. Motivating and encouraging students to perform or complete flipped learning activities is a challenging issue affecting the success of the flipped classroom. This research posits that gamification presents a promising solution, and adding gamification to the flipped classroom is important for its success. However, little is known about the effects of integrating gamification into flipped learning without sufficient results to generalize. Pedagogical designs with appropriate theoretical foundations should be added to the literature on flipped learning and gamification. This research proposes a learning model that combines gamification within flipped classroom via quizzes online platform with the main flow theory requirements. The purpose of this combination is to motivate and engage learners in flipped classroom activities.

Methodology The data were collected from 101 undergraduate students in a database management course at Al al-Bayt University in Jordan. The students were assigned to four different instructional methods according to their preferences (traditional non-gamified, non-gamified flipped, traditional gamified, and gamified flipped classroom). A study with a quasi-experimental factorial design was carried out using midterm and final exam instruments to assess the students' overall

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achievement. Two-way factorial ANOVA was employed to examine the main effect of the instructional method, student gender, and the interaction effect on students' overall achievement. Bonferroni's multiple comparisons test was carried out to compare and determine which instructional method had the main effect and achieved the best grades among test groups.

Contribution	The current study proposed a gamified flipped learning model guided by the theoretical foundations of flow theory. This study offers a novel contribution to the literature by illustrating the importance of employing gamification in the flipped classroom and how the gamified flipped instructional method affects student achievement, especially when appropriate gamification design and careful game element selection. The effects reported by this study provide empirical evidence and valuable insights for researchers, practitioners, and educators about the issues of gamified flipped classroom and guide instructional designers to apply appropriate game elements.
Findings	The findings showed that the gamified flipped group outperformed the other three groups and significantly improved students' overall achievement with a large effect size. Employing gamification within the flipped classroom instructional method improved 23.9% of the total variance in the students' achievement through increasing their motivation to complete flipped classroom activities. It has also been found that the non-gamified flipped group outperformed both the traditional non-gamified and the traditional gamified groups. Students' gender was also not a significant factor regarding male and female achievement in using gamified flipped classroom.
Recommendations for Practitioners	This study recommends that instructors who utilize flipped classroom should combine other new technologies within in-class activities, such as gamification, instead of traditional discussion in classroom meetings. Thus, the in-class activities become more attractive, increasing their students' motivation.
Recommendations for Researchers	Researchers need to understand the factors enhancing the flipped learning activities and the ways of designing and implementing gamification elements to develop new learning models.
Impact on Society	Gamified flipped learning can help students improve their achievement and help instructors perform in-class instructional activities, leading to more effective and efficient higher education. Appropriate design and use of gamification elements within flipped learning can promote and encourage the use of such a model.
Future Research	Additional research should be conducted to explore and measure students' motivation, engagement, and in-class collaboration due to the gamified flipped classroom instructional model. Further experimental studies on other courses in different environmental variables are also recommended.
Keywords	gamification, flipped classroom, academic performance, database management, gamified quizzes, flow theory

INTRODUCTION

The need for additional time for in-class activities and implementing different pedagogies for students during lectures present challenges, especially for higher education instructors (Sailer & Sailer, 2021). Recent technology-based learning approaches, such as the flipped classroom, address those issues by enabling out-of-class knowledge acquisition instead of in-class. Thereby, teachers can guide and scaffold students' learning processes and provide valuable feedback and face-to-face discussion

in class. The flipped classroom approach has been adopted and used recently in various subject disciplines and has proven useful, especially for saving time, learner-computer interaction, and location dependency (Husain & Al-Shayeb, 2023).

In flipped classroom, the sequence of the learning procedure consists of direct in-class instruction, followed by out-of-class learning activities performed by learners as homework is converted (Lage et al., 2000). Direct instruction moves from group in-class learning to individual out-of-class learning activities. Students do pre-class preparations by watching related videos and reading materials, while the in-class time is dedicated to doing activities and discussing the pre-class topics (Honeycutt & Garrett, 2014). This form of interaction stresses the important role of in-class activities that are essential in flipped learning success (O'Flaherty & Phillips, 2015). Nevertheless, designing in-class flipped classroom sessions that foster motivation and increase the learning activities level of students presents a challenge (Sailer & Sailer, 2021). A successful classroom approach relies on motivating students to complete its activities (Kim et al., 2014). Yang (2017) argues that the flipped learning strategy is helpful for motivated students, who are likely able to achieve more with flipped learning (Chuang et al., 2018). Thus, motivating and encouraging students to perform and complete flipped learning activities is critical to flipped classroom helpfulness. Indeed, when students are not engaged in flipped learning activities, they are hindered from acquiring helpful learning. The link between employing gamification and enhancing the flipped learning quality must be investigated and established, allowing the problem to be resolved and the flipped learning quality to be improved.

A growing body of literature reports on the educational benefits of gamification and shows that integrating gamification into learning activities helps maintain the motivation of students (Alajaji & Alshwiah, 2021; Kabilan et al., 2023). In this concept, it is believed that the appropriate employment of gamification contributes significantly to flipped learning and helps address motivation and achievement issues (Ramírez-Donoso et al., 2023). New technology-based approaches, such as flipped classroom and gamification, present a promising solution to improve learning and teaching (Sánchez et al., 2020). Thus, such a combination can be beneficial and useful (Ekici, 2021).

