

The Impact of Gamification on Students' Achievement in Online Learning Environments

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Received: August 31, 2022 Accepted: September 27, 2022 Published: September 30, 2022

doi:10.5296/ijld.v12i3.20232

URL: <https://doi.org/10.5296/ijld.v12i3.20232>

Abstract

The implementation of gamification techniques has unquestionably altered educational environments and conventional learning styles by dramatically altering the student and instructor positions. The aim of this study is to investigate the effect of the gamification techniques on students' academic achievement when applied in online learning environment. A quasi-experimental approach was utilized to determine the impact of gamification on students' academic achievement. Two 3rd grade mathematics classes consisting of 50 students total were selected, one as the experimental group and the other as the control group. Both groups received online learning via the Microsoft Teams platform. The experimental group received treatment that utilized gamification elements, while the control group did not. A pretest and posttest were given to students in the two groups. Findings revealed that gamification techniques did not affect students' academic achievement.

Keywords: gamification, learning achievement, online learning

1. Introduction

1.1 Overview

The application of gamification techniques in education helps to stimulate students' cognitive knowledge such as problem-solving and critical thinking. As a result, students become more engaged in the content of the lesson. In this regard, students' disengagement in the learning process can be considered a significant problem. It can contribute to poor performance and lack of understanding. The gamification approach supports students' achievement, increases their interest in the learning environment, and enables the acquisition of knowledge to be more fun for students. The overall goal is to boost a student's knowledge by teaching new

things, and prizes are provided to act as motivators. Gamification has also resulted in increased participation and attendance of students in classes. In educational settings, gamification has played a significant role in enhancing the learning that increases student achievement.

1.2 Importance of the Study

The major goal of this study is to examine the effect of gamification on students' academic achievements in mathematics in online learning. Most of the studies in the field were conducted in the USA and Canada (van Gaalen et al., 2021). In addition, the previous literature shows that few studies were conducted in high school or primary school (Indriasari et al., 2020), and most of the studies focused on the university level (Ekici, 2021). For this purpose, this study tried to explore the effect of gamification on 3rd-grade students in Saudi Arabia. Future research can also examine the effect of certain games on students' academic achievements in education.

1.3 Literature Review

1.3.1 Concept of Gamification

The adoption of gamification tools has contributed to students' increased interest in learning. Gamification can be defined as the use of gaming elements in a non-game context to create a game-like environment (Lister 2015). Gamification mainly involves applying elements of games such as badges and leaderboards in an educational context to make learning enjoyable (Attali & Attali, 2015). Gamification elements have been introduced to solve the problems associated with traditional learning methods that students may consider boring; therefore, it has helped promote their engagement. Most schools encourage gamification since it contains stimulating effects that motivate students, such as getting rewarded, having a feeling of achievement, and receiving immediate feedback (Turan, Avinc, Kara, & Goktas, 2016). These stimulating effects provide incentives that influence the behavior of students.

In the gamified learning environment, gaming components are aligned with learning goals to ensure that students' interest is awakened and that they are excited to compete in the tasks given. Therefore, gamification focuses on internalizing the external motivation provided by components of games (Türkmen & Soybaş, 2019). According to Alsubhi, Sahari, and Tengku Wook (2020), game elements have been proven to influence students' behavioral and cognitive aspects. Turan, Avinc, Kara, and Goktas (2016) state that, during the application of gamification, the cognitive knowledge of students should be considered to ensure that students can use gamification effectively and have the ability to retain knowledge and acquire new skills. The concept has created continuous learning practices that have reflected the high performance of students. The evolving technology has driven reformers to develop advanced teaching styles that will meet learners' needs (Türkmen & Soybaş, 2019). Gamification allows students to face failures revolving around learning, and the games drive the feeling of curiosity; hence, this increases their class participation.

