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İsmail YILDIZ
ismaily@kastamonu.edu.tr

Ersin TOPÇU
Amasya University, ersintopcu@amasya.edu.tr

Esra İZMİR
Sinop University, ekaptan@sinop.edu.tr

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The Effect of Gamification on Pre-Service Teachers' Technology Acceptance

İsmail Yıldız
Kastamonu University

Ersin Topçu
Amasya University

Esra İzmir
Sinop University

Abstract

This study delves into the transformative potential of gamification within the realm of education by integrating game elements into a lesson process primarily designed for non-gaming purposes and contexts. In this study, gamification was created by incorporating game elements, such as points, badges, and leaderboards, into lessons designed for a non-game purpose and context. The study investigated the effect of gamification on pre-service social studies teachers' technology acceptance. The Technology Acceptance Scale for Teachers (T-TAM) and structured interviews were used to collect data. The study utilized a quasi-experimental design with a pretest-posttest control group to test the cause-and-effect relationship between variables. According to the findings obtained after the six-week implementation period, gamification had significant effects on pre-service teachers' perceived usefulness, perceived ease of use, attitude toward use, facilitating conditions, technological complexity, perceived enjoyment, and behavioral intentions. The results underscore the potential of gamification as an effective pedagogical tool for enhancing the integration of technology in educational contexts, particularly for pre-service teachers. Consequently, this research contributes valuable insights to the role of gamification in fostering more technologically adept educators, with implications for the broader field of educational technology and instructional design.

Keywords: gamification, technology acceptance, social studies, teacher education

Introduction

In today's world where human, comfort-oriented, and speed-oriented developments are deeply felt, information and technology, which constitute the essence of these developments, have introduced us to the concept of Information and Communication Technologies (ICT) as an indispensable part of life. ICT basically refers to communication and computer technologies used to create, share, organize, store, transmit, and manage information (Blurton, 1999; Olakulehin, 2007). Today, devices such as computers, smartphones, tablets and internet-based services are the pioneers of these technologies. However, technologies that initially emerged to meet people's needs have created their own needs over time. For those who want to benefit from technology, acquiring basic technological skills, such as using computers, communicating over the internet, and participating in common networks, has become a vital necessity (Figel, 2007). Technology, which is used for various purposes in almost every aspect of life, now seems to be mandatory in the field of education as well. The new generation, born into the digital age and growing up with a constant flow of digital information, accepts computers/smartphones and the internet as a natural part of their lives and even their bodies (Dingli & Seychell, 2015, p. 9). Therefore, it no longer seems possible to engage young people by applying traditional teaching methods that emphasize the leading role of teachers and rely heavily on pencils, boards, notebooks and physical books.

Research reveals that technology activates students in accordance with the student-centered constructivist approach that is widely used in many education systems today. It even facilitates the teaching process for students to achieve the objectives of the course and thus increases students' academic achievement by providing a more permanent learning environment compared to courses using traditional teaching methods (Baek et al., 2010; Ratheeswari, 2018; Fernado, 2020). In order to sustain this positive change prepared by ICT, teachers should have technical and techno pedagogical content knowledge competencies to use technology successfully (Harris, 2001; Koehler & Mishra, 2005; Amiri & Sharifi, 2014; Saka-Öztürk, 2017). In this sense, teachers' perceptions and attitudes toward the use of technology, or their acceptance of technology in general, are of great importance. Teachers with high technology acceptance are expected to have the necessary knowledge and skills to follow the constantly developing technology and to use it effectively in the classroom. However, studies show that teachers do not or cannot use technology widely and effectively despite their positive attitudes toward technology (Kurtdede-Fidan et al., 2016; Yılmaz, 2019; Canbay, 2020).

This may be due to the expectation of ready-made content, teachers' lack of techno pedagogical knowledge, the technology-method confusion they experience, their perspectives, perceptions, or attitudes toward technology (Çetin et al., 2014; Şendurur & Arslan, 2017). In order to prevent this situation, it is important to allow pre-service teachers to experience the impact of technology use on learning before they start their profession. In addition, since pre-service teachers' attitudes and intentions toward technology acceptance emerges as a result of their cognitive processes toward technology use, it is thought that providing future teachers with the opportunity to transform these processes into behavior through gamification applications may be beneficial in terms of technology acceptance.

This study builds its main argument on two important findings of previous research: gamification increases students' motivation (Kim, 2015; Dicheva & Dichev, 2015) and

teachers' beliefs influence their learning and use of technology in the classroom (Pajares, 1992; Fullan, 2007; Chen et al., 2009). In this context, this study aims to encourage pre-service teachers to use technology in their classrooms when they start working and to develop positive attitudes toward the use of technology in education. The research question for this study is as follows:

1. What is the effect of gamification on pre-service teachers' technology acceptance?
    a. What is the effect of gamification on perceived usefulness, perceived ease of use, perceived enjoyment, anxiety, behavioral intention, compatibility, technological complexity, subjective norms, facilitating conditions, attitude toward use, and self-efficacy?

Literature Review

Technology Acceptance

Previous studies show there is a positive and moderately significant relationship between teachers' self-efficacy beliefs and their use of technology (Bolat et al., 2017; Dereli, 2017; Aktürk & Delen, 2020). Therefore, it is important to develop knowledge, skills, and perspectives about technology in teacher education. In order to fully explain the network of relationships related to the use of technology in the teaching process, Davis (1985) developed the Technology Acceptance Model (TAM) by adapting the Theory of Reasoned Action (TRA) proposed by Ajzen and Fishbein (1977) to explain the usage behaviors in computer and information technologies. Davis's (1985) TAM is shown in Figure 1.