However, little is known about the effects of integrating gamification into flipped learning (Parra-González et al., 2021; Sulong et al., 2021). Varied results regarding the effects of such a combination have been found, but there are no sufficient results to generalize (Ekici, 2021). Further studies under different environmental variables are needed to explore how to design and implement gamified flipped learning and to investigate the gamification effect on flipped classroom. Pedagogical designs with appropriate theoretical foundations should be added to the literature on flipped learning and gamification. For higher education, the issue relies on designing in-class activities that best support all students in large classroom settings.

The current study addresses such gaps in research and builds upon previous research and flow theory. The learners' academic achievement will ultimately be improved when adding the flow theory requirements as gamification elements that best support learners' engagement in the flipped classroom. A gamified flipped learning model using gamified quizzes within database management flipped classroom lectures is introduced and empirically investigated. To examine and compare the effects of flipped learning with gamification on students' achievement, the course was offered using four instructional approaches: traditional non-gamified, non-gamified flipped classroom, traditional gamified, and gamified flipped classroom.

AIM OF THE STUDY

Database management is an advanced course for senior students requiring additional effort to understand and attain complex learning outcomes. It is noted from a previous study that flipping such a course helps improve students' achievement (Husain & Al-Shayeb, 2023). However, students' achievement can be further improved since they are less engaged with the flipped learning activities and reluctant to complete and watch the recorded materials due to time and effort limitations during

that study period. They are hindered from acquiring helpful learning when comparing their actual performance to the expected performance represented by their average grades and class accuracy. Students usually have lower motivation levels in this kind of educational method because it requires them to exert more effort and afford more responsibility compared to traditional teaching methods, decreasing the learning outcomes (Smith et al., 2022).

The problem addressed in this study was initiated by the need to motivate undergraduate students to complete flipped database management classroom activities and encourage them to watch the recorded materials to improve their achievement (Husain & Al-Shayeb, 2023). It is well known that less motivated and less engaged students in the flipped course activities will mainly prevent the success of such a learning strategy (Hao & Lee, 2016; Kim et al., 2014). Senior students may find the video lectures less engaging and need help maintaining their attention (Burke & Fedorek, 2017; Jensen, 2011). Potential reasons behind that may be due to the extra workload, crowded timetables, stress accompanying their final year project, and graduation issues. Database management students require supplementary efforts to be motivated within flipped course activities to help attain flipped learning benefits and improve their academic achievement (Husain & Al-Shayeb, 2023). Students with higher motivation will likely achieve more with flipped learning (Chuang et al., 2018). Consequently, gamification focuses on motivating learners and ensuring their engagement with learning activities (Marczewski, 2015; Simões et al., 2013). Therefore, the current study proposed using gamification to provide a solution that best motivates and engages learners in flipped learning activities. Indeed, the study aims to improve students' achievement in flipped learning by adding gamification and taking advantage of its elements. The effect of the gamified flipped classroom instructional method has been investigated and compared to the traditional non-gamified, non-gamified flipped classroom, and traditional gamified instructional methods on the student's overall achievement in the database management course. The study seeks to answer the following questions:

- Does the gamified flipped classroom instructional method have a significant main effect on the students' overall achievement in the database management course?
- Does the students' gender have a significant main effect on the students' overall achievement in the database management course?
- Is there any significant interaction effect between the instructional method and the students' gender on the students' overall achievement in the database management course?

THEORETICAL BACKGROUND

FLOW THEORY

Flow theory, introduced by Mihaly Csikszentmihalyi, is commonly used to explain people's motivation needs (Csikszentmihalyi, 1975, 1978). Flow is "an optimal experience in which people reach the state of full absorption and concentration" (Chan et al., 2019). According to flow theory, the main three characteristics or components for reaching flow experience are goal clarity, immediate feedback, and balanced challenges with skills, which were positively associated with learning outcomes (Jackson & Csikszentmihalyi, 1999; Rossin et al., 2009). Gamification is the easiest strategy to attain the above flow components compared to other applicable learning activities (Chan et al., 2019). Indeed, gamification can be designed to support flow experience by adjusting the challenges according to a suitable level of skills (Csikszentmihalyi, 1975). Several studies were performed to evaluate the effects of flow experience on students learning and proved their correlation and positive effects. The result demonstrated that students can entirely focus on the learning process and perform better when a flow experience occurs (Admiraal et al., 2011; Rossin et al., 2009). Therefore, it is expected that learners who possess flow experience can achieve better learning experiences and outcomes. Thus, matching the flow characteristics with the gamified learning content is imperative. Behind gamification, some psychological theories support game elements, such as the flow theory (Buchanan & Csikszentmihalyi, 1991). Flow theory is one of those theories in gamification research (Zainuddin et

al., 2020). Flow requirements are essential for designing a gamified environment and are strongly related to motivation and engagement, which are important issues in flipped learning (Buchanan & Csikszentmihalyi, 1991; Matallaoui et al., 2017). Designing a gamification application under flow theory that requires design and clear goals implementation, immediate feedback, and a suitable level of skills and challenges is necessary for achieving learners' motivation and engagement for flipped classroom activities (Huang & Hew, 2018).

