Gamified flipped learning: Students' motivation, engagement and academic achievement

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Abstract

The aim of this study was to examine the effect of gamification on the motivation, engagement and academic achievement of students studying in a flipped learning. The study was conducted with a split-plot factorial design. The participants consist of 54 students studying at a state university in Turkey. The students in the experimental and control groups were studied in flipped learning for 12 weeks. In-classroom activities were conducted based on interactive group activities. Out-of-classroom activities were carried out with asynchronous videos, audio recordings, assessment tests, text, and graphic-based course content. Unlike in the control group, gamification was used in the experimental group. Gamification was used in the out-of-classroom component of the flipped learning. Gamification was carried out using a design model that takes into account the characteristics of the target audience. As a result, it was seen that gamification did not have a significant effect on the motivation, engagement, and academic achievement of students in the flipped learning. The most important question raised by this study is whether the difference between a flipped classroom and flipped learning. Another question this study raises is which component of flipped learning is more effective for gamification. Perhaps, if course contents and in-classroom activities are designed effectively, a trigger will not be needed to motivate or engage students.

Keywords: flipped learning, gamification, motivation, engagement, academic achievement

Introduction

Students' expectations of learning environments have changed. They prefer interactive environments where they will receive immediate feedback (O'Flaherty & Phillips, 2015). This has led to a decrease in student participation in the traditional teacher-centered classroom. The traditional classroom remains limited for students. Learning environments should be enriched with educational technologies and redesigned with innovative approach (Zhao et al., 2021).

Nowadays, the education system is going through a transformation process (Ali, 2020; Goh & Sandars, 2019). Information technologies and innovative approaches play a key role in this transformation (Parra-González et al., 2020). For this reason, face-to-face education has begun to leave its place in innovative approach such as blended learning. It is thought that blended learning will have important in the digital transformation of higher education. In blended learning, face-to-face and online learning are used together (Garrison & Kanuka, 2004). Flipped learning is a subcomponent of blended learning (Staker & Horn, 2012). In flipped learning, theoretical courses are carried to online environments and face-to-face courses are designed student-centered learning (Sams & Bergmann, 2013).

To practice effective teaching in flipped learning, students must engage in the learning process (Gebre et al., 2014). The failure of students to accomplish the tasks of out-of-classroom affects in-classroom performance and hinders the success of flipped learning (Kim et al., 2014; Strayer, 2012). One of the crucial problems of flipped learning is the insufficiency of engagement in out-of-classroom activities (Akçayır & Akçayır, 2018; Hao & Lee, 2016). In addition, lack of engagement is the main problem of online learning too (Czerkawski & Lyman, 2016; Reich & Ruipérez-Valiente, 2019). Besides, teachers

have difficulty motivating students in online learning (Ramírez-Donoso et al., 2021). If students do not show interest in course content, flipped learning will not present better learning outcomes than that traditional classroom (Lai & Hwang, 2016). Therefore, online learning materials should be designed more carefully (Sulong et al., 2021), and students should be encouraged to engage in out-of-classroom activities (Huang et al., 2019; Sun et al., 2017).

There is a need to use new strategies in the flipped learning for students to examine the course content before in-classroom activities (Cheng et al., 2020; de Araujo et al. 2017). Students should be encouraged to engage in out-of-classroom activities such as watching videos and solving assessment tests. Gamification may offer a solution to this problem. Gamification is defined as the use of game elements in non-game contexts (Deterding et al., 2011). In online learning, gamification may use to give feedback to students, to create a fun learning, increase engagement and motivation. Gamification may attract the attention of students to learning content and encourage them to learn better. In the literature, it is seen that gamification is used to increase the time spent in the online environment, to increase the number of course completion and to reduce dropout rates (Castro et al., 2018; Looyestyn et al., 2017). In this context, it is thought that gamification may increase the motivation, engagement, and academic achievement of students in flipped learning. There are recommendations in the literature that these two new approaches may be used together.