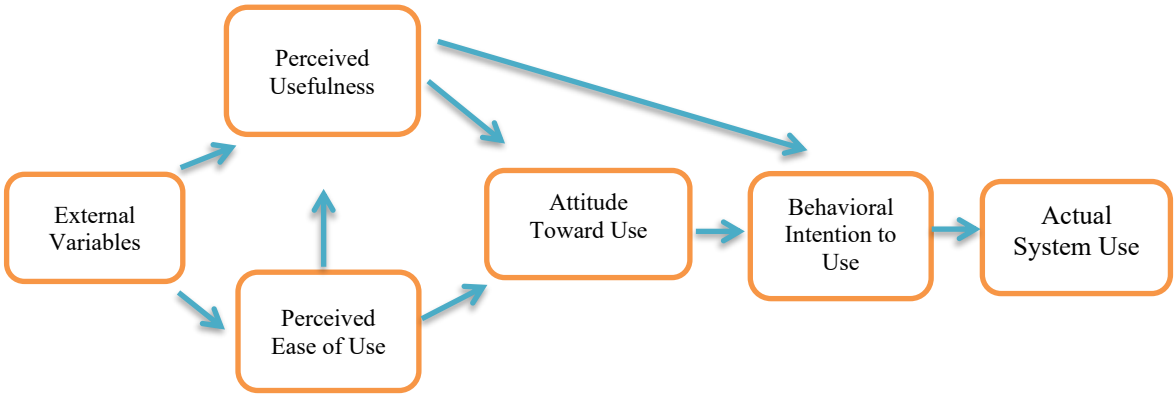

Figure 1: Technology acceptance model (Davis et al., 1989)

Davis (1985) employed this model in an attempt to elucidate the acceptance of information systems by users and to pinpoint the key determinants that predominantly shape the acceptance of technology. According to TRA (Davis, 1985), from which TAM emerged, intentions are the

primary motivation for human behavior, and intentions are determined by attitudes, which are formed by our beliefs and norms, which are influenced by self-evaluations of the outcome of behavior and our perceptions of the beliefs of those around us. Hence, by centering on attitudes and social norms, the TRA offers a framework to identify and assess the underlying factors contributing to an individual's inclination to either engage or refrain from a specific behavior. Consequently, it asserts that one's intention to partake in a particular behavior serves as the most reliable predictor of their actual engagement in said behavior. The theory also posits that perceived usefulness and perceived ease of use act as intermediaries, mediating the impact of external factors (e.g., system attributes, development process, training) on the intention to utilize. In this context, there exist interconnected social influences that affect an individual's decision when presented with the choice to adopt or decline a new system; these include subjective norms, willingness, and self-image. These concepts can be defined as follows:

> *Subjective norms:* The belief that the majority of significant individuals in a person's life either endorse or discourage a particular behavior.
>
> *Willingness:* Degree of perception that the decision is not mandatory (Venkatesh, 2015).
>
> *Image:* The extent to which an individual believes that adopting an innovation will enhance their standing within their social environment (Moore & Benbasat, 1991).

TAM was created to track the effects of external factors that influence individuals' acceptance of technology on internal beliefs, attitudes, and intentions. According to TAM, increased job performance when using a system and the fact that its use requires less effort have a positive effect on technology acceptance. TAM assumes that people form intentions to use computer systems largely based on a cognitive assessment of how it may improve their performance. Moreover, perceived usefulness and perceived ease of use, which are influenced by external conditions, are of primary importance for computer acceptance behaviors. In their 2014 study, Ursavaş, Şahin, and McIlroy argued that TAM produces varied results when applied to different technologies and user groups. Consequently, the generalizability of these findings to diverse samples is limited. To address this issue, they proposed enhancing the explanatory power of TAM by introducing new variables. They subsequently developed the Technology Acceptance Measure for Teachers (T-Tam), consisting of 37 items categorized into 11 factors: perceived usefulness (four items), perceived ease of use (four items), perceived enjoyment (four items), anxiety (three items), intention (four items), compatibility (three items), technological complexity (three items), subjective norms (three items), facilitating conditions (three items), attitude toward use (four items), and self-efficacy (three items). This comprehensive measurement tool aims to provide a more nuanced understanding of technology acceptance, particularly among educators. These 11 concepts constitute the factors of the scale used in the study and are explained in the methodology section.

Gamification

The most important factor affecting the use of technology is related to the individual's acceptance of it (Wu & Chen, 2017; Aparicio et al., 2019). The individual's perception of technology plays an important role in this acceptance. At this point, gamification is known to

be effective in the perception of technology acceptance (Baptista & Oliveira, 2017). Gamification can be defined as "the use of game design elements in non-game contexts to increase target behavior and interaction" (Kim, 2015). As per Lee and Hammer's (2011) research, the concept of gamification in education is akin to blending peanut butter with chocolate. It is an approach devised to bolster students' motivation, engagement, and retention of knowledge by integrating elements of games into educational settings (Dicheva & Dichev, 2015). These game elements, such as participation points, badges, rewards, and reputation systems with levels and leaderboards, are used to enhance the user experience or to engage the user in the environment (Deterding et al., 2011). In this study, gamification was created by incorporating game elements, such as points, badges, and leaderboards, into a lesson process that was originally designed for a non-gaming purpose and context.