1.3.2 Gamification Elements

Gamification activities have helped to increase the success of learning for students. Timers, avatars, teams, and content-unlocking are some of the elements that have helped eradicate boredom in the classroom setting (Alsubhi, Sahari, & Tengku Wook, 2020). The team element creates collaboration since students can solve challenges together. Using avatars has enabled students to feel secure and comfortable when undertaking activities since they don't have to show their identity. The use of badges in education setups also increases the level of motivation among students. The displaying of badges to learners allows them to gauge their performance in class since the best students are awarded the badges (Abramovich, Schunn, & Higashi, 2013). The gamification elements help to improve the collaboration of students and increase competition in class.

Leaderboards, dashboards, and progress bars are other elements applied to manage students' engagement levels. A leaderboard helps build students' interest in class, as the students' results are posted on a board based on the badges and the number of points earned. The dashboard also enables students to know their performance outcomes by displaying the analytics of activities undertaken during learning (Alsubhi, Sahari, & Tengku Wook, 2020). Points are applied to motivate students when they achieve certain levels of success in class. The progress bar is another framework used to track the understanding and effectiveness of learning. Reward methods are often used in gamification, making students eager to learn more since their efforts are compensated. These elements of reward positively engage the students, and they drive competition in class.

1.3.3 Why Gamification Isn't Game-Based Learning

Gamification utilizes elements of gaming to promote student performance and behavior during learning. It does not involve students playing with electronics and toys; therefore, it is not a game, but it still encourages competition as a means of keeping students engaged. Gamification cannot be compared to game-based learning, because gamification utilizes encouragement techniques during learning as a game (TeachThought Staff, 2014).

On the contrary, Game-based learning is composed of already established games that enhance the learning process, while gamification employs elements of games such as badges, progress bars, leadership boards, and trophies to boost students' knowledge. In gamification, students are provided with quizzes and tests that they are supposed to undertake, and when they achieve the tasks, they are given rewards as motivation. Therefore, gamification is simply employing game design to enable students to learn patience, collaboration, competition, and self-direction. Gamification helps improve the thinking skills of talented and struggling students.

1.3.4 Gamification in Education

The incorporation of aspects of entertainment in learning has led to a deepened understanding of concepts by learners. Gamification has a psychological influence on students by increasing their interest in and ability to perform their schoolwork (Ndlovu & Mhlongo, 2020). It also helps to increase the overall productivity of students. Gamification allows maximum benefits in the classrooms by driving the focus of goals in class through the performance of challenging tasks (Roberto, Ortiz, Nicolas, & Julian, 2019). One example of a gamification

tool is DimensionU, which involves a series of math games and provides academic support and promotes critical thinking skills (Attali & Attali, 2015). It has been employed to boost students' speed performance in tests and increase their motivation since the gaming aspect provides an immediate response after performing the test.

ConectaIdeas database is another program that employs gamification in learning setups. The program has been designed to help students solve math problems (Roberto, Ortiz, Nicolas, & Julian, 2019). It contains sessions with exercises aligned with topics covered in class, and it helps to assess and track students' achievement levels by comparing them with other classmates. Gamification has, therefore, positively impacted the engagement of students in different subjects in the learning environment.

1.3.5 Positive and Negative Effects of Gamification

Gamification has positively influenced the relationship between students and teachers. The strategy has created a platform for exchanging and sharing knowledge, therefore embracing high-order thinking and cognitive engagement (Alsubhi, Sahari, & Tengku Wook, 2020). Classrooms have also become livelier and more fun since students are motivated and happy. The gamification activities have enabled teachers to quickly track and assess the learning performance of every student (Abramovich, Schunn, & Higashi, 2013). Another positive effect of the technology is that it leads students to make inquiries online to gain more knowledge of their course work. Therefore, it is a great strategy to improve learners' engagement.