GAMIFIED FLIPPED CLASSROOM

Gamification, as a pedagogical concept, is the process of integrating game-based elements or game mechanics into learning to motivate students' participation, engagement, and loyalty (Zainuddin et al., 2019). Game-based elements or game mechanics such as points, badges, or leaderboards are employed within a learning model to motivate and engage the students, encouraging them to take action to enhance their interest and motivation through collaboration and fun competition with peers (Buckley & Doyle, 2017; Groening & Binnewies, 2019; Lo & Hew, 2020). Examples of game-based elements or game mechanics commonly used with brief definitions are presented in Table 1. It is important to distinguish gamification from computer games in education (Squire, 2003). Computer games in education represent the use of commercial games as learning tools. However, as a pedagogical concept, gamification involves integrating design game elements or mechanics into learning contexts and does not necessarily involve using an actual game. The term gamified flipped classroom or gamified flipped instructional method refers to the combination of the gamification concept and flipped classroom instruction for learning.

Table 1. Common elements of gamification (Buckley & Doyle, 2017)

Title	Definition
Achievement	A specific, defined objective within the game
Avatars	A visual representation of a player's character
Badges	A visual representation of achievement
Collection	A group of related badges
Content unlocking	The provision of new content upon reaching a goal
Gifting	The provision of aid for other players
Leaderboards	Allow the direct comparison of players' expertise.
Level	Difficulty moderated based on player expertise.
Points	Numeric record of players' performance to date
Social graph	Social networks are enabled with gamified activity.

Prior research has shown that playing games can increase the release of chemicals such as norepinephrine, epinephrine, and dopamine in the brain, which helps more open-mindedness and receptivity to learning (Guitierrez, 2012; Rackwitz, 2012). Deploying gamification in education can strengthen the students' creativity and stimulate their motivation to perform learning activities (Ahsan et al., 2023). That is perhaps because IT educators have sufficient technical skills to make deploying such technological approaches in their courses easy, as indicated by Dicheva et al. (2015). Several research studies showed that deploying gamification approaches in teaching can improve students' motivation, engagement, collaboration, and achievement (Dicheva et al., 2015; Smith et al., 2022).

Meanwhile, the flipped classroom instructional method has received much attention as an alternative to the traditional teaching approach. Several studies have shown that deploying flipped classroom in

higher education is helpful for students and leads to improving learning outcomes (Bishop & Verleger, 2013; Honeycutt & Garrett, 2014; Talan & Gulsecen, 2019). However, from the experience of educators and as indicated in some research studies (Smith et al., 2022), students usually have lower motivation levels in this kind of educational method because it requires them to exert more effort and afford more responsibility as compared to traditional teaching methods which lead to decreasing the learning outcomes.

To tackle this shortcoming, many educators incorporated gamification approaches into flipped classroom arrangements to increase the student's engagement and motivation when doing in-class activities (Dichev & Dicheva, 2017). The driving force for combining these two approaches is that the researchers investigated the effect of flipped and gamified methods on learning outcomes. Several studies concluded that combining these two approaches significantly improved the achievement of learners (Parra-González et al., 2020, 2021).

Many researchers utilized the combined approach by investigating the effect of applying flipped classroom with gamification in higher education, especially for motivating students and improving their achievement, and concluded positive results. For instance, Aşıksoy (2018) compared two groups taking an undergraduate physics class. The experimental group was taught using a gamified flipped classroom arrangement, whereas a flipped classroom without gamification was used in the control group. Ho (2020) Performed an experimental study to compare the motivation and engagement of Chinese ESL learners in a flipped classroom with a traditional classroom using a sketchpad platform. Sailer and Sailer (2021) used video links and Quizalize to investigate the effect of gamified in-class activities compared to non-gamified in-class activities using exercise sheets. Zainuddin et al. (2019) assessed students' learning performance between a gamified flipped classroom and flipped classroom instruction using iSpring. Asiksoy and Canbolat (2021) proposed a gamified flipped classroom environment to tackle the issue of the lack of student participation in online activities in flipped-classroom learning systems. Gündüz and Akkoyunlu (2020) conducted an exploratory sequential study to examine and determine the effect of gamified flipped learning on the student interaction, participation, and achievement of participants. The effect of employing points, badges, levels, experience points, and leaderboard game elements in flipped principles and methods course learning activities was investigated by Yildirim (2017). However, the findings obtained by these studies revealed that gamified flipped classroom learning positively affects students by increasing their motivation and improving their learning performance, outcomes, and achievement. Furthermore, the findings obtained by Aşıksoy (2018) and Yildirim (2017) showed that the students' attitudes towards the lessons of the gamified flipped courses were positive.

Sanchez et al. (2020) conducted an experimental study for university students to examine the effects of gamified flipped learning against the isolated use of flipped learning on students' motivation and interaction. PeerWise tool has been used to implement the gamified approach in the study, and the results revealed that the gamified flipped classroom enhances student-teacher interaction and student-student interaction. Ahmed and Asiksoy (2021) conducted an experimental study using a true-experimental design to investigate the effects of the gamified flipped learning method on the self-efficacy and innovation skills of first-year engineering students in a physics lab. The experimental group was taught using the gamified flipped learning method, whereas the traditional flipped learning method was used with the control group. The findings showed that the gamified flipped learning method improved the student skills and positive perception of gamification.