Research demonstrates that gamification increases students' motivation, interest, and participation in the lesson, develops communication skills, helps to shape their identity, contributes to their socialization, facilitates learning, increases their permanence, and even increases new skills and learning abilities by 40% (Iwamoto et al., 2017; Landers & Armstrong, 2017; Yıldız et al., 2021). The more individuals perceive that gamification is easy to use, the more it influences behavioral attitudes toward the usability of the game, which in turn increases the user's intention and behavior to use gamification for education (Abdullah & Ward, 2016; Scherer et al., 2019). The existence of a positive relationship between TAM and gamification has been reported in studies such as Fredericks and Bosanquet (2017), Kao et al. (2018), Kissi et al. (2018), Aparicio et al. (2019), and Vanduhe et al. (2020).

However, the belief that technology enhances performance and that utilizing a specific technology demands minimal physical and cognitive exertion increases technology acceptance (Davis et al., 1989). Since perceived ease of use affects perceived usefulness, it is seen as a determining factor in the success or failure of any information system project (Davis, 1993; Shih-Chih et al., 2011). Therefore, if gamification applications are considered as a system, its positive impact on teachers' acceptance of technology will reveal the success of this system in education. According to this model, if individuals use a system to a great extent with little effort and improve their performance, the system is useful and therefore successful. Based on the literature review, we propose the following hypotheses:

H1. Perceived usefulness score of the technology acceptance model for gamification is significantly higher in the experimental group than in the control group.

H2. Perceived ease of use score of the technology acceptance model for gamification is significantly higher in the experimental group than in the control group.

H3. Perceived enjoyment score of the technology acceptance model for gamification is significantly higher in the experimental group than in the control group.

H4. Behavioral intention score of the technology acceptance model for gamification is significantly higher in the experimental group than in the control group.

H5. Compatibility score of the technology acceptance model for gamification is significantly higher in the experimental group than in the control group.

H6. Technological complexity score of the technology acceptance model for gamification is significantly higher in the experimental group than in the control group.

H7. Facilitating conditions score of the technology acceptance model for gamification is significantly higher in the experimental group than in the control group.

H8. Attitude toward use score of the technology acceptance model for gamification is significantly higher in the experimental group than in the control group.

H9. Subjective norms score of the technology acceptance model for gamification is significantly higher in the experimental group than in the control group.

H10. Self-efficacy score of the technology acceptance model for gamification is significantly higher in the experimental group than in the control group.

H11. Anxiety score of the technology acceptance model for gamification is significantly higher in the experimental group than in the control group.

Methods

Research Design

The main purpose of the study is to reveal the effect of gamification practices on pre-service teachers' technology acceptance. In the study, a quasi-experimental design with a pretest-posttest control group was used, designed to test the cause-and-effect relationship between variables (Cohen et al., 2017). The sample of this study consisted of 56 pre-service teachers taking the Basic Law course, 36 in the experimental group, and 20 in the control group. In the experimental group, the lessons were taught using gamification, while in the control group, the lessons were conducted without using gamification applications. A test was applied before and after the application to determine whether there was a difference between the groups.

Measures

The Technology Acceptance Scale for Teachers (T-TAM) compiled by Ursavaş et al. (2014) was used as a data collection tool to determine what influences acceptance and intention to use technology. This scale is a five-point Likert-type scale consisting of 11 factors and 37 items: perceived usefulness, perceived ease of use, attitude toward use, subjective norms, self-efficacy, facilitating conditions, technological complexity, anxiety, perceived enjoyment, compatibility and behavioral intention. These factors can be explained as follows:

1. *Attitude toward use:* The tendency to show positive or negative behavior toward any situation and event (Davis, 1989).
2. *Perceived usefulness*: The prospective user's perception that using a particular application system will improve business performance in an enterprise context and how little effort it takes to use a technology. This perception indirectly affects the perceived benefit (Davis et al., 1989).

3. *Perceived ease of use*: The level of anticipation regarding the ease of use expected by the user for the target system (Davis, 1989).
4. *Behavioral intention*: It is the main determinant of a behavior for creating possibility of performing a certain behavior, and it is an indicator of how much a person is willing to perform the behavior (Fishbein & Ajzen, 1975, p. 288). According to TAM, an individual's acceptance or refusal to use any technology primarily depends on the individual's intention. Warshaw and Davis (1985, p. 214) defined behavioral intention as "the degree to which a person has formulated conscious plans to perform or not perform some specified future behavior" (Ramayah & Ignatius, 2005).
5. *Subjective norms*: The conviction that a significant individual or a specific group will endorse a particular behavior (Ham et al., 2015).
6. *Self-efficacy*: The extent to which an individual believes in his/her capacity to perform a particular job/task (Compeau & Higgins, 1995).
7. *Facilitating conditions*: Organizational support that facilitates the use of ICT.
8. *Technological complexity*: The extent of innovation in a novel technology or system, bringing forth unique aspects that result in its simplicity, distinctiveness, and unorthodox application (Mardiputra et al., 2021), which determines how challenging it is perceived to be in terms of comprehension and utilization.
9. *Anxiety*: The degree of apprehension or even fear the individual feels when faced with the possibility of using a computer (Venkatesh & Davis, 2000).
10. *Perceived enjoyment*: The extent to which the activity of using a specific system is perceived as enjoyable in itself, as well as the performance outcomes resulting from the use of the system (Teo & Noyes, 2011).
11. *Compatibility*: An individual's perception of the extent to which the target system is applicable to the job (Venkatesh & Davis, 2000).

The qualitative data of the study were obtained through a the five-question structured interview form developed by the researchers. The questions cover the effects of the applications on the participants' perspective of the lesson, motivation toward the lesson, use of technology, and the use of gamification in their professions.