However, gamification also has some negative effects. Technical issues can negatively affect the usefulness of the gamification system to learners, as they can cause frustration to students when they are trying to study, leading to low levels of motivation (Alsubhi, Sahari, & Tengku Wook, 2020). Gamification can also create difficulty for lecturers when evaluating the level of engagement of their students. Also, gamification of all learning activities can create confusion for some students when it comes to learning online. Students are impacted differently by gamification; however, some students are not motivated by this strategy. The stronger students are likely to be less motivated by gamification since they score higher all the time; therefore, they lack the motivation to compete with other students. Likewise, less competitive learners are demoralized by the approach due to its competitive nature (Lister, 2015). Therefore, due to gamification's negative impacts on some students, course designers should create a platform that matches all learning profiles to ensure that gamification is effective.

1.3.6 How Gamification Relates to Students' Engagement and Motivation

Gamification helps to improve students' activity levels in class. Since competition is a crucial aspect of gamification, it allows students to stay motivated by stepping out of their comfort zones. This contributes to the development of skills and creativity. The activities also enable learners to enjoy their schoolwork because of the variety of activities they are performing (Ndlovu & Mhlongo, 2020). The ability to measure performance in gamification enables students to stay grounded and alert in class. The gaming technology also creates an

opportunity for students to experience failures and learn from them through the freedom to fail element (Alsubhi, Sahari, & Tengku Wook, 2020). Gamification is a great tool to improve the learning progress and performance of students in class.

The competitive nature of gamification can negatively impact students' engagement and participation in class. Despite the positive effects that gamification contributes to students' productivity, it is also likely to demoralize certain aspects of performance. Emotional responses are likely to occur due to the high competition associated with gamification. Students must reach specific targets to achieve rewards, which can pose stress and anxiety levels for individuals struggling to attain specific outcomes. Students may also fail to understand the main agenda of using gaming elements to achieve learning outcomes (Turan, Avinc, Kara, & Goktas, 2016). Therefore, they may lack encouragement to face their schoolwork since there is a lot of comparison with their peers. According to the cognitive load theory, overworking the memory with high cognitive loads can affect an individual (Turan, Avinc, Kara, & Goktas, 2016). Therefore, for students suffering from stress and anxiety due to gamification, their motivation and performance levels are likely to be reduced.

1.3.7 Gamification in an Online Environment

Online learning, especially with the utilization of gamification elements, has made learning effective and efficient. Game elements such as content unlocking and quizzes help to bolster students' positive attitudes during online classes. The use of levels (akin to those found in video games) has enabled instructors to present different unit modules and course material online, helping students track their records. A learning management system (LMS) is another concept that has been employed to manage online education in gamification. LMS allows teachers to gauge the performance of their students by creating a platform for submitting results, accepting assignments, and updating the students' results digitally (Alsubhi, Sahari, & Tengku Wook, 2020). A LMS also provides automated marking of learning assessments; therefore, it helps to make teaching easier for instructors. In addition, e-learning discussions (which can be hosted on a LMS) help increase the participation of students in class, promoting high levels of cognitive engagement.

1.3.8 Gamification and Students' Achievement Within Online Learning Environment

Gamification strategies aim to bring the desired change in students' behavior, but this is not always the case in actuality. Aji and Napitupulu (2018) conducted research to determine the impact of gamification on e-learning with support for learning motivation and learning achievement. Their sample size was 24 students in junior high school in Indonesia, and a questionnaire was used to collect data, which was analyzed via t-test. Findings show that gamification within e-learning does not result in a positive impact on enhancing the learning achievements and learning motivation of the students. Dikmen (2021) conducted a meta-analysis study looking at the consequences of the gamification of learning on the academic accomplishment on online platforms. Of 1,746 studies considered, 52 studies were included in the meta-analysis. Three levels of participants, middle school, high school, and university students in Turkey, were included. The results suggest that gamification does not have a noteworthy impact on academic success in technology-based courses (Dikmen, 2021).

Moreover, physical games have a more positive impact compared to digital games.

