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INVESTIGATING THE PERFORMANCE AND ENGAGEMENT OF 6TH-GRADE STUDENTS UNDER THE CONDITION OF GAMIFICATION IMPLEMENTATION

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Abstract. Gamification is the use of game design elements (gamification components) to drive motivation and engagement in non-game environments. The purpose of this quasi-experimental study is to examine the effects of gamification elements included in the ClassDojo classroom management application on student academic achievement and engagement. The study sample consists of 50 6th grade students. Unlike the group without gamification, the gamification elements (avatars, scoreboards, nicknames, and leaderboards) included in ClassDojo were also used in the gamified group. Data leading up to the study were collected using the IT Achievement Test and the Engagement Questionnaire, which were given at the end of the four-week implementation process in the gamified and non-gamified groups. The Mann-Whitney U test was used to compare the means of the group tests. There was no significant difference between groups for the achievement variable. However, the difference in engagement scores was statistically significant in favor of the gamified group. In addition, the gamification elements caused a significant difference in the engagement scores of male and female students in the gamified group. Female students in the gamified group showed higher engagement than male students. In conclusion, it can be said that gamification effectively increases students' engagement in class.

Keywords: gamification, gamification elements, student engagement, ICT course for secondary school, ClassDojo.

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1 Introduction

Game is older than culture (Huizinga, 1949). Since culture expresses the traditions and habits of human societies, it can be said that game existed before humans were socialized. Play is not an insignificant product of culture, but a fundamental factor in the formation of different cultures (And, 2003). The game has always been present in people's lives for various reasons. At the top of these reasons are the elements of pleasure (fun), joy (mirth), and excitement (tention) (Huizinga, 1949). Although the existence of gameplay is very old and effective for humans, it has ceased to be a regular habit with the increasing industrialization and urbanization in the last centuries. Even for children, playgrounds and playtime have reduced. Moreover, since the beginning of the new millennium, with the development of mobile technologies, the new generations are living an integrated life with video games, mobile internet technologies, wearable technologies, 3D imaging tools, augmented reality, virtual reality, artificial intelligence, and lately the virtual universe (Metaverse). This new trend is noteworthy for all parents, health professionals, game developers, and educators. As for educators, the remarkable and engaging characteristics of

video games have led to the idea of incorporating game elements into teaching materials and learning processes (Deterding et al., 2011). Prensky (2001a) defined digital natives as native speakers of language of computers, video games, and the Internet and also noted that they prefer games to "serious" tasks and that instant gamification features and regular rewards encourage them.

Gamification is the implementation of game design elements in non-game environments to increase engagement and motivation. Werbach and Hunter (2012) divides these gamification elements into three categories, namely dynamics, mechanics, and components. Dynamics are actions that shape the overall structure of the game, and they are actions that interact with mechanics in the game. While mechanics are elements that encourage the user to participate in the content and engage through actions, the actual elements used to incorporate gamification into the particular environment are called components. It can be observed that gamification implementations are used in very different ways in very different domains. For example, Foursquare, a popular search and discovery application, rewards users with badges for places visited. The Nike+ application not only attracts users with its social networking feature, but also encourages them to exercise by rewarding those who participate in running races with badges. Another very impressive example is the fact that the complex protein sequence of the HIV virus was solved by users in a short time after being gamified in an application. Furthermore, gamification is also gaining interest and acceptance in educational and business processes due to its motivational support (Imran, 2019).

Similarly, gamification has been used in education to increase student engagement and learning (Codish & Ravid, 2014). Albertazzi et al. (2019) identified eight main areas of research on gamification during the six-year period in which they studied gamification research. Almost half of these studies were found to be in education, training, and academia. With the proliferation of web applications in education, popular gamification elements are being added to these applications. For example, ClassDojo, a classroom management application, includes gamification elements like badges, avatars, nicknames, scoreboards, etc.