Study Group

For the quantitative dimension of the study, the researchers used a non-random purposive sampling approach that enables in-depth analysis of information-rich situations in accordance with the purpose (Büyüköztürk et al., 2018). The interview participants were determined by a stratified purposive sampling approach, which is preferred to capture large differences (Patton, 2002). The study group for the qualitative data of the research consisted of five pre-service teachers (three female, two male) in the experimental group. Accordingly, the participants were determined on the basis of their achievements at three levels within the group, namely low, intermediate, and high levels. In order not to change the natural environment of the students,

they were allowed to be with their classmates, and this caused a difference in the number of groups. The study group consisted of 36 experimental groups (22 females, 14 males) and 20 control groups (9 females, 11 males), totaling 56 pre-service teachers studying in the second grade of the Department of Social Studies Education in the spring semester of the 2018–2019 academic year.

Data Collection Process

The procedure summarized below was followed throughout the implementation process.

Step 1: The study lasted for six weeks in the spring semester of the 2018–2019 academic year within the scope of a Basic Law course taught in the third semester of the Social Studies Teacher Education Department. While the pilot study was applied to 30 students in the last week of September, the actual study was applied to 36 pre-service teachers for six weeks in October and November. Throughout the process, pre-service teachers were informed about gamification and applications such as Kahoot, Edmodo, and Gdrive. The pretest was administered to the experimental and control groups in the first week of October and the posttest in the third week of November (week six).

Step 2: Nineteen questions were prepared for six weeks in line with the learning outcomes of the course curriculum. The questions were uploaded to the Kahoot application and administered to the whole class via the SMART Board at the end of each week in accordance with the weekly lesson plans prepared at the beginning of the semester.

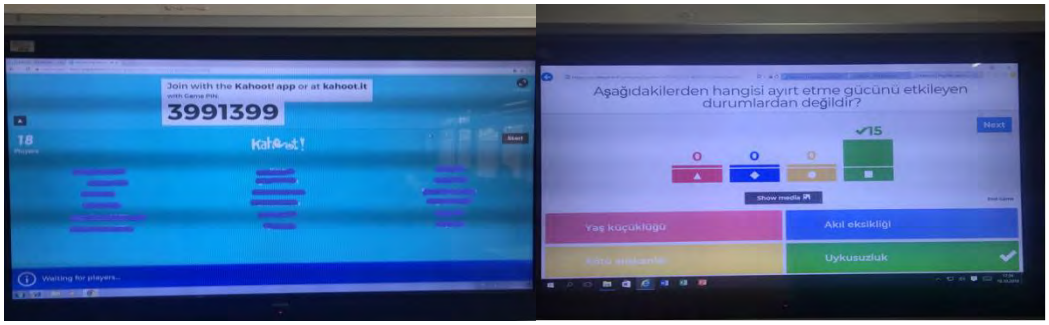

Figure 2. Examples of questions shared with the class in Kahoot on the SMART Board

Step 3: After the Kahoot experience, the last question of the day (question 20), called the bonus question, was sent to the students' mobile phones via the Edmodo program at exactly 7:00 p.m. of the same day. Students were asked to answer the question within 30 minutes after logging into the system.

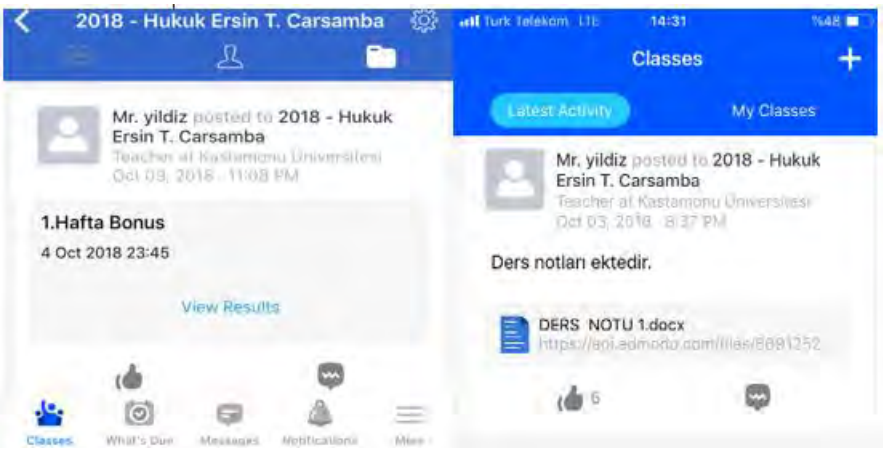

Figure 3. Screenshot showing that questions were sent to the students' mobile phones via the Edmodo program

Step 4: The scores of the students as a result of the questions sent to the Edmodo account during the day and at 9:00 p.m. on the same day were combined. The class rankings were then sent to the students on the Edmodo account the next day.

Figure 4. Screenshot showing that the class rankings were sent to teacher candidates via Edmodo

Step 5: Rankings were determined according to the scores received by the students, and the students were given ranks according to the grades they received. The titles of the ranks were determined according to the areas of specialization within the ahi community, which is the most important artisan organization of Turkish culture. The first student with the highest score was ranked as USTA (master), those between 2–5 as KALFA (undermaster), those between 6–12 as ÇIRAK (apprentice), and finally the students ranked 13 and higher as YAMAK (helper). Each student had the chance to improve their ranking on a weekly basis.