Can and Dursun (2019) initiated a research study to analyze the effectiveness of a blended learning environment with embedded gamification elements. Quantitative and qualitative data were obtained via survey, academic achievement test, and focus group interviews. The sample size was 63 freshmen students in Turkey enrolled in a course on information technologies in education. The results of the study state that there was a significant increase in the posttest scores of both the control and experimental groups for academic achievement. Moreover, there is no difference in the mean scores of both groups in regards to teaching presence, social presence, cognitive factors, and motivation scores

Öztop (2022) conducted a study to determine the impact of digital games compared to non-digital games on primary mathematics teaching. Data was collected using a meta-analysis methodology from 20 studies conducted in Turkey (Öztop, 2022). The findings are that the non-digital games for primary school mathematics teaching were found to be successful, while digital gamification had a small impact compared to non-digital gamification. The results also stated that non-digital gamification was better than digital games for academic accomplishment in primary school mathematics teaching.

Aljraiwi (2019) investigated the success of gamification of web-based learning for creative thinking as well as academic accomplishment. The study was conducted among primary school students. The sample size was two equal groups consisting of 30 primary school students who were taking an English course in Saudi Arabia. A quasi-experimental approach was utilized to identify the relationship between dependent variables and independent variables. A tolerance test of creative thinking was used among the participants. The results show that there is a difference in the mean scores of post-test academic achievement between the control and experimental group in favor of the experimental group, which means the gamification of web-based learning helped in conceptual understanding for the experimental group. Gamification promoted learning and made the educational process more fun.

Jacobs (2016) conducted a mixed-method study to provide insights regarding gamification components in online teaching to influence student success in online courses. The study also aimed to know the impact of three gaming components on the academic success of students in an introductory child development online course. Participants were 106 undergraduate students at a university in the midwestern United States. Results found that the students were optimistic about the gamification component. Of the three gaming components used, which were unlimited lives, badges, and level-locking, only unlimited lives had a negative impact on student accomplishment.

Elshemy (2017) conducted a study to identify the impact of the gamification strategy on academic achievement and academic motivation among 68 9th-grade students who were enrolled in a science class in Oman. Participants were divided into control and experimental groups. A quasi-experimental approach and descriptive-analytic methodology were used. Findings were in favor of the experimental group, with a statistically noteworthy dissimilarity found between the experiment group and control group in enhancing academic motivation as well as achievement.

Türkmen and Soybas (2019) aimed to find out the influence of gamification methodology on mathematics learners. The study sample consisted of 5th-grade students divided into two groups, with 28 students in the experimental group, which had game-based learning methods, and 22 students in the control group. Mixed method research was used for data collection, which included unstructured interviews and in-class observations (Türkmen & Soybaş, 2019). Quantitative methods were used, as well as a semi-experimental design for the control group for pre-test and post-test analysis. Results, which were analyzed using SPSS, state that there is no difference between the achievement and attitude scores of the experimental and control groups. However, the achievement of experimental group students was slightly increased than that of the control group students.

Gafni et al. (2018) conducted a study to explore the results of gamification elements in the e-learning experience of students in software studies. The study subject was basic Linux commands. The study sample was 139 students, who were divided into two groups with 92 students in the experimental group and 47 students in the control group. The results show that although the exam grades were not statistically noteworthy among the groups, the aspiration to learn was much higher with the help of gamified e-learning platform.

1.4 Research Question

1. Is there a significant difference in the pre-test and post-test of students' achievement scores of the experimental and the control groups?

2. Method

2.1 Participant Characteristics

The participants of the study consisted of 50 third-grade students studying mathematics in a public elementary school in Saudi Arabia, in the spring term of the 2021- 2022 academic year. They take six lessons in math a week with 40 minutes allocated to each lesson. Their ages were between 9-11 years old.

2.2 Sampling Procedures

A convenience sample was used, consisting of participants who were convenient for the researchers. One class was assigned randomly as the control group while the other was assigned as the experimental group. Twenty-five students were in the experimental group and 25 in the control group.