New approaches, such as gamification and flipped learning, have significant potential to improve the learning and teaching process (Pozo Sánchez et al., 2020). It is thought that gamification will make important contributions to the flipped learning (Ramírez-Donoso et al., 2021). Combining flipped learning with a dynamic approach, especially gamification, will be beneficial to the learning and teaching process (Ekici, 2021). There are few studies in which flipped learning and gamification are used together (Parra-González et al., 2021; Sulong et al., 2021). These studies have conflicting results. In similar studies, it is stated that gamification has a positive effect on flipped learning (Aşıksoy, 2018; Huang et al., 2019) and it has no effect (Mese & Dursun, 2019; Tan & Hew, 2016). Therefore, more experimental studies on gamification are needed (Silva et al., 2019). Although some positive or negative results have been found regarding the effects of gamified flipped learning, there is insufficient evidence to generalize (Ekici, 2021). The number of studies based on a theoretical model is limited (Lo & Hew, 2018; Zainuddin, 2018). Compared to previous research, gamification designs are now explained in relation to learning theories and psychological factors (Raitskaya & Tikhonova, 2019). Therefore a trend toward personalized gamification designs has begun (Santos et al., 2021). It is also important to make a theory-based design before investigating the effect of gamification on flipped learning. Gamification studies customized to user/player types are limited in the educational context (Comert & Samur, 2021). For this reason, in this study, the gamification design was carried out by determining the motivation sources of the students through the user/player types.

Theoretical background

The importance of blended learning is increasing day by day. Flipped learning is seen as one of the learning approaches of the future. However, the problem of engagement and motivation remains in this approach. It is thought that gamification may offer a solution to the problem experienced in the flipped learning. At the same time, it is recommended to use flipped learning and gamification together in the literature.

Flipped learning

Advancing information and communication technologies have increased the applicability of flipped learning and made flipped learning the focus of attention. Flipped learning is an effective teaching and learning approach that is increasingly accepted worldwide (Birgili et al., 2021). Flipped learning is a sub-component of the rotation model of blended learning classification (Staker & Horn, 2012). It

stands out with the favourable approach it offers to increase student engagement. It is one of the models that blend the advantages of face-to-face education and technology in the best way.

In flipped learning, theoretical courses are carried to online environments where students can work before coming to the classroom (Davies et al., 2013; Strayer, 2012). Flipped learning basically has two components. The first is the presentation of theoretical course content out-of-classroom and the other is the learning process carried out in-classroom (Bishop & Verleger, 2013). Theoretical course contents are presented to students in the form of asynchronous online learning. Students learn the theoretical course content before the in-classroom time. Education in-classroom is conducted in interactive activities where the teacher guides the students, and the students actively participate (Sams & Bergmann, 2013). For flipped learning, four important pillars consisting of the flexible environment (1), learning culture (2), intentional content (3), and professional educators (4), need to be put to work (Hamdan et al., 2014). Flexible learning should be offered to the student, allowing the student to choose where, when, and how to learn. Students should be moved to the center of learning and given opportunities to organize their own knowledge and evaluate their own learning. Course contents to be presented to students via individual teaching out-of-classroom should be created by considering the concepts and skills needed in-classroom activity. The instructor should undertake much more detailed tasks, from creating course contents and classroom activities to observing students, from evaluating the study to providing instant feedback. In this way, students are provided with the opportunity to develop their skills as well as their conceptual knowledge (Baepler et al., 2014).

Gamification

Gamification is defined as "*the use of game elements in non-game contexts*" (Deterding et al., 2011). Successful practices of gamification in areas such as marketing, health, society, management, and entertainment have also attracted the attention of educators (Surendeleg et al., 2014). Gamification is used in education to create behavioral change in students, to attract students' interest in the course content, and to increase their motivation and engagement.

Gamification mainly focuses on intrinsic motivation (Marczewski, 2015). Feedback is given through game elements. Game elements play the role of triggers of intrinsic motivation such as reputation, peace, and satisfaction (Eyal & Hoover, 2014). Behind of gamification, there are important psychological theories that support game elements such as Behavior Model (Fogg, 2009), Self-Determination Theory (Ryan & Deci, 2000), Hook Model (Eyal & Hoover, 2014), and Flow Theory (Csikszentmihalyi, 1991).

Gamification needs to be carefully designed to increase student engagement and motivation (Domínguez et al., 2013; Kapp, 2012; Landers et al., 2015). Therefore, it is recommended to follow a design model in gamification solution. Following up a design model facilitates the process and increases the success of gamification practice. Since individual differences are an important factor affecting the success of gamification practice, the target audience should be analyzed (Mekler et al., 2017). It is recommended to use player/user types to analyse the target audience and determine individual differences in gamification designs (Kumar & Herger, 2013; Werbach & Hunter, 2015). In this context, "*Gamification Design Framework*" of Marczewski (2017) was followed in this study. Marczewski's (2015) "*Gamification User Types Hexad*" was used to define the motivational source of the target audience.

Purpose of study

With flipped learning, it is aimed to increase the learning performance of students (Baepler et al., 2014). The fact that students do not engage in activities prevents the success of flipped learning (Hao & Lee 2016; Kim et al., 2014). It is known that students who engage in the course are more successful (Gebre et al., 2014). Motivation is positively correlated with engagement (Garcia & Pintrich, 1996).