Step 6: In the last week of the implementation, in order to keep the students more active until the beginning of the lesson, tests consisting of three questions were sent five times a day, at 10:00 a.m., 12:00 p.m., 2:00 p.m., 3:00 p.m., and 4:00 p.m.. They were asked to answer them through the Edmodo program. When the lesson started, at 4:30 p.m., the SMART Board screen was turned on and the students watched the rankings and grades they obtained in line with the

scores they received from the five rounds of exams they took throughout the day on Gdrive at five-minute intervals.

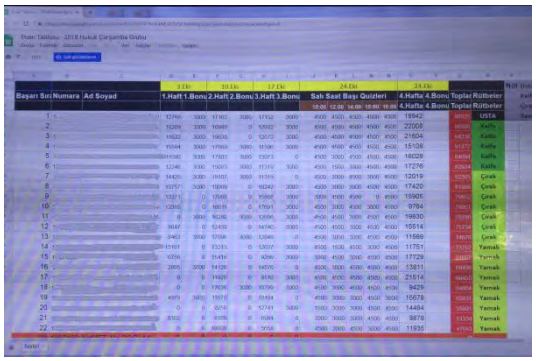

Figure 5. The screen on which pre-service teachers watched their scores

Step 7: At the end of the lesson, students reached their final rankings with the final Kahoot application of 20 questions. Afterward, the T-scale and a structured interview form were applied.

Data Analysis

For the quantitative analysis of the data obtained, SPSS 22 software was used. After the Technology Acceptance Scale for Teachers (37 questions) was applied to the experimental and control groups as a pretest, variables were created by determining the averages of the items belonging to 11 dimensions. Following this, the experimental stimulus gamification was given to the experimental group, while the Technology Acceptance Scale was applied to the control group teachers who did not use gamification. A similar procedure was adopted to create the variables in the posttest. The variables were determined by the averages of the items belonging to 11 factors. After the manipulation checks were made and reported, the differences between the pretest and posttest scores were determined using the related sample t-test. Thus, the effects of experimental stimulus gamification practices on technology use were determined. In the analysis of qualitative data, descriptive analysis was used since the themes were determined before the analysis. The findings were presented with direct quotations to support the quantitative data.

Manipulation Controls and Ethical Considerations

When we looked at the factors of the scale used in the research, the lowest Cronbach alpha coefficient was obtained for the self-efficacy factor with 0.798, and the highest was obtained for the perceived enjoyment factor with 0.909. If the factor loading of an item is greater than 0.50, it can be said that the item is reliable (Hair et al., 2006). On this scale, factor loading

values of all groups ranged between 0.67 and 0.93. Based on these data, it can be accepted that the scale is reliable.

In the context of manipulation controls, the question as to whether the differentiation in the pretest and posttest scores determined in the TAM dimensions occurred randomly or as a result of the gamification applications was examined. It was tested whether the pretest scores and posttest scores of the TAM dimensions differed significantly between the experimental and control groups. If the scores of these dimensions do not differ according to the experimental and control groups in the pretest, it is possible to argue that the samples are homogeneous. If there appears a difference between the scores of the groups, then it indicates that the gamification practices play a significant role. On the other hand, if the posttest results of the dimensions differ between the experimental group and the control group, it strengthens the view that manipulation with gamification applications is effective in shaping the participants' TAM perceptions.

In the pretest results, it was determined that attitude toward use (t(54)=-0.324, p=747), perceived usefulness (t(54)=-0.386, p=.701), perceived ease of use (t(54)=-0.463; p=.645), perceived enjoyment (t(54)=-0.031, p=.975), anxiety (t(54)=-0.959, p=.342), behavioral intention (t(54)=-0.284, p=.777), compatibility (t(54)=-0.220, p=.886), technological complexity (t(54)=-0.651, p=518), subjective norms (t(54)=-0.631, p=531), and facilitating conditions (t(54)=-0.395, p=694) use-oriented scores did not show a significant difference between the control and experimental groups except for self-efficacy (t(54)=-2.073, p=.043) scores. The scores of all other variables did not differ between the observation and experimental groups except for self-efficacy, which indicates that the participants in both groups had similar TAM perceptions.

The posttest results revealed that self-efficacy (t(54)=-1.720, p=.091), behavioral intention (t(54)=-1.594, p=.117), compatibility (t(52.351)=-1.577, p=.121), subjective norms (t(54)=0.000, p=.1000), perceived usefulness (t(46.146)=-4.145, p=.000), facilitating conditions (t(54)=-1.281, p=.206), and attitude toward use (t(54)=-1,263, p=.212) scores did not show a significant difference between the control and experimental groups, whereas ease of use (t(50.547)=-2.868, p=0.006), perceived enjoyment (54)=-2.731, p=0.009), anxiety (t(54)=-2.448, p=0.018), and technological complexity (t (54)=-3.313, p=.002) scores showed significant difference between the control and experimental groups. Significant differences detected in the posttest results indicate that the manipulations made within the scope of this study were influential in shaping the TAM perceptions of the participants in the experimental group.

For the sake of gaining credibility on qualitative data, the applications were performed in accordance with the triangulation technique. Direct quotations from the participants were used to verify the results. In order to provide the reliability of the qualitative data, the data were analyzed by three different social studies education experts and the findings were compared (Patton, 2014; Miles & Huberman, 2015). According to Stemler's (2001) measurement reliability formula, the higher the percentage of agreement between the coders, the higher the measurement reliability. In this study, the percentage of agreement between two coders was used. For this, Miles and Huberman's (2015) P (Percentage of agreement) = Na (Agreement) / Na (Agreement) + Nd (Disagreement) x100 reliability formula was used. As a result of the calculations, the reliability was 84%, and the qualitative dimension of the research was

considered reliable. To ensure confidentiality, participant data were de-identified. Informed consent was obtained from participants, including their explicit understanding of the option to withdraw from the study at any stage without facing any adverse consequences.