Although many empirical studies have demonstrated the effectiveness of gamified flipped classroom in education, some contradictory results have been obtained. For example, Durrani (2019) conducted a study using the Kahoot Online Gamified Platform to compare gamified flipped classroom with traditional classroom regarding students' attitudes, engagement, and academic performance. The results showed that learning outcomes achieved through the traditional classroom model were better than those achieved through the pure gamified flipped classroom, suggesting the need to combine innovative and classical teaching tools and techniques for learning. Several studies have identified various

technological and delivery challenges and limitations faced by students and teachers, including selecting suitable game elements, the instructional design of the intended course, and technical issues (Zainuddin et al., 2020). Initially, researchers have suggested that gamified flipped classrooms' success depends mainly on the efficient selection of game elements that promote meaningful learning and align with specific learning goals and instructional content (Putz et al., 2020). Indeed, simply using game elements may not guarantee efficiency, and selecting elements with appropriate design is challenging (Kyewski & Krämer, 2018). Additionally, some researchers have raised concerns about over-including gamified elements, which may create a trend toward game addiction and become detrimental to student learning (Zainuddin et al., 2020). Meanwhile, others, such as Hung (2018), argue that not all courses and their contents can be transformed into gamified content; students need to acquire knowledge through conventional teaching methods.

By reviewing gamified flipped learning studies, several research gaps can be identified: (a) the number of studies that have been conducted to investigate the effects of combining gamification into flipped classroom is limited, especially within information technology subjects, and without sufficient results to generalize; (b) gamified flipped classroom studies have focused mainly on out-of-class gamification activities during pre or post sessions, compared to fewer studies that have focused on in-class gamification activities; and (c) more comparative studies that extend the understanding of gamified flipped learning in higher education, and for information technology students with longer experimental duration are required.

This study offers a novel contribution to the literature by illustrating the importance of employing gamification in the flipped classroom and how the gamified flipped instructional method affects students' overall achievement, especially with appropriate in-class gamification design and careful element selection. This study extends ongoing studies on combining gamification into flipped classroom and provides notable implications for research and practice. This study employs a gamified flipped learning model via quizzes online platform with the main flow theory requirements for database management students and measures its effect on their overall achievement for one academic semester period.

METHOD

SUBJECTS

The sample consisted of 101 undergraduate students (63.40% males and 36.60% females) enrolled in two sections of a course in database management offered by the College of Information Technology at al-Bayt University in Jordan. A non-random sampling technique was used in this study as the students were assigned to four different groups and instructional methods based on their preferences: a control group (traditional non-gamified) and three experimental groups (non-gamified flipped classroom, traditional gamified, and gamified flipped classroom), as presented in Table 2. The groups are composed of 26, 26, 27, and 22 students, respectively.

Table 2. Study groups

Section	Section 1		Section 2	
Group	Traditional Non-gamified (N=26)	Non-gamified flipped classroom (N=26)	Traditional Gamified (N=27)	Gamified flipped classroom (N=22)
Flipped	No	Yes	No	Yes
Gamified	No	No	Yes	Yes

INSTRUMENTS

Two instruments were used to assess the student's achievement in the course (the midterm and the final exam). The midterm was composed of 20 multiple-choice items and two scenarios in which each one weighs five points. The final exam was composed of 30 multiple-choice items and four scenarios in which each one weighs five points. The items of both tests were selected purposefully from an item bank constructed by the author of the course textbook. The content validity of each test was evaluated by presenting them to two experienced colleagues. The stratified Alpha coefficients for both tests were computed and found to be .880 and .910, respectively.

PROCEDURES

All study groups were taught by the first author in the first semester of the 2022/2023 academic year, as the experiment lasted 14 weeks of instruction duration, every week consisting of three 50-minute instructional sessions. The traditional non-gamified instructional method was used with the control group based on in-class face-to-face lectures and homework assignments, which are delivered on the Moodle platform, followed by correcting the homework and returning it to the students for discussion in the upcoming meeting. The first experimental group was taught using the non-gamified flipped classroom instructional method based on video-recorded lectures, prepared before the face-to-face classroom activities and discussions, and delivered via Moodle platform. The video-recorded materials for each lecture are prepared and recorded by the course instructor using the textbook PDF file, whiteboard tools for marking and drawing, and any other supplementary images and tables from other internet sources. All these sources are used to explain the lecture ideas and learning outcomes with the instructor's voice and recorded using screen recorder software, producing an MP4 video file with 20 to 30-minute length for each lecture covering a specific subject. The video file is edited, pre-processed, enhanced, and uploaded for students with the related PDF file for that subject and the PowerPoint slides material. The LMS course interface is organized as sections according to textbook chapters, with a post for each lecture within each chapter section.