Gamification, which is becoming more prevalent in both digital educational content and interactive educational content, is applied in different ways with different game elements in different situations. Therefore, these applications also show different results. Ravandi and Batooli (2022) reviewed 25 systematic reviews and meta-analyses in the field of game-based learning and education. The results show that most of these studies have implemented gamification in online learning environments. Therefore, they concluded that more research on gamification in face-to-face courses is needed. There is not yet sufficient empirical evidence to determine whether the effectiveness of the results justifies efforts to integrate gamification. This quasi-experimental study aims to examine the impact of some gamification elements (score, leaderboard, nickname, avatars, competition) offered by the ClassDojo classroom management environment on student participation and success in the course, as well as the gender factor. The research questions of the study;

Does the academic success of students in the gamified group differ from that of the non-gamified group in the Information Technologies and Software (ICT) course?) Does student engagement in the gamified group differ from that of the non-gamified group?) Does the engagement of female and male students in the gamified group differ in the ICT course?

1.1 Literature Review

Gamification is the use of game-specific components in non-game environments (Deterding et al., 2011; Fotaris et al., 2016; Hanus, & Fox 2015). Gamification can increase the effectiveness of educational activities through engagement mechanisms that can improve learner performance and make learning experiences more enjoyable (Coccoli et al., 2015). The activities that students generally dislike, especially in which game mechanics are used in assessment activities, become fun for students in the first place and they have completed the main task in the process (Fotaris

et al., 2016). It is critical that instructors implement games as a modern and innovation-driven tool to engage students and make them competitive (Areed et al., 2021).

One of the dimensions to which gamification should contribute is student motivation. Motivation can be understood as a sense of energy and action to do something (Ryan, & Deci, 2000). Two types of motivation are distinguished: intrinsic and extrinsic. The main difference between these two is that intrinsic motivation (a sense of altruism, competition, cooperation, belonging, love, or aggression) refers to doing something because one finds it intrinsically interesting and enjoyable, while extrinsic motivation (achieving grades, levels, points, badges, and awards) provides an external gain for the purpose of the work (Ryan, & Deci, 2000). Given this situation, the type of motivation and whether it is internally or externally focused has implications for the durability of learning. Gamification motivates participants to continue their interaction (i.e., participation) (Hamari et al., 2014).

Fotaris and others (2016), attempted to find empirical evidence of the use of gamification techniques in computer programming courses through design, implementation, and evaluation; concluding that the results motivate students and encourage their attendance and engagement in the course. Since the level of participation has a direct impact on learning outcomes (Andrew, 2014), components that increase engagement in learning processes are needed. The goal of gamification is to increase student engagement and activity in the classroom. Adams and Du Preez, (2022) presented key considerations in the study on the use of gamification to support student engagement over a 2-year period. In the study, game components can be selected according to developmental domains; they rated it as a process to change the engagement status of students to support the achievement of learning goals. Similarly, there is still a need to investigate the applicability and usefulness of such results in different subjects at different levels in different educational settings (Su, & Cheng, 2014). More recently, (Huang et al., 2020) found that different gamification elements yielded different results in their meta-analysis studies. Since a variety of gamification elements are used, there still seems to be a need for empirical research on the conditions and domains in which they might be most effective. Thus, as Kim and Werbach (2016) also noted, there is still a need for experimental research that develops ideas and practices for gamification processes that increase class participation and directly increase course success.

2 Method

This section describes the steps of the study, including the selection of the search design, participants, implementation process, data collection instruments, and analysis processes.

2.1 Research Design

This study used a post-test design with a control group, which is one of the quasi-experimental methods. The purpose of the study was to investigate the effects of gamification components on students' academic success and participation in the course ICT. A quasi-experimental design was used to compare the class (experimental group) in which the subject was taught by incorporating gamification components into the lesson plans and the class (control group) in which the subject was taught only through the lesson plans.

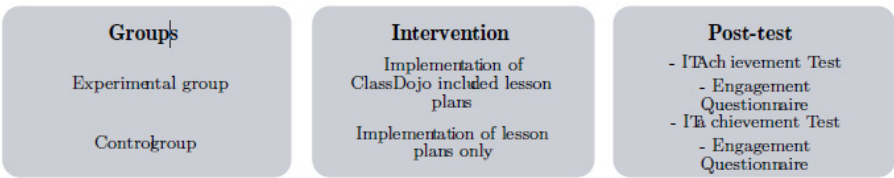

Figure 1: Research design of the study

2.2 Participants

In cases where the sampling units are not randomly assigned to the experimental and control groups, the research method is called quasi-experimental (Creswell, 2017). In this quasi-experimental design, the sample is spontaneously formed into groups (class, family, institution, etc.). In the study, easily accessible case sampling, one of the purposive sampling methods, was preferred (Büyüköztürk et al., 2014). This method was chosen from units that are close to the researcher and easy to reach in order to speed up the research and make it feasible (Yıldırım, & Şimşek, 2016). The sample of this study consists of 50 6th grade students (see Figure 2).