This makes motivation an important factor in the learning process (Schunk et al., 2014). Gamification is focuses on motivation (Marczewski, 2015) and it has a significant potency in ensuring engagement (Simões et al., 2013). In this direction, a study was conducted to provide a solution to the engagement problem experienced in flipped learning through gamification.

This study, it is aimed to increase the learning performance of students in flipped learning by taking advantage of gamification. The main purpose of the study is to examine the effect of gamification on the motivation, engagement and academic achievement of students studying in the context of flipped learning. Under this main purpose, the research questions (RQ) to be answered are as follows:

RQ1: Is there a significant difference between the motivation scores of the students in the experimental and control groups?

RQ2: Is there a significant difference between the engagement scores of the students in the experimental and control groups?

RQ3: Is there a significant difference between the academic achievement scores of the students in the experimental and control groups?

Method

Research model

The study was conducted with a split-plot factorial design. This factorial design allows the researchers to examine the main effects of two or more independent variables on dependent variables as well as to determine the interaction effect of a factor depending on another factor (Kirk, 2012). There are two independent variables that affect the dependent variables were examined in this study. One of them is a different experiment process and the other is repeated measurements of students. Students were measured on the dependent variable before and after the experiment. The measurements of the experimental and control groups consisting of different students were compared.

The motivation scale and achievement test were applied as a pre-test before the training. The students in the experimental and control groups were educated in a flipped learning for 12 weeks. Unlike the control group, in the experimental group, gamification was used in the out-of-classroom component (online learning) of the flipped learning. At the end of the training, the measurements of the dependent variables were taken again with the same measurement tools. In this way, the groups were measured twice with the pre-test before the training, and the post-test at the end of the training regarding their motivation levels and achievement levels. Engagement levels were measured only at the end of the training (Table 1).

Participants

Students studying in the second year of the Computer Programming Program of a state university in Turkey constitute the participants of the research. This study was conducted in the 2019-2020 academic year with second-grade students aged between 18-20 years. The participants consist of total 54 students, 13 (24%) female and 41 (76%) males. The participants determined with the convenience sampling method. The participants consisted of the researcher's own students.

Table 1. Research design

Group	Pre-test	Training	Post-test
Experimental	Q_1	X_1	Q_3
Control	Q_2	X_2	Q_4

X_1: Gamifyed flipped learning, X_2: Flipped learning, Q_1, Q_2: Pre-test (Motivation scale, Achievement test), Q_3, Q_4: Post-test (Motivation scale, Achievement test), Engagement scale

To minimize group differences, students were assigned to groups by matching them according to their first-year grade point averages. Student pairs were formed according to their grade point averages. One of the couples was assigned to the first group and the other to the second group. Two groups were matched based on students' grade point averages.

According to the results of the Shapiro-Wilk ($n < 50$), the grade point average of the students in the first group ($p = 0.699$) and second group ($p = 0.259$) were normally distributed and according to the Levene test result ($p = 0.217$) variances were found to be homogeneity. Since the score means of the first group ($M = 2.022$, $SD = 0.713$) and the second group ($M = 2.031$, $SD= 0.557$) are very close and there is no significant difference between the groups ($t_{(52)} = 0.055$, $p = 0.956$), it is assumed that the groups are equivalent according to grade point averages. One of the matched groups was determined as the experimental group and the other as the control group.

Data collection tools

The "*Motivation Scale (MS)*" was developed by Pintrich et al. (1993) and later adapted into Turkish by Büyüköztürk et al., (2004), was used to determine the student's motivation levels. The scale was developed to determine students' motivations according to their own answers. It is stated that this scale is easily applicable for higher education students. The theoretical substructure of the motivation scale consists of value, expectancy and affects main components. The scale consists of a total of six factors and thirty-one items: intrinsic goal orientation, extrinsic goal orientation, task value, control belief for learning, expectancy are students' perceptions of self-efficacy, and test anxiety. These six factors together form the motivation levels of the students. The items in the scale range from "*not at all true for me (1)*" to "*very true for me (7)*" according to the 7-point Likert type. Regarding the scale, it is stated that the items have a good distinguishing feature (Büyüköztürk et al., 2004). The Cronbach Alpha coefficient of the whole scale was found as 0.815 for this study.

"*Student's Engagement Scale*" developed by Sun and Rueda (2012) and adapted into Turkish by Ergün and Usluel (2015) was used to determine the engagement level of students. The scale has been used in many studies at higher education level regarding student engagement in blended learning and online learning (Henrie et al., 2015). The scale consists of three sub-factors: behavioral, cognitive, and affective. The scale consists of 19 items ranging from "*Strongly disagree (1)*" to "*Strongly agree (5)*" according to the 5-point Likert type. The Cronbach Alpha coefficient of the whole scale was 0.90 and was found as 0.815 for this study. It is stated that the whole of the scale is in the reliable range, it presents results consistent with the original scale, and the fit indices are in the acceptable range (Ergün & Usluel, 2015).