The second experimental group was taught using the traditional gamified instructional method that is mainly based on designing and implementing gamified quizzes using game points and leaderboards to create a game-like environment and provided as an in-class activity in addition to face-to-face traditional in-class lectures. The third experimental group was taught using the gamified flipped instructional method that combines the flipped classroom and gamification by providing students with recorded materials before lectures and implementing gamified quizzes as a regular in-class activity. Table 3 summarizes the used four instructional methods.

Table 3. Instructional Methods

Learning model		In-class	Out of class
Gamified	Flipped		
		Direct instruction: lesson presentation by instructor	Self-study and revision, doing homework
	Flipped	Homework discussion, questions and answers, learning activities	Lesson presentation via recorded materials delivered in Moodle platform
Gamified		Direct instruction: lesson presentation by instructor, Gamified quizzes	Self-study and revision, doing homework
Gamified	Flipped	Homework discussion, question and answers, Gamified quizzes, and learning activities	lesson presentation via recorded materials delivered in the Moodle platform

The flow theory has been utilized in the current study by employing its requirements within the gamified quizzes to achieve an optimal psychological and psychical state that can maximize the enjoyment and engagement of learners. Therefore, the gamification instructional method is mainly based on in-class gamified quizzes that employ points and leaderboards gamification elements that represent clear goals to be achieved by learners and provide a challenging environment with immediate feedback during gamification. During the last lecture of every week, a gamified quiz is performed as an in-class activity in which game points and leaderboard are used to create a game-like environment. Several instructors use quizzes during in-class sessions to engage students in learning activities (Cilli-Turner, 2015). Quizzes are often used as a starting point to implement gamification in teaching and learning settings (Sailer & Sailer, 2021). Thus, we adopted this strategy and designed gamified quizzes for each part of the intended course. Each quiz encompasses the learning outcomes targeted during the lectures of the specified week. The quizzes platform (<https://quizizz.com/>) has been adopted in the current study (Yildirim, 2017; Zamora-Polo et al., 2019), and we selected points and leaderboards game elements to create a gamification scenario. Several gamified quiz platforms such as Kahoot (<https://kahoot.com/>), Quizalize (<https://www.quizalize.com/>), and Quizizz have been increasingly applied in teaching and learning settings with several game elements. In this regard, it is found that leaderboards and points are the most popular elements used in gamified flipped classroom approaches in the educational field (Sánchez et al., 2020). Thus, the gamified quizzes are designed in such a way as to provide task-level feedback via awarding points for the correct answers and allow for competitive and cooperative forms of interaction between learners by implementing team leaderboards.

For each gamified quiz, students were randomly assigned to three teams by the Quizizz platform system with the shuffle option by the instructor. The members of each team are displayed on the main presentation screen in the class, and each student is aware of all teams and their classmates. While answering the quiz, students had to work on the questions on their web-connected mobile individually, and their individual leaderboards based on awarded points were dynamically displayed on the presentation screen, as illustrated in Figure 1. The students' names moved toward the top of the presentation screen, indicating their progress during the quiz. Points are awarded to students based on the correctness, answering speed, and selected power-ups provided by the quizzes for each question. Quizizz offers several power-ups for players to choose from during quizzes, offering additional opportunities to achieve more points. Power-ups are designed to increase students' engagement and participation and are activated when they click the icon for a particular question. For example, the "Supersonic" power-up grants students 1.5x points for 20 seconds when they play at a faster speed. Accordingly, a team leaderboard in the form of a ranking, consisting of the total sum scores of team member students, is also performed and presented in real-time. These points were added to the corresponding team leaderboard, which is continuously shown on the presentation screen, as illustrated in Figure 2. At the end of the quiz session, the winning team with higher total points was announced, and each score of the participants was shown below the corresponding team score. Individual answers are also available, as shown in Figure 3.



Figure 1. Leaderboard for individual students ranked according to their progress.

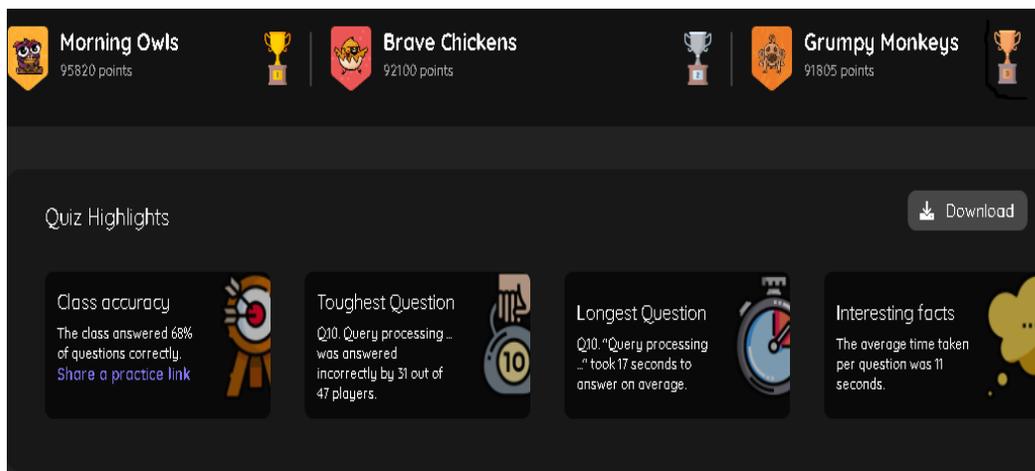


Figure 2. Team leaderboard (3 teams, for instance, namely: Morning Owls, Brave Chickens, and Grumpy Monkeys with their total points and ranking (1, 2, and 3)).