Findings

The study revealed significant positive effects in several key dimensions of technology acceptance. However, it was found that gamification did not have a significant effect on the dimensions of anxiety, subjective norms, and self-efficacy. The anxiety variable increased according to the posttest result. However, since gamification applications are expected to reduce anxiety, this result was interpreted as non-significant. The measurement results regarding the factors that cause pre-service teachers' technology acceptance are explained in Table 1.

Table 1
Results of the hypotheses tests

Variable Name	**Difference Between Group Means (Pretest, Posttest)**	**t**	**df**	**p**	**Hypotheses Tests**
Perceived usefulness	-.66667	-4.709	35	.000	H1-supported
Perceived ease of use	-.45370	-3.198	35	.003	H2-supported
Perceived enjoyment	-.68750	-3.792	35	.001	H3-supported
Anxiety	-.43750	-2.939	35	.006	*H4-not supported*
Behavioral intentions	-.32407	-2.009	35	.052	*H5-not supported*
Compatibility	-.40278	-2.322	35	.026	H6-supported
Technological complexity	-.38889	-2.563	35	.015	H7-supported
Subjective norms	-.30556	-1.254	35	.218	*H8-not supported*
Facilitating conditions	-.35185	-2.038	35	.049	H9-supported
Attitude toward use	-.54630	-2.475	35	.018	H10-supported
Self-efficacy	-.18519	-1.044	35	.304	*H11-not supported*

As shown in Table 1, the study revealed significant positive effects in several key dimensions of technology acceptance. Gamification positively influenced the perceived usefulness, perceived ease of use, perceived enjoyment, compatibility, technological complexity, facilitating conditions, attitude toward use, and behavioral intentions of the pre-service teachers. The findings of factors that cause significant differences in technology acceptance of pre-service teachers are explained under various headings below.

Findings on the Effect of Gamification on the Perceived Usefulness

The pretest and posttest scores of the participants in the experimental group regarding the *perceived usefulness* variable demonstrate there is a significant difference between these scores at the $p<0.001$ level. The results showed that the posttest scores (M=4.5208; SD=.62785) were significantly higher than the pretest scores (M=3.8542; SD=.94562). It was observed that gamification applications led to positive changes in the perceived usefulness level of the teacher candidates. The findings indicate that the gamification applications used by the pre-service teachers in the lessons made their technology use more beneficial, increased their performance and productivity, and made their work easier. Participant 4 stated that

> it caught my attention visually because it has technology in it. With applications such as Kahoot and Edmodo, we both strengthened our knowledge and prepared for the exam. As soon as the information is sent, it comes to our phone or device immediately. I think it was a very suitable method not only for this course but also for every course in the field of social studies.

This statement of the participant directly coincides with the result obtained from the quantitative analysis that "gamification leads to positive changes in the perceived usefulness level of teacher candidates."

Findings on the Effect of Gamification on the Perceived Ease of Use

The pretest and posttest scores of the participants in the experimental group for the *perceived ease of use* variable depict a significant difference at the $p<0.01$ level between these scores. It was determined that the posttest score (M=4.4812; SD=.62821) obtained in the context of perceived ease of use in the experimental group was higher than the pretest score (M=4.0278; SD=.82952). It was seen that gamification led to positive changes in the level of perceived ease of use for the teacher candidates. The findings indicate that the gamification used by the pre-service teachers in the lessons made it easier to acquire the skills required for technology use. In this regard, Participant 1 said, "It seemed to me like playing simple phone games that are not very difficult to implement. I did not encounter any difficulties, and the lesson became more practical." This statement of the participant directly coincides with the result obtained from the quantitative analysis that "gamification practices lead to positive changes in the perceived ease of use of teacher candidates."

Findings on the Effect of Gamification on the Perceived Enjoyment

The pretest and posttest scores of the participants in the experimental group regarding the *perceived enjoyment* variable show that a significant difference at the $p<0.01$ level was found between these scores. It was determined that the posttest score (M=4.4792; SD=.90903) obtained in the context of perceived enjoyment in the experimental group was higher than the pretest score (M=3.7917; SD=1,06486). It was observed that gamification led to positive changes in the perceived enjoyment level of the teacher candidates. It was revealed that gamification increased the perceived enjoyment, excitement, and pleasure in using technology. Participant 1 commented, "My point of view toward this course has changed with the practices we have done. It kept my attention sharp throughout the lesson, they made the lesson fun and created an ambition for success." This statement directly coincides with the result obtained from the quantitative analysis that gamification "practices lead to positive changes in the perceived enjoyment levels of teacher candidates."

Findings on the Effect of Gamification on Behavioral Intention

The pretest and posttest scores of the participants in the experimental group regarding the *behavioral intention* variable illustrates there is a significant difference at the $p<0.01$ level between these scores. It was determined that the posttest score (M=4.3125; SD=.81586) obtained in the context of behavioral intention in the experimental group was higher than the pretest score (M=3.8750; SD=.93637). It was found that gamification led to positive changes in the level of behavioral intentions of the pre-service teachers. The findings indicate that gamification increased their intention to use and recommend technology. Participant 2 stated, "Thanks to these applications, I started to think about using these applications with my students when I was going to teach. Thanks to this application, I believe that my students who will listen to my lecture will pay more attention to my lectures." This statement of the participant coincides with the finding obtained from the quantitative analysis that "gamification practices lead to positive changes in the behavioral intention levels of teacher candidates."