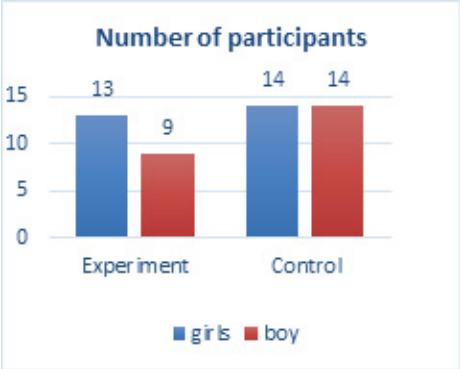

Figure 2: Participants of the study

2.3 Data Collection Instruments

The data were collected using two instruments namely, Engagement Questionnaire and IT Achievement Test.

Achievement Test

To answer the first research question, the basic IT academic achievement test was applied to the groups. The test consists of 20 items. The achievement test was prepared as a teacher's test by the teacher who taught the course and who is also one of the researchers. The test addresses the topics that were covered during the four-week intervention period.

In developing the test, the first step was to determine the purpose of the scores to be obtained with the test. Then, the learning objectives that the test would measure were determined, and then the table of objectives levels (taxonomy) was created. Using this table, the test items were created based on the objectives and compared to the pool of test questions used in previous years by the teacher. The table was revised in consultation with some other IT teachers.

Engagement Questionnaire

The engagement questionnaire used to answer the second and third research questions was adapted from the study of (Hıdıroğlu, 2014) to measure the engagement of seventh grade students in science classes. The structure of the questionnaire was examined using the four dimensions of behavioral, emotional, cognitive, and agentic engagement. The original scale was developed by (Reeve & Tseng, 2011) with the participation of 369 high school students, and each of the four dimensions was adopted from different scales. The scale, which consists of a total of 22 items, takes the form of a five-point Likert scale. Since the name of the course is mentioned in the items of the scale, as in the study of (Hıdıroğlu, 2014), the course name was changed to "Information Technologies and Software Course" in this study.

2.4 Intervention process

In the intervention process, the learning objectives were taught to 22 students (13 girls, 9 boys) in the gamified group by incorporating the gamification elements of scoreboard, leaderboard,

avatar, and nickname components, as well as the competitive mechanics of the ClassDojo classroom management application. On the other hand, the same lesson plan was used with 28 students (14 girls, 14 boys) in the non-gamified group for eight class periods (320 minutes) over four weeks. Three students who were absent from class more than once during these four weeks in the gamified group were excluded from the study.

For the class (experimental group-6A) in which gamification elements are included, a class was created in the classroom management application ClassDojo. While students received positive points for the criteria in Figure 3, they received negative points for the behavioral and attitudinal criteria to be developed in Figure 4. The group's scoreboard can be seen in Figure 5.

Figure 3: The criteria evaluated with positive points

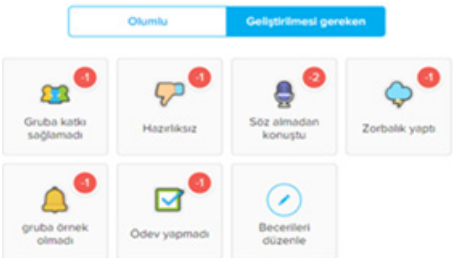

Figure 4: The criteria evaluated with negative points

Figure 5: Scoreboard of the gamified group

2.5 Analysis of Data

The steps taken before the statistical calculations of the data collected with the scales are shown in Figure 6.