To determine the academic achievement of students; achievement test, rubric and self and peer assessment form (SPAF) were used. An achievement test consisting of 23 questions with sufficient reliability (KR-20 = 0.712). Item difficulty index and item discrimination strength index were examined of the achievement test. The academic achievement test has very good discrimination ($r = 0.44$) and moderate facility ($p = 0.49$). Consisting of five main criteria (scenario, technical possibilities, assembly, software, timing) and four performance levels (weak, medium, good, excellent), analytical rubric was developed to evaluate the products. For the students to evaluate both themselves and their peers in the problem-based learning process, the "*Self and Peer Assessment Form*" prepared by Arslan Turan (2014) was used. This form consists of 7 items with a 3-point Likert-type. The activities in the flipped learning focus on structuring rather than repeating the information, multiple assessment methods were used (Boud, 1990; Yurdabakan, 2011). An academic achievement consists of the knowledge gained by students, the ability to use of this knowledge, and the evaluation of the products they produce at the end of the training (Glasgow, 1997). Multiple assessment methods were used in determining academic achievement, and it was proportioned according to learning goals (Başol, 2018). The academic achievement of the students was formed by the achievement test (62%), rubric (21%) and self and peer assessment (17%) scores. There are a total of 24 goals in the curriculum of training. Fifteen learning goals are measured with the achievement test, five goals with the rubric, and four

Table 2. Distribution of learning goals

Assessment Methods	Cognitive Domain												Total	
	Remembering		Understanding		Applying		Analyzing		Evaluating		Creating			
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Achievement Test	4	16.66	4	16.66	3	12.5	4	16.66	-	-	-	-	15	62.48
Rubric	-	-	-	-	-	-	-	-	2	8.33	3	12.5	5	20.83
Self and Peer Assessment	-	-	-	-	1	4.17	1	4,17	1	4.17	1	4.17	4	16.68
Total	4	16.66	4	16.66	4	16.67	5	20.83	3	12.50	4	16.22	24	100

goals with the self and peer assessment. Learning goals are shown in Table 2 according to Bloom's revised taxonomy (Anderson & Krathwohl, 2001).

Data analysis

Since the group size was less than 50, the Shapiro-Wilk test was used to determine whether the data obtained from the students showed normal distribution (Büyüköztürk, 2020). Levene test was used to determine the homogeneity of variances. The distribution values of the data are shown in Table 3.

It is observed that the motivation pre-test and post-test scores, engagement scores and academic achievement test scores of the experimental and control groups are normally distributed ($p > 0.05$). Although it is seen that the achievement test data of the experimental and control groups are not normally distributed according to Shapiro Wilk test, as the skewness (1.129) and kurtosis (0.438) values of the experimental group and the skewness (0.658) and kurtosis (-0.564) values of the control group are in the range of ± 1.5; it can be said to be normally distributed (Tabachnick & Fidell, 2015, p. 79-83). The normal distribution of the data and the homogeneity of the variances show that they meet the parametric test assumptions. It was also observed that there was no significant difference between experimental and control groups before the experiment in both motivation ($t_{(52)} = 0.828$) and achievement test ($t_{(52)} = 1.106$) scores (Table 4).

Table 3. The distribution values of the data

Test	Group	Pre-test		Post-test		
		Motivation (p)	Achievement test (p)	Motivation (p)	Academic achievement (p)	Engagament (p)
Shapiro Wilk	Experimental	0.312	0.001*	0.442	0.295	0.377
	Control	0.087	0.026*	0.101	0.869	0.364
Levene	Experimental Control	0.208	0.167	0.131	0.946	0.904

*p> 0.05

Table 4. T-test results regarding pre-test data

Pre-test	Group	N	Mean	SD	df	t	p
Motivation	Experimental	27	161.85	19.54	52	0.828	0.412
	Control	27	165.88	16.12			
Achievement Test	Experimental	27	17.39	12.23	52	1.106	0.274
	Control	27	21.41	14.41			

Two-Way ANOVA for Mixed Measures was used to determine whether gamification made a significant difference on the motivation of students in the flipped learning environment. Two-Way ANOVA for Mixed Measures is used in the analysis of the data obtained from the split-plot design, which involves independent measurements and time-dependent repeated measurements depending on the process groups (Büyüköztürk, 2020). The variance of group scores and covariance of groups for pairwise combinations of measurement sets are also equal ($p > 0.05$).