Findings on the Effect of Gamification on the Compatibility

The pretest and posttest scores of the participants in the experimental group for the *compatibility* variable indicated that a significant difference at the $p<0.05$ level was found between these scores. It was determined that the posttest score (M=4.2500; SD=1.01770) obtained in the context of compatibility in the experimental group was higher than the pretest score (M=3.8472; SD=.81783). It was revealed that gamification led to positive changes in the dimension of compatibility. The gamification that pre-service teachers used in their lessons increased their perceptions that technology is appropriate in terms of professional need, importance, and relevance. The views of one of the pre-service teachers are as follows: "Today, I don't think a

lesson can be taught without using technology. By using this technology in the social studies course, we can better prepare our students for the needs of the age."

Findings on the Effect of Gamification on the Dimension of Technological Complexity

The pretest and posttest scores of the participants in the experimental group regarding the *technological complexity* variable shows a significant difference between these scores at the $p< 0.05$ level. It was determined that the posttest score (M=4.4537; SD=.59710) obtained in the context of technological complexity in the experimental group was higher than the pretest score (M=4.0648; SD=.78405). It was observed that gamification led to negative changes in the level of technological complexity of the pre-service teachers. Gamification was found to be time-consuming and increased the technological complexity of technology use. This finding indicates that gamification did not reduce technological complexity and was a difficult practice for them. The opinions of a pre-service teacher support this result.

> In my opinion, although this practice is a positive practice, there have been some negative aspects arising from the implementation of these practices, because there are those who do not have internet. There are some errors in the system as well. Late answers cause us to lose points due to such reasons as the internet not working, the phone being slow, not being able to see the question, the student dropping out of the system during the competition or not being able to enter, or the questions being late to our devices.

This statement of the participant directly coincides with the result obtained from the quantitative part that "the gamification applications are time-consuming and the use of technology increases the technological complexity."

Findings on the Effect of Gamification on the Facilitating Conditions Dimension

The pretest and posttest scores of the participants in the experimental group for the *facilitating conditions* variable was displayed. The table portrays a significant difference between these scores at the $p<0.05$ level. The posttest score (M=4.1204; SD=1.03633) obtained in the context of facilitating conditions in the experimental group was higher than the pretest score (M=3.7685; SD=.86490). It was revealed that gamification led to positive changes in the level of the pre-service teachers' facilitating conditions. Gamification facilitated learning through competition and repetition, and gamification provided access to content outside of school. Participant 2 indicated that

> No matter what age we are, when computer support is included in learning, it becomes more enjoyable, and this makes our learning easier. With the Kahoot application, we have the opportunity to repeat what we have learned successfully in a sweet competition in the classroom. Thanks to these repetitions, the knowledge becomes permanent. In addition, thanks to Edmodo and Gdrive, being able to access the evening lecture notes and questions in the dormitory increased my concentration and interest in the course.

This statement directly coincides with the result obtained from the quantitative analysis that "gamification practices lead to positive changes in the level of facilitating conditions of teacher candidates."

Findings on the Effect of Gamification on the Dimension of Attitude Toward Use

The pretest and posttest scores of the participants in the experimental group regarding the *attitude toward use* variable shows a significant difference at the $p<0.05$ level was found between these scores. It was determined that the posttest score (M=3.9537; SD=1.00523) obtained in the context of attitude toward use in the experimental group was higher than the pretest score (M=3.4074; SD=1.07234). It was observed that gamification led to positive changes in the level of attitude toward use of the teacher candidates. Gamification practices showed that the use of technology by pre-service teachers increased some attitudes, such as having happiness in the profession, making lessons fun, and enjoying lecturing. Participant 5 expressed views supporting this:

> Although I approached these programs with a very prejudiced attitude about the relationship between lesson-game-technology, I changed my mind. I thought that the lesson and the applications were actually more difficult to teach to children, but now I think that it can be taught in an entertaining way with such applications in a more memorable way.

This statement directly coincides with the result that gamification practices obtained from the quantitative analysis "cause positive changes in the attitudes of teacher candidates toward use."

Discussion and Conclusion

In this study, the impact of gamification on pre-service teachers' technology acceptance was systematically investigated using the Technology Acceptance Model (TAM) as a reference point. The findings from the study suggest that gamification had different effects on different dimensions of technology acceptance among pre-service teachers. Outcomes indicate that gamification enhanced the teacher candidates' perception that technology is beneficial, easy to use, enjoyable, relevant to their profession, and compatible with their needs. Additionally, gamification increased their intention to use and recommend technology in educational settings. The pre-service teachers' statements and testimonies also confirmed the quantitative findings. The pre-service teachers described how gamification made lessons more engaging, fun, and practical, which increased their motivation and intention to integrate technology into their teaching practice. The findings also showed that the gamification practices used in the study fostered a sense of technological competence and confidence among the pre-service teachers. However, it is important to note that gamification was also associated with an increase in perceived technological complexity. This suggests that while gamification may have increased technology acceptance, it may have also brought some challenges or complexities in the process, such as technical issues and the need for adequate infrastructure.

It was found that gamification did not have a significant effect on the dimensions of anxiety, subjective norms, and self-efficacy. The anxiety variable increased according to the posttest result. This unexpected result suggested that despite the expectation that gamification would reduce anxiety, it did not demonstrate a significant impact in this regard. The dimensions in which the gamification effect was not detected in pre-service teachers may be related to the inadequacy of the applications in this context, or it may be related to the participants' general reluctance, technological inability, or technical difficulties. The related literature indicates that inconsistent results obtained in the Technology Acceptance Model may be due to technological differences, user differences, and differences in the items in the measurement tool (Schepers & Wetzels, 2007; Ursavaş et al., 2014). In this study, the underlying reason behind this may have been the struggle to keep the participants active with different applications at different times and places during the process, which may cause complexity in the organization or loss of the students' concentration to establish connections through different channels. However, this drawback was not considered much of a problem, considering gamifications' many other benefits.