The non-gamified group does not meet the normal distribution assumption for the measurements of both scales with respect to the normality assumptions in Table 1. Since the kurtosis

Operations on measured points before inferential statistical tests

- Entering the data into SPSS
- Reversing some items on the scales
- Performing an analysis of missing data
- Defining missing data
- Performing normality tests
- Providing all assumptions depending on the type of tests to be performed

Figure 6: Steps before comparing statistical means of groups

Table 1: Normal distribution statistics of scales

Test	Group	N	SK	KK	Shapiro-Wilk		
					Statistic	*sd*	*p*
Achievement Test Post-test	Gamified Group	22	-.552	-.438	.932	22	.137
	Non- Gamified Group	28	-1.536	3.377	.875	28	.003
Engagement Question-naire Post-test	Gamified Group	22	-.259	-.152	.983	22	.957
	Non- Gamified Group	28	-1.377	3.177	.888	28	.006
Gamified Group **Engagement Question-naire Post-test**	Girl	13	-1.235	1.766	.883	13	.077
	Boy	9	.310	-1.451	.900	9	.253

values of the non-gamified group also do not fall between the reference range of -2 and +2, the assumption of normal distribution of the data is not met (Tabachnick & Fidell, 2013). Therefore, for the inferential tests, the nonparametric Mann-Whitney U test was performed for independent groups. For the academic achievement tests, the group means were compared.

3 Results

After completing the intervention process, the results of the achievement test and the results of the engagement scale were analyzed in this process for the gamified group and the non-gamified group. The results of the tests for each research question are presented in turn.

Comparison of the results of the academic achievement scale in the groups for the first research question, the Mann-Whitney U test was used to compare academic achievement test scores by group (see Table 2).

Table 2: Results of the Mann-Whitney U test for the average values of the groups' academic achievement

Variable	Groups	N	$\bar{X}$	Sum of Ranks	Mean Rank	*U*	*z*	p
Achievement Test Post-test score	Gamified Group	22	72,09	609,00	27,68	260,000	-.940	.347
	Non- Gamified Group	28	68,10	666,00	23,79			

According to Table 2, there is no statistically significant difference between the achievement scores of the gamified group and the achievement scores of the group that did not include gamification elements ($U = 260.00, p = .347$). It can be concluded that gamification elements

do not cause a significant difference in students' acquisition of course outcomes compared to the other group.

3.1 Comparison of the scale values of the questionnaire on engagement in the groups

The Mann-Whitney U test was used to compare class engagement by group between the class that included gamification elements and the class that did not include gamification elements. The results obtained are shown in Table 3.

Table 3: Results of the Mann-Whitney U test for the average values of the groups' classroom engagement

Variable	**Groups**	**N**	**Sum of Ranks**	**Mean Rank**	***U***	***z***	**p**
Engagement Question-naire	Gamified Group	22	693,50	31,52	175,500	-2.592	.010
	Non- Gamified Group	28	581,50	20,77			

Table 3 shows a statistically significant difference between the engagement questionnaire scores of the groups ($U = 175,500, p = .010$). Accordingly, the students in the gamified group engaged more in lessons than the students in the non-gamified group.

Finally, given that the assumption of a normal distribution is met, an independent-sample t-test was conducted to determine if the mean engagement scores of male and female students differed in the group of gamified activities with gamification elements. The results can be seen in Table 4.

Table 4: Results of the independent sample t-test for engagement scores of the gamified group by gender

Variable	**Groups**	**N**	$\overline{X}$	**sd**	***t***	**df**	**p**
Gamified Group **Engagement Questionnaire Post-test**	Boys (from gamified group)	9	3.95	0.31	-3.26	20	.004
	Girls (from gamified group)	13	4.45	0.37			

Examination of Table 4 reveals a statistically significant difference between male students' mean engagement score ($\bar{X} = 3.95$) and female students' mean engagement score ($\bar{X} = 4.45$) in the group that included gamification elements $[t(20) = -3.26, p = 0.00 < 0.5]$. Accordingly, female students participated in the course more than male students.

4 Discussion and Conclusion

This study, which used a quasi-experimental design, examined the effects of gamification on educational outcomes, student engagement, and gender factors. The main finding of this study is that students in the gamified group showed more engagement and interest in the lesson than students in the non-gamified group. On the other hand, no significant difference was found between the academic achievement scores of the groups. In educational environments where gamification elements are used, students may stand out with their different characteristics. Competitive mechanisms are triggered by commonly used scoreboards, badges, and leaderboards.