One-way ANOVA was used to determine whether there was a significant difference between the group means scores obtained from the students' engagement. One-Way ANOVA is used to test whether the difference between the mean of two or more independent samples is significantly different (Büyüköztürk, 2020). The engagement scale was applied to the students only at the end of the training. Engagement scale scores of the experimental and control groups are normally distributed. It was observed that the group variances of the dependent variables and the covariance were equal ($p > 0.05$).

One-factor ANCOVA test was used to determine whether there is a significant difference between the academic success which corrected according to achievement test pre-test scores of the students in the experimental and control groups. It was observed that there was a relationship between the pre-test and achievement test scores at the level of $r = 0.368$ and this relationship was linear. Pre-testXgroup common effect on academic achievement is not significant [$F_{(1, 50)} = 0.822$; $p= 0.369$]. This finding shows that the slopes of the regression lines calculated to predict the academic achievement scores based on the pre-test scores of the students in the experimental and control groups are equal. In this context, one-factor ANCOVA was applied by controlling the pre-test as a covariate to find out whether the experimental process had an effect (Büyüköztürk, 2020). Because academic achievement consists of three different measurements [achievement test, rubric and self and peer assessment].

Gamification design and application

While creating the gamification solution to be used in the online learning environment of the experimental group, Marczewski's (2017) "*Gamification Design Framework*", which allows us to think in more detail and consists of repetitive steps, was followed. The student control, motivation, interaction, and feedback strategies needed to attract students' interest and increase engagement in course contents were carry out through gamification elements. "*Gamification User Types Scale*" developed by Tondello et al. (2019) based on Marczewski's (2015) user types model and adapted into Turkish by Taşkın and Kılıç Çakmak (2020), was used to define the target audience. Among the gamification elements (mechanics, components, and ideas) proposed by Marczewski (2015), the items to be used were determined considering the distribution of user types. Gamification elements can appeal to one type of user, as well as they can affect more than one type of user at different rates. For example, the item "*Certificates*" has a weight of 1.00 for the Achiever type, while the same item has a weight of 0.25 for the Socialisers and 0.50 for the Player type (Table 5). Based on research on users' interest in gamification elements, Marczewski (2016) determined different weights for each gamification element. The total weight of all gamificaiton items for the "*achiever*" user type is 9.25; 12.5 for "*player*"; 7.00 for "*free spirit*"; 7.5 for "*philanthropist*" and 7.5 for "*socialisers*" (Marczewski, 2016). Table 5 shows the gamification items used in this study and their weights.

The total weight of the game elements used in this study 9.25 for the "*achiever* "; 8.80 for "*player*"; 5.75 for "*free spirit*"; It is 4.25 for "*philanthropist*" and 4 for "*socialisers*". Marczewski (2016) states that the ratio of the total weight of the game elements used to the total weight of all game elements multiplied by the distribution of user types will give the estimated participation rate. For example, 29.1% of game items belong to achievers. It is predicted that these elements will create a 25% increase in engagement in the target audience. There is 75% coherence between the user type distribution of the target audience and the gamification elements used in the design (Marczewski, 2016). Table 6 shows the user type distribution, the distribution of the used gamification elements and the estimated engagement rate.

Table 5. Gamification elements

	Achiever	Free Spirit	Philanthropist	Socialisers	Player
Achiever					
Challenges	1	-	-	-	-
Certificates	1	-	0.25	-	0.50
Learning / New Skills	1	-	-	-	-
Quests	1	-	-	-	-
Levels / Progression	1	-	-	-	0.50
Boss Battles	1	-	-	-	-
Socialiser					
Social status	-	-	0.25	1	-
Competition	-	-	-	1	0.50
Social Pressure	-	-	-	1	-
Philanthropist					
Meaning / Purpose	-	-	1	-	-
Access	-	-	1	-	-
Sharing Knowledge	-	-	1	-	-
Free Spirit					
Exploration	-	1	-	-	-
Branching Choices	-	1	-	-	-
Easter Eggs	-	1	-	-	0.25
Unlockable / Rare Content	-	1	-	-	0.25
Customisation	-	1	-	-	-
Player					
Experience Points (XP)	-	-	-	-	1
Leaderboards/ Ladders	0.25	-	0.25	0.25	1
Badges / Achievements	0.25				1
General					
On-boarding / Tutorials	0.25	-	0.25	-	0.25
Signposting	0.25	-	-	-	0.25
Loss Aversion	0.50	0.25	-	0.25	0.75
Progress / Feedback	0.75	-	-	-	0.50
Theme	-	-	-	0.25	0.25
Curiosity / Mystery Box	0.25	0.50	-	-	0.50
Time Pressure	0.50	-	0.25	0.25	0.50
Schedules					
Fixed Reward Schedule	0.25	-	-	-	0.25
Time Dependent Rewards	-	-	-	-	0.25
Total	9.25	5.75	4.25	4	8.80