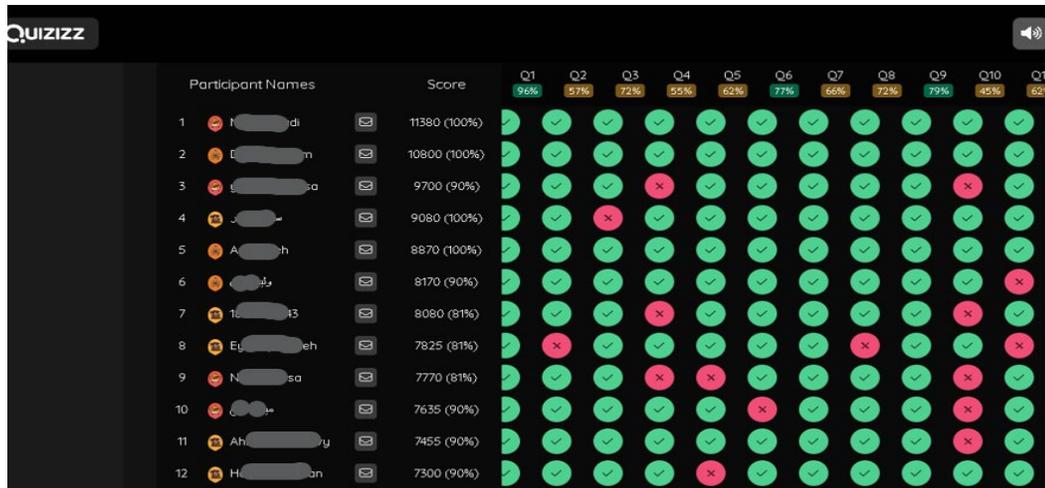


Figure 3. Points per student with detailed answers.

Gamified quizzes were applied weakly as an in-class activity for all attending students using their mobile phones with instant feedback points and team ranking. The students’ overall achievement in the course is evaluated by combining the obtained grades in the midterm, semester works, and final exam. The midterm, semester work, and final exam grades weigh 30, 20, and 50 points, respectively.

EXPERIMENTAL DESIGN

The current study used a 4x2 quasi-experimental factorial design: four levels of instructional method (traditional non-gamified, non-gamified flipped classroom, traditional gamified, and gamified flipped classroom), and student gender. The dependent variable was the overall achievement grade in the database management course.

Mean scores and standard deviations of the student’s overall achievement grades were calculated and presented in Table 4.

Table 4. Cell size (*N*), mean score (*M*), and standard deviation (*SD*) of the overall achievement grades.

Instructional Method	Gender	<i>N</i>	<i>M</i>	<i>SD</i>
Traditional Non-Gamified	Male	19	51.473	12.584
	Female	7	42.428	8.263
	Total	26	49.038	12.130
Non-Gamified Flipped Classroom	Male	17	59.823	12.938
	Female	9	56.111	13.797
	Total	26	58.538	13.088
Traditional Gamified	Male	15	48.2000	12.410
	Female	12	52.333	13.627
	Total	27	50.037	12.879
Gamified Flipped Classroom	Male	13	67.230	13.084
	Female	9	63.222	9.934
	Total	22	65.590	11.810

It has been observed that the mean scores of the overall achievement grades in the gamified flipped classroom group exceeded the mean scores in the other counterpart groups. The results showed that Gamified Flipped Classroom students, the flipped classroom group with gamification activities, achieved the best grades among all groups. This achievement has decreased for Non-Gamified Flipped Classroom students when eliminating gamification activities from the flipped classroom teaching strategy and adopting only traditional in-class activities. The influence has decreased even more for Traditional Gamified students when eliminating the flipped classroom teaching strategy and replacing it with a traditional classroom that uses gamification activities during face-to-face meetings. Finally, the Traditional Non-Gamified group that studied using traditional classroom without gamification activities achieved the worst overall achievement grades. It was also noticed that the males outperformed the females in all groups except the traditional gamified group, as the females outperformed the males.

A two-way factorial ANOVA was performed to examine the effect of the instructional method and gender on the overall achievement grade. The data had no outliers, as assessed by inspection in box-plots. The Shapiro-Wilks test of normality indicated that the data is not normally distributed ($p = .025$). Therefore, data transformation was performed by computing the square root of the raw scores on the dependent variable. The Shapiro-Wilks test indicated that the transformed data is normally distributed ($p = .294$). Levene's test of equality of error variances did not violate the assumption of homogeneity of variances ($p = .947$). Factorial ANOVA results are presented in Table 5.

Table 5. Results of two-way factorial ANOVA to determine the effect of the instructional method and gender on the overall achievement grade.