It has been observed that group or individual competitions are effective. In addition, group activities in the daily schedule promote the cooperation mechanisms of gamification. Similarly,

Halloluwa et al. (2018), in their study of gamified mobile educational apps mobile applications in primary school mathematics, found that students collaborate with each other even when they are not expected to do so. In a competitive environment, students take on different roles. Researchers Barata et al., (2010) divided these types of students into three groups; the first group of students, that is, they are successful, complete all tasks, get good grades, do not miss classes, and are active; the second group, the hopeless, leave the competition after a period of time with successes and are not satisfied with the gamification experience; the third group is the group with the worst grades and the lowest attendance, they are unsuccessful, they do not care about completing tasks and being better than others. According to the observations during the intervention process in our study, students in the gamification environment show a similar distribution as in this study. Some students compete for points and badges, while others do not participate in the competition and abstain.

First, as in some similar studies (Hanus & Fox, 2015; Khan et al., 2017), there was no significant difference between the comparison groups in terms of achievement scores. Also, when examining the effects of gamification in the classroom in their longitudinal studies (Hanus & Fox, 2015), they found that the intrinsic motivation of students in the gamified group decreased over time, while their final grades decreased. However, the insignificance of the difference contradicts (Khaleel et al., 2016)'s finding that "gamification improves students' understanding of the material and learning outcomes." In this case, it can be supplemented with group activities and discussions to enhance learning and understanding of the topic. In particular, alternating between different gamification elements can help maintain interest and motivation. Indriasari et al. (2020) also pointed out that most of the studies reviewed in their study involved multiple game mechanics used in combination, and that most were conducted in traditional or distance learning contexts in higher education.

On the other hand, in the study where gamification elements of the Edmodo environment were used, students differed significantly from the other group in terms of academic achievement (Uz Bilgin & Gul, 2020). Thus, it can be said that the included game elements and their different combinations lead to different results in different situations. In the bibliography (Jayalath & Esichaikul, 2022), it is suggested to place game elements in the implementation phase of teaching. Moreover, gamification strengthens both learning and engagement (Nand et al., 2019). However, the experiments on adapted gamified systems reviewed by Oliveira et al. (2022) generally provided insufficient statistical evidence, especially with respect to learning performance.

Students in the gamified group had a higher engagement in class than students in the non-gamified group. On the other hand, gamification practices have a positive effect on students' engagement in class in accordance with the targeted achievement (Andrew, 2014; Imran, 2019; Khan et al., 2017; Leaning, 2015; Su & Cheng, 2014; Ravandi & Batooli 2022). Jayalath and Esichaikul (2022) found that the implementation of gamification, especially in the application phase of the lecture, contributes to the achievement of competencies by increasing motivation and engagement. Indriasari et al. (2020) found in their peer-reviewed literature study of 39 papers that the papers predominantly reported positive effects of gamification on student engagement. However, Khan et al. (2017) stated that as students became more familiar with the gamification elements in the environment, their engagement and interest decreased over time. Imran, (2019) emphasizes the need for studies involving feedback and social interaction, even though the gamification elements of the badge earned and time spent increase engagement. In our study, as shown in Figure 3, the positive and negative ratings given for the desirable and the undesirable behaviors in the classroom also provide feedback. Indriasari and others (2020) also noted that student reflection on feedback received is largely unexplored in the context of gamification. In this case, the game element may increase class participation by providing competition and interaction. In this case, the game element can increase class engagement by providing competition and interaction.

In addition, this study also examined gender differences in classroom engagement. Male and female student engagement in the gamified group did not remain at the same level for four weeks. This conclusion is supported by some previous research findings (Khan et al., 2017). The engagement of female students in the gamified group was higher than that of male students. However, Zahedi et al. (2021) found that gamification as a strategy to increase learning also increased gender performance, but females were not entertained and motivated. However, one of the possible reasons that led to the result in favor of female students in our study could be that the gamification components used in the study (avatar, leaderboard, scoreboard, nickname, etc.) attracted the attention of female students more than that of male students. According to Oliveira and others (2022), the reviewed studies mainly considered learner gamer types to adapt instructional systems.

In the following studies, students' reactions to the gamification elements and the value and meaning given need to be observed longitudinally in the qualitative design. The reactions of male and female students to different gamification elements can be compared. Because it is found that gamification does not contribute to academic success in the four-week phase, an experimental design can be used to investigate whether it prevents students from being gained familiarity over time by incorporating different gamification elements into the process. It could be investigated whether gamification elements make a significant difference between individual activities and group activities. Research findings can be further enriched by equalized groups and larger groups in experimental designs.

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