Table 6. User types of reverse analysis results

User types	User Type Distribution (Scale)	The Distribution of Gamification Elements (LMS)*	Estimated Engagament Rate **
Achiever	25 %	29.1 %	25 %
Player	23 %	26.8 %	15.64 %
Free Spirit	21 %	18.1 %	17.25 %
Philanthropist	18 %	13.4 %	10.2 %
Socialisers	13 %	12.6 %	6.9 %

* Percentage of items focused on a particular type of user (sum of user type weights of selected gamification items / sum of all gamification items used X 100)

** Estimated engagement rate of a particular type of user (sum of user type weights of selected gamification items / sum of all proposed gamification elements weight by user type X user types of distribution rate)

The selected gamification elements were combined with game mechanics in line with the targeted behaviours such as students' interacting more with the course contents, spending more time in the online learning environment, and completing tasks on time. The awards were distributed according to the realization of predetermined actions or goals. For example, students who performed targeted behaviours such as logging into the system, completing a course, earning a certificate, and passing the test were rewarded with points. Students who had completed special tasks such as achieving high success in tests or who have special skills were given a badge as a visual representation of their success. The points earned, the number of course completions and badges were used to level up students, while these levels were used to unlock content. Some special levels give students the authority to send messages, to open a topic in the discussion and to change the profile photo. Students who complete the course on time earn a certificate. A leaderboard has been created so that students can see the status of other students in the system and compare themselves with them. With the progress bars, students are shown where they are and where they should reach. Scores provide detailed feedback, levels and progress bars provide continuous feedback, leaderboards and badges provide cumulative feedback. Feedbacks were provided with information graphics for students to evaluate their own performance. A time limit was used for situations such as completing the weekly course contents and solving the assessment test.

Both the students in the experimental and control groups trained for 12 weeks according to the flipped learning approach of the "*Audio and Video Applications*" course. In-classroom activities; it consists of three lessons of 45 minutes each. In-classroom activities of both groups are given by the same instructor. Training consists of a combination of two important teaching techniques in both groups: interactive group-based activities in-classroom and computer-aided individual teaching out-of-classroom. In-classroom courses were conducted based on interactive group activities consisting of discussion, question and answer, practices, and problem-based learning. Activities out-of-classroom were carried out with asynchronous web-based videos, audio recordings, assessment tests, text, and graphic-based course contents. While theoretical courses were presented as out-of-classroom activities, group-based problem-solving activities were carried out in-classroom. Assessment tests were activated at the end of the classroom course in accordance with the pedagogical structure of the flipped learning. Course contents are assigned to students weekly within the framework of the training program. There is no difference in the course contents offered to the experimental and control group students.

In-classroom activities started with questions-answers and discussions. Five different practices have been developed for in-classroom activities to support the theoretical lessons. These practices were carried out-of-classroom in different weeks (4th, 5th, 10th, and 11th week). The problem-based learning process was carried out in two separate sessions (2-6th week and 7-12th week) within the framework of two different problem situations. The solutions presented at the end of the problem-

based learning process have been transformed into the final product. The final products were carried out in-classroom. The technical equipment that students need to create the products is presented to them in the classroom. The final products produced at the end of the problem-based learning process were presented by the groups and evaluated by the students and the instructor with a rubric. At the end of the problem-based learning process, self and peer assessment was made. There are no difference in-classroom activities of the groups. Unlike the control group, gamification was used in the experimental group's out-of-classroom component of flipped learning.

Results

Students' motivation

The motivation score means of the students in the experimental group was 161.85 before the training and was 166.96 after the training. The motivation score means of the students in the control group was 165.88 before the training and 170.62 after the training. Accordingly, it was observed that there was an increase in the motivation score means of the students in both the experimental and control groups after the training. The results of the Two-Way Mixed ANOVA performed to examine whether this increase observed in motivation score mean is significant is given in Table 7.

It was observed that the motivation scores of the students in the experimental and control groups did not differ significantly from before and after the training, and the common effect of being in different groups and repeated measures factors on motivation was not significant [$F_{(1,52)}$ = 0.016; p = 0.900]. This finding shows that gamification is not effective on the motivation of students. There is no significant difference between the motivation pre-test and post-test scores of the students in the experimental and control groups studying in different environments [$F_{(1,52)}$ = 1.266; p = 0.266]. This finding shows that there is no significant difference between the motivation scores of the experimental and control groups. Regarding the main effect of measurement without making any group discrimination, there is no significant difference between the students' motivation score means before and after the training [$F_{(1,52)}$ = 3.174; p = 0.081]. This finding shows that when there is no group discrimination, the motivation scores of the students do not change depending on the training.