Source	Type III SS.	DF	MS.	F. Value	Sig.	Partial η^2
Instructional Method	20.036	3	6.679	9.719	.000	.239
Gender	.986	1	.986	1.435	.234	.015
Interaction	2.569	3	.856	1.246	.298	.039
Error	63.908	93	.687			
Total	5591.000	101				

The two-way factorial ANOVA results showed that the instructional method did have a statistically significant main effect on the overall achievement grade ($F(3,93) = 9.719, p = .000$) with a large effect size (Partial $\eta^2 = .239$) according to Cohen's benchmarks (Cohen, 2013), indicating that 23.9% of the total variance in the students' overall achievement was attributed to the instructional method. The instructional method is important for improving the students' overall achievement. This finding suggests that students' overall achievement might be improved based on the instructional method adopted for each study group. On the other hand, no statistically significant gender main effect ($F(1,93) = 1.435, p = .234$) and no interaction effect between the instructional method and student gender ($F(3, 93) = 1.246, p = .298$) was revealed. Indeed, the direct effect and interaction effect for gender is insignificant on student achievement; this result indicates that students' academic performance in all groups is independent of their gender, and the obtained grades are not different among males and females.

Accordingly, Bonferroni's multiple comparisons test was carried out to compare and determine which instructional method had the main effect and achieved the best grades among test groups. Bonferroni's test of the pairwise post hoc comparisons revealed that the instructional method omnibus main effect was due to the difference between the mean score of the gamified flipped classroom method compared to the mean score of the traditional non-gamified method ($p = .000$) and traditional gamified method ($p = .000$) in favor of the gamified flipped classroom method. Furthermore,

the results revealed a significant mean difference between the non-gamified flipped classroom method compared to the traditional non-gamified method ($p = .033$) in favor of the non-gamified flipped classroom method, meaning that gamified flipped was the most influential strategy on the students' achievement and outperformed the other three groups. This result suggests that students who studied using the gamified flipped classroom and were exposed to in-class gamified quizzes were more likely to be motivated to complete flipped activities and watched recorded materials regularly before the class instruction compared to the other students. Therefore, they achieved better grades, which improved their overall achievement. Additionally, the pairwise comparisons revealed that the non-gamified flipped group outperformed both the traditional non-gamified and the traditional gamified groups. This result also indicates that flipped activities are more helpful for students to achieve better grades and improve their achievement compared to traditional instruction, even with gamified activities.

DISCUSSION

The main objective of this study is to investigate the effect of the gamified flipped classroom instructional method on students' overall achievement and compare the result to other related methods. Additionally, it is aimed to determine the main effect and the interaction effect between the students' gender and instructional method on the students' overall achievement.

First, this study has attempted to examine the effect of the gamified flipped classroom instructional method on the student's overall achievement in the database management course compared to the traditional non-gamified, non-gamified flipped classroom, and traditional gamified instructional methods. The results show a significantly positive effect of the gamified flipped classroom instructional method on the students' achievement and outperformed the traditional non-gamified, non-gamified flipped classroom, and traditional gamified methods. This result suggests that students who studied using the gamified flipped classroom and were exposed to in-class gamified quizzes were more likely to be motivated to complete flipped activities and watched recorded materials regularly before the class instruction compared to the other students. Therefore, they achieved better grades, which improved their overall achievement. This finding is in line with the previous studies (Asiksoy & Canbolat, 2021; Aşıksoy, 2018; Gündüz & Akkoyunlu, 2020; Ho, 2020; Sailer & Sailer, 2021; Yildirim, 2017; Zainuddin et al., 2019) in which the use of the gamification in the flipped approach resulted in better learning performance and achievement for the students. The results of the present study confirm that adding gamification into the flipped instructional method plays an important role in motivating the students to complete the flipped activities, particularly watching and revising the recorded materials before class, which ultimately improves their overall achievement.

The high performance of the gamified flipped classroom students could be attributed to the advantages of both the flipped classroom and the gamification. Computerized materials, learning methods, learner-computer interaction, location, and time are flipped classroom advantages (Ahmed & Asiksoy, 2021) that are enhanced with gamification attributes that make students more motivated to study and more interested in revising the recorded materials before the lectures. Using appropriate multimedia in designing quizzes to be attractive, engaging, and enjoyable for students and containing gamification elements and features far outweighs the rigid quizzes or other activities, making learning more challenging and fun. Adding gamification elements into the flipped classroom instructional method may have contributed to improving the performance of students and their achievement in several dimensions; firstly, students are motivated to watch and revise the recorded materials and come to class well-prepared for the lectures to challenge their classmates and achieve a higher score in gamified quizzes. Student preparation is an imperative factor for the flipped classroom strategy to be useful (Gross et al., 2015); secondly, providing immediate feedback for the students when playing or performing gamified quizzes helps scaffold their learning performance and improve overall achievement (Hattie & Timperley, 2007; Kulik & Kulik, 1988). Students consider immediate feed-

back as points in gamified quizzes, a tangible benefit that pushes them to more challenges in the upcoming lectures (Sailer & Sailer, 2021). Additionally, competitive interaction between students achieved through leaderboards or team leaderboards creates cooperation and mutual support among students and leads them to improve each other's skills (Rigby & Ryan, 2011). Cooperation and competition are more likely to be effective gamification strategies (Sailer & Homner, 2020) in which students can share similarities with friendly competition (Zainuddin et al., 2020).