According to the results obtained from this study, it was seen that gamification led to positive changes in the perceived ease of use of pre-service teachers. The finding that gamification used by pre-service teachers in their lessons positively affected their technology usage skills reveals that it also increased their perception of ease of use, in line with the result of a study conducted by Bolat et al. (2017). Perceived ease of use is a direct determinant of perceived usefulness. The less effort it takes to use a system, the more it can improve job performance (Venkatesh, 2015). This result is supported by Robey's theory that people have a negative attitude toward systems they perceive to be difficult to use and a positive attitude toward systems that they perceive to be easy to use (Davis, 1989).

The results indicate that gamification practices lead to positive changes in pre-service teachers' perceived enjoyment levels. The finding that gamification used by pre-service teachers in lessons increases the perceived enjoyment, excitement, and pleasure in technology use was also reported by Bolat et al. (2017) and Şıklar et al. (2015). This result also explains motivation in terms of three basic psychological needs—autonomy, competence, and relatedness—and emphasizes that when a person is intrinsically motivated, they act for the sake of fun or challenge, not because of pressures or rewards (Kim et al., 2017). This is supported by the Situational Learning Theory, which is based on the assumption that learning occurs through social interaction (Cihangir-Çetinkaya, 2009).

As a result of the study, it was revealed that gamification led to positive changes in pre-service teachers' attitude toward use. It was seen that gamification applications increased pre-service teachers' positive attitudes toward technology use, happiness in the profession, lesson planning, fun, and lesson enjoyment, and also caused positive changes in pre-service teachers' behavioral intention levels. The findings show that gamification increases pre-service teachers' intentions to use and recommend technology. The finding that gamification used by pre-service teachers in their lessons increased their intention to use and recommend technology is supported by the Success Management Theory, which emphasizes that individuals are motivated by their desire to achieve a set goal (Kim et al., 2017). It is also supported by TRA's claim that "the most important determinant of behavior is the behavioral intention of what a person intends to do and what not to do. Behavioral intention is determined by attitude and subjective norm

(an individual's attitude toward any behavior of those he or she considers important)," which forms the basis of TAM (Nunkoo & Ramkissoon, 2010; Trafimow, 2009).

Another significant result of this study is that gamification led to positive changes in pre-service teachers' compatibility levels and positively affected their perceptions that technology is appropriate in terms of professional needs, importance, and relevance. However, it was observed that these practices led to negative changes in pre-service teachers' technological complexity level. This finding shows that gamification does not reduce technological complexity and is difficult and time-consuming for pre-service teachers. Apart from this finding, it was revealed that gamification led to positive changes in the level of facilitating conditions of pre-service teachers. Teo et al. (1999) state that when a system is easy to use, it requires less effort from users, thus increasing its acceptance and use. In contrast, systems that are complex or difficult to use are less likely to be accepted because they require considerable work and attention from users. In addition, perceived ease of use is known to save a person the physical and mental effort of using a computer or computerized system (Davis, 1989). As a result, according to TAM, the user should first understand how to use a technological item, know whether it could be easy to use, and be familiar with the innovations brought by that technology and the benefits it provides in the user's field. Perceptions that technology is easy to use and useful are among the most important factors that determine the user's attitude toward that technology. These attitudes will determine the intention to use or not use that technology (Davis et al., 1989, p. 985). In light of Lander's Theory of Gamified Learning (TOGL), examining behaviors and attitudes toward technology is an important contribution to gamified learning research. Although gamification does not directly affect learning, it directly affects the learner's behavior and attitudes, which indirectly affects learning (Rivera & Garden, 2021).

In conclusion, this study underscores the potential of gamification as a valuable pedagogical tool for enhancing technology acceptance among teacher candidates. While some dimensions of technology acceptance were not significantly affected, the positive outcomes in perceived usefulness, ease of use, enjoyment, compatibility, and more suggest that well-designed gamification interventions can be instrumental in preparing future educators to effectively integrate technology into their teaching practices. However, educators and institutions should be aware of the potential technological challenges that may arise when implementing gamification and take steps to mitigate them. Overall, the findings of this study contribute to our understanding of the complex relationship between gamification and technology acceptance in the context of teacher education.

Limitations and Future Studies

The study focused on the integration of gamification in a specific context, which may limit the generalizability of the results to other courses or lessons. The study used the Technology Acceptance Model (TAM) as a framework for evaluation. While TAM is widely accepted, it may not capture all the nuances of technology acceptance, and its application may not fully represent the complexity of pre-service teachers' experiences. This study first assessed the short-term effects of gamification on technology acceptance. The long-term effects or sustainability of these changes in attitudes and intentions were not explored. Qualitative data

were collected through a structured interview form with only five questions. This limited the depth of qualitative insights and may not have captured the full range of participant experiences. The study does not account for potential differences in the types of technology used or gamification methods, which may have affected the results differently. Longitudinal studies could be conducted to examine the long-term impact of gamification on technology acceptance and use among pre-service teachers. This would provide insight into whether any changes are sustainable over time. To assess the generalizability and adaptability of gamification, its effectiveness in various educational contexts (e.g., different subjects, grade levels, and cultural backgrounds) and gamification elements could be explored.

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