Students' engagement

The results of the One-Way ANOVA analysis, which was conducted to determine whether the engagement scores of the students showed a significant difference compared to the experimental and control groups, are given in Table 8.

Table 7. ANOVA results of pre-test/post-test motivation score means

Source	SS	df	MS	F	p	η^2
Group	511.343	1	511.343	1.266	0.266	0.24
Motivation (Pre-test/Post-test)	528.898	1	528.898	3.174	0.081	0.58
Group*Motivation	2.676	1	2.676	0.016	0.900	0.00
Error	8664.926	52	166.633			

Table 8. ANOVA results of engagement scores according to experimental and control groups

Group	N	M	SD	df	F	p	η^2
Experimental	27	63.037	2.03	3-50	2.352	0.083	0.124
Control	27	66.592	1.88				

It is seen that the control group's engagement scores are higher than the experimental group. As a result of ANOVA analysis, it was seen that there was no significant difference between the engagement scores of the experimental and control groups [$F_{(3,50)} = 2.352$; $p = 0.083$]. These finding shows that the scores obtained from engagement scale do not change depending on the experimental and control groups.

Students were sometimes absent in-classroom activities during the 14-week course period. But a student participated in-classroom activities for at least 10 weeks. In both groups, students were participated in-classroom activities at the same rate (75%).

Students' academic achievement

To find out whether gamification influences the academic achievement of students, the academic achievement according to the achievement pre-test scores of the groups was compared. The academic achievement of the students was obtained from using rubric scores, achievement test, self and peer assessment scores. The means of the students in the experimental and control groups score are given in Table 9.

It is seen that the post-test achievement test score of the control group is higher than that of the experimental group, while rubric and self and peer assessment scores are lower. The achievement test score (pre-test) of the students in the experimental group was 17.39; academic achievement score mean is 64.735. The mean score of the control group students before the training was 21.41 and the mean score after the training was 64.052. When the mean scores are examined, it is seen that the students have low scores before the training and high scores after the training. Looking at these scores, it is seen that there is a difference and the academic achievement score of the students in the experimental group is higher. ANCOVA results regarding whether the difference observed between the groups' academic achievement scores according to the pre-test is significant or not is given in Table 10.

According to the ANCOVA results, it is seen that there is no significant difference between the students in the experimental and control groups in terms of academic achievement scores [$F_{(1,51)} = 0.413$; $p = 0.523$].

Table 9. Academic achievement sub-score factors

Group	N	Achievement Test Score (Pre-test)		Achievement Test (Post-test)		Rubric		Self and Peer Assessment		Academic Achievement Score	
		M	SD	M	SD	M	SD	M	SD	M	SD
Experimental	27	17.39	12.23	54.75	19.26	77.60	3.96	85.73	7.47	64.735	13.139
Control	27	21.41	14.41	57.00	17.81	73.35	15.42	78.57	11.09	64.052	13.090

Table 10. ANCOVA results according to the academic achievement scores

Sourse of Variance	SS	df	MS	F	p	η^2
Pre-test (Reg.)	1270.876	1	1270.876	8.446	0.005	0.142
Group	62.195	1	62.195	0.413	0.523	0.008
Error	7673.728	51	150.465			
Total	8950.904	53				

SS: sum of squares, MS: mean square

Discussion

This study, it was aimed to examine the effect of gamification in the context of flipped learning. To answer the research questions, students' motivation, engagement, and academic achievement were examined. The results are discussed in the context of the current findings, literature, and theoretical background.

In this study, it was observed that gamification did not affect the motivation, engagement, and academic achievement of students in the context of flipped learning. Tsay et al., (2018) did not report any positive effects of gamified flipped learning approach. In a study by Tan and Hew (2016), it was seen that gamification did not have a significant effect on the learning of the students. Similarly, Meşe and Dursun (2019), it was seen that gamification did not have a significant effect on the motivation and academic achievement of students in the flipped learning. However, generally, the positive effect of gamified flipped learning is mentioned in the literature (Ekici, 2021; Smith et al., 2022; Sulong et al., 2021). This study has two different situations from other studies in the literature. First, gamified flipped learning studies often point to flipped classrooms (Aşıksoy, 2018; Hasan et al., 2018; Hung, 2017; 2018; Zainuddin, 2018). In this study, gamification was used in the context of flipped learning. Second, the in-classroom context received more interest in terms of the use of gamification (Ekici, 2021; Smith et al., 2022). Gamification was integrated into the out-of-classroom component of flipped learning in this study.