Moreover, the pairwise comparisons also revealed that the non-gamified flipped group outperformed both the traditional non-gamified and the traditional gamified groups. This result indicates that the flipped instructional method is more helpful for students to achieve better grades and improve their achievement compared to traditional instruction that does not provide any supportive materials outside that class, even using in-class gamified activities. Flipped activities represented as computerized, multimedia, and interesting materials offered to students with fewer restrictions about time, location, and human interaction help students study well and improve their overall achievement compared to the traditional methods. This is consistent with several flipped classroom studies such as (Liu & Zhang, 2022). Indeed, the flipped classroom outperforms the other two traditional methods, and the gamified flipped classroom outperforms the flipped classroom because of adding gamified activities.

However, contrary to the obtained result, a few studies found that learning outcomes achieved through the traditional classroom model were better than those achieved through the pure gamified flipped classroom, such as Durrani (2019). This suggests the need to combine innovative and classical teaching tools and techniques for learning. Several challenges and limitations faced by students and teachers have been identified, including selecting suitable game elements, the instructional design of the intended course, and technological issues (Zainuddin et al., 2020). Simply employing game elements may not guarantee student benefits, over-including gamified elements becomes detrimental to students' learning, and students still need to acquire knowledge using conventional teaching methods for specific courses.

Second, this study examined the effects of students' gender and their interaction with the instructional method on their overall achievement. The results indicate that the students' gender main effect and interaction effect with the instructional method is insignificant to the students' overall achievement. Students' gender was not a significant factor regarding male and female achievement in using a gamified flipped classroom. This result is in line with the findings of Ikwuka and Okoye (2022), who found that no significant difference was observed among students' gender on academic achievement in the flipped classroom. Ikwuka and Okoye (2022) confirmed that the flipped classroom is gender friendly, which is also observed in this study. Therefore, this result indicates that students' academic performance is independent of their gender, and the obtained grades are not different among males and females. The motivation of males and females to complete the gamified activities is equal.

Applying gamification during database management flipped lectures has the potential to make the students focus their attention on learning without feeling pressured during the learning activity (Blume, 2020) and can decrease anxiety, paving the way for input acquisition. Gamification is highly motivating and entertaining, and it can give shy students more opportunities to express their opinions and feelings. Gamified quizzes are fun and make learners willing to practice, discover, and interact with their environment (Blume, 2020). This allows students to compete with others and attain higher points during gamified quizzes, correctly answer the gamified questions, perform better in the course's exams, and attain higher grades. As a result, this potentially attracts students to learning, impacts their attitudes toward the subject, and makes the learning process more challenging and fun. From the perspectives of teachers and educational institutions, more attention should be given to providing tangible evidence to apply gamification in their classes. This can help the students enhance their achievement, thereby increasing their acceptance and willingness to study.

CONCLUSION

Combining gamification within a flipped classroom according to flow theory requirements has been proposed in this study as a solution to motivate students to complete its activities and thereby improve their achievement. This study offers novel contributions to the literature by illustrating the importance of employing gamification in the flipped classroom and how the gamified flipped instructional method affects students' achievement, primarily through appropriate gamification design and careful game element selection. Empirical results have proven that the gamified flipped instructional method was the most influential strategy on the students' achievement and outperformed the other three groups, i.e., the traditional non-gamified, non-gamified flipped classroom, and traditional gamified instructional methods. The overall findings indicate that students who studied using the gamified flipped classroom and were exposed to in-class gamified quizzes were more likely to be motivated to complete flipped activities and revised recorded materials regularly before the class instruction compared to the other students. Therefore, they achieved better grades and improved their overall achievement. The findings of this study also show that gender is not a significant factor as regards male and female achievement in the use of gamified flipped classroom.

While flipped classroom strategy, on the one hand, enables students to learn at their own pace according to the differences between them and gain a better understanding in a repeatable manner, gamification, on the other hand, can help students to participate and engage better within the learning activities. The study provides valuable insights and practical implications for instructional designers to apply the gamified flipped classroom method with appropriate game elements. It extends ongoing gamified flipped learning studies, providing notable implications for research and practice. Incorporating gamification within the flipped instructional method is important for higher education to encourage students to regularly access and use the flipped materials to improve their academic performance and for educational institutions to increase their sustainability by attracting distinguished students and improving their overall satisfaction and achievement.

The limitations encountered in this study may represent opportunities for future research. Thus, more research is required to investigate the efficacy of using the gamified flipped classroom instructional method on other courses in different environmental variables with an appropriate gamification design. We recommend paying more attention to gamification design strategies and alternatives to achieve better results, especially when selecting and employing gamification elements. We also recommend examining the effect of the gamified flipped classroom on other attributes such as motivation, engagement, self-efficacy, and academic self-concept. Controlling the students' behavior during the in-class gamification activities and using an appropriate design of the game elements that best suit the subject and the students are additional challenges for consideration. Finally, although the findings obtained in this study are satisfactory, sample size and subject area should be recognized as limitations of the study. Replicating this study on a larger scale, in various settings, and in other academic courses from other schools and universities is recommended.

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