2.2.1 Sample Size, Power, and Precision

Using G*Power software, the sample size needed with power = 0.50 and effect size = .5 was 46. Thus, the sample of 50 satisfied the required sample size for the independent t-test

2.2.3 Research Design

A pre-test–post-test control group design of the quasi-experiment was used, since it was hard to manipulate the school settings.

2.3.4 Experimental Manipulations or Interventions

The study aims to explore the impact of gamification on achievement; thus, the experimental group was taught using gamification strategy while the control group was taught using a traditional strategy.

3. Results

A two-tailed independent samples t-test was conducted to see if there were any significant differences in mean scores of knowledge and skills between the control and experimental group at the pre-test stage. The pre-test results showed no significance based on the Alpha value (0.05), $p = 0.785$, and $t(32) = 0.27$, indicating the acceptance of the null hypothesis. In other words, there was no noteworthy dissimilarity between the control and experimental group for the mean scores of knowledge and skills at the pre-test stage. The students' knowledge and skills appeared to be homogenous.

Table 1. Two-tailed independent samples t-test for pre-test by groups

Variable	Control		Experimental		<i>T</i>	<i>P</i>	<i>D</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			
pre_Test	8.53	0.62	8.47	0.62	0.27	.785	0.09

Note. $N = 34$. Degrees of Freedom for the t-statistic = 32. *d* represents Cohen's *d*.

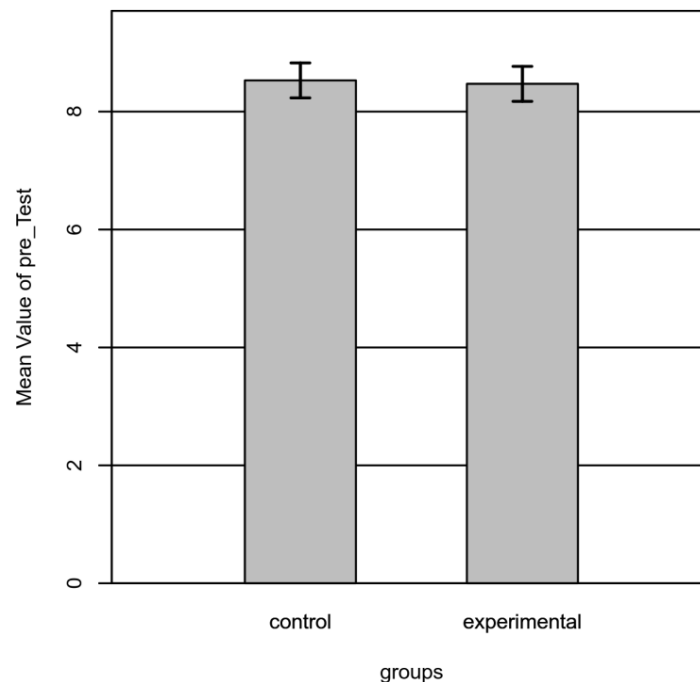


Figure 1. The mean of pre-test by levels of groups with 95% CI error bars

Similarly, a two-tailed independent sample t-test was conducted to look for dissimilarity between the means of the control and experimental group at the post-test stage. Based on Alpha value (0.05), $p = 0.325$ and $t(32) = 1.00$, it can be stated that there is no noteworthy dissimilarity between the control and experimental group for the mean of the post-test. We accept the null hypothesis.

Table 2. Two-tailed independent samples t-test for post-test by groups

Variable	Control		Experimental		<i>T</i>	<i>P</i>	<i>D</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			
post_Test	10.00	0.00	9.94	0.24	1.00	.325	0.34

Note. N = 34. Degrees of Freedom for the t-statistic = 32. d represents Cohen's *d*.