Although it seems that flipped classrooms and flipped learning are used interchangeably in the literature (Chen et al., 2014), these two concepts are different from each other (Hamdan et al., 2014). Flipped classrooms emphasize the physical structure, while flipped learning focuses on the process and redefines classroom time as student-centered activities. Jo et al. (2018) state that if the classroom activities and course contents are well prepared, students will be motivated and engaged in the course even if there is no gamification. Lo and Hew's (2018) state that flipped learning is more effective than gamification. Parra-González et al. (2020) states that both flipped learning and gamification have similar effects on students' achievement, and motivation. These statements point to the importance of activities and the similar effects of flipped learning and gamification.

Fang et al, (2021) emphasize student-student interaction and collaborative activities in a flipped learning approach. For the success of the flipped learning approach, it is necessary for students to engage in interactive group activities (Cho et al., 2021; van Alten et al., 2020). Although out-of-class course contents are very important, if the students do not engage in the in-class activities, the course materials will not make any sense (Strelan et al., 2020). It is known that problem-based activities offer students the opportunity to increase student performance (Walker & Leary, 2009). In the classroom component of this study, interactive group activities were used within the framework of problem-based learning. In both groups, students engaged in-classroom activities at a high level and at the same rate. If classroom activities are insufficient, gamification may be effective in this context, especially in flipped classrooms. Therefore, it is recommended that future research includes comparing the use of gamification in different components of flipped learning.

There are many studies in the literature pointing out the effect of gamification on increasing engagement and motivation (Dehghanzadeh et al., 2021; Dichev & Dicheva, 2017). But gamification has no direct effect on learning performance of students. In the literature, it is seen that gamification does not directly affect academic achievement (de-Marcos et al., 2016; Dias, 2017; Stansbury & Earnest, 2017). It affects the academic performance of students by increasing their engagement and motivation (Hanus & Fox, 2015). Considering that engagement and motivation are positively related to academic achievement (Garcia & Pintrich, 1996; Kuh, 2009), the closeness of engagement and motivation scores between groups may be the reason for the lack of difference in academic achievement.

Finally, the effect of gamification reduces over time (Looyestyn et al., 2017). Hanus and Fox (2015) argued that the long-term use of gamification has negative effects on motivation and academic achievement. Dominguez et al. (2013) state that the effect of gamification on students decreases over time. The fact that gamification does not make a difference in this study may be due to the decrease in the effect of gamification in long-term studies. For this reason, there is a need for research that reveals the short-medium and long-term effects of gamification.

Limitations

This study was carried out in an experimental design, but the addition of qualitative data for future studies will lead to more valid findings. The game elements used in the gamification design are limited to the capability of Talent Learning Management System. Experimental and control groups were educated according to the flipped learning approach. So, the study is limited to the context of flipped learning. The study was carried out with associate degree university students. Results are limited to university students as they may differ between secondary and high school students.

Conclusion and future work

In this study, we found that gamification does not have a significant effect on the motivation, engagement, and academic achievement of students in the flipped learning. The most important question raised by this study is whether the difference between a flipped classroom and flipped learning. Flipped learning differs from of study in flipped classrooms, as it focuses on interactive group-based activities. Perhaps, if out-of-classroom course contents and in-classroom activities are designed effectively, a trigger such as gamification will not be needed to motivate or engage higher education students. Shi et al. (2020) states that it will not guarantee that the simple implementation of flipped approach design will improve students' learning. Cheng et al. (2020) state that in-classroom activities should not be simple like exams or learning pages, but they should be in a way that students use their knowledge to solve problems.

Another question this study raises is which component of flipped learning is more effective for gamification. It is obvious that there is a problem of engagement in the out-of-class component of flipped learning. But may this problem be closed with in-class activities? Could the in-class component of the flipped learning be more suitable for gamification? At the same time, the effect of gamification when used in-classroom, out-of-classroom, or both components of flipped learning is unclear. Also, there is a need for research that reveals the short-medium and long-term effects of gamification.

Both groups in this experimental study received educated in flipped learning approach. The inclusion of groups that are educated in traditional teacher-centered and online learning will provide to obtain clearer findings on the effect of flipped learning. In this study, gamification was adapted in the out-of-classroom context of flipped learning. The effect of gamification on flipped learning, which is either in-classroom or both in and out-of-classroom components, is uncertain. In future studies, the effect of gamification on flipped learning in such contexts may be examined.

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