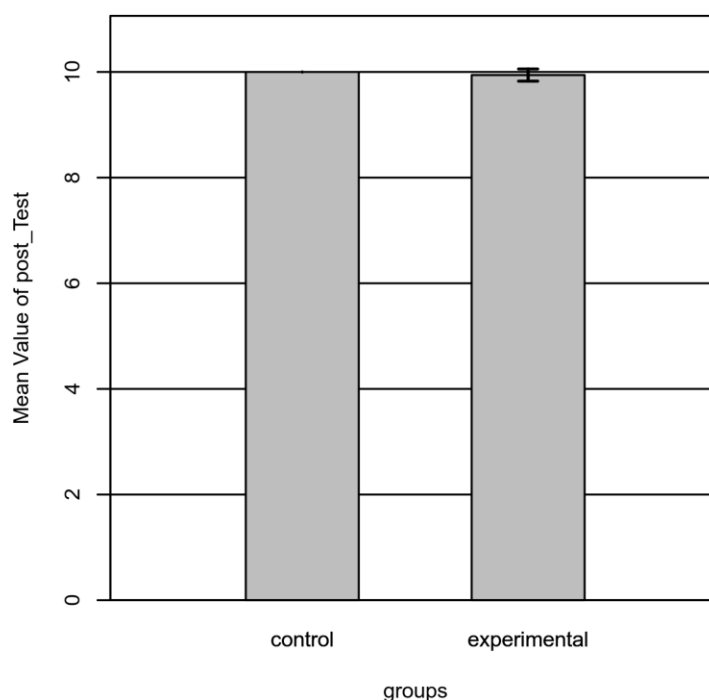


Figure 2. The mean of post-test by levels of groups with 95% CI error bars

4. Discussion

The research results proved that there is no noteworthy dissimilarity between the means of the pre-test and post-test scores for the control and experimental groups. Both groups were improved at the same rate. In other words, gamification has no impact on the success of the learners in the online learning environment, which means there is no difference between the grades of the control and experimental groups in both the pre-test and post-test stages. The results are consistent with the work of other researchers (Aji & Napitupulu, 2018; Can &

Dursun, 2019; Dikmen, 2021; Türkmen & Soybas, 2019), who found that gamification in e-learning did not result in a positive impact on the learning achievements, motivation, or academic success. However, they differ from Aljraiwi (2019) and Elshemy (2017), who did find noteworthy differences and enhanced motivation. Finding more of a middle ground, Gafni et al. (2018) showed that although the difference in exam grades was not statistically noteworthy between their control and experimental groups, the aspiration to learn was much higher with the help of a gamified e-learning platform for the experimental group.

There can be numerous reasons behind the lack of difference in the mean scores of the control and experimental group in the present study. One of the reasons could be the short time of the implementation. It is difficult to analyze the performance or improvement in three weeks because it takes time for students to develop a habit of studying using different techniques. Apart from this, the small sample size could be another reason. There were only 46 participants, and all of them were males. Another reason can be the type of subject, which in this case was basic computation skills, which are often considered to be noncomplicated math skills by the majority of students, suggesting that gamification would not give students any real advantage.

4.1 Suggestions for Future Research

The research study has provided a new experience regarding the awareness of the likeliness of gamification strategies in online studies. Numerous suggestions have been proposed based on the outcomes of the research. The first is to increase the number of samples. The higher the sample size, the more accurate will be the results. The second awareness is that gamification should be done consistently in the online learning environment for better results. The third is to investigate the impact of replacing the actual teachers in the online learning environment because the students may experience poor motivation. Next is to add numerous gamification features so that students could understand the concepts and learn even in the absence of the teacher. Next is to conduct the research on students of different age groups because this study focused only on third-grade male students.

4.2 Conclusion

To conclude, the role of the instructor is important at all levels of teaching. An instructor and learning strategies can motivate and guide students to achieve the learning objectives. The results obtained show no noteworthy dissimilarity in the control and experimental group of pre-test and post-test levels when applying gamification strategies within the online learning environment.

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