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The examination of the gamification process in undergraduate education: a scale development study

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ABSTRACT

For this study, a scale was developed to measure the factors that may affect the gamification process in undergraduate education. The sequential exploratory mixed method was used to recruit the required data. Through the use of convenient sampling, 91 pre-service teachers participated in this study. Kahoot!, one of the online game platforms, was applied by the researchers to create a gamified learning environment, and a 10-week course plan was implemented. To collect the qualitative data, unstructured observations were undertaken each week. All the qualitative data were analysed via the content analysis method. Then, a scale initially including 26 items was developed based on the observation results and related literature. The quantitative data were gathered using this scale and exploratory factor analysis (EFA) was applied to examine the factor structure of the scale. The observation results were categorised under the following six themes: learning effect, expected outcome, competition, entertainment, engagement and intention. After required EFAs were implemented, three items were removed; thus, the final scale consisted of 23 items, and six factors that affect the gamification process in undergraduate education were revealed. The results concluded that the developed scale to measure the factors affecting the gamification process was remarkably valid and reliable.

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KEYWORDS
Gamification; Kahoot!; gamified learning environment; scale development

Introduction

Entertainment has occupied an important place in educational research in recent years and games are the settings in which entertainment is actively used. There has been a significant increase in the use of video games in the entertainment industry and popular culture with this area becoming a focus of study for the last 15 years (Seaborn & Fels, 2015). The concepts of educational game or serious game are used for the instructional use of video games. Video games are interactive activities that provide the continuation of new goals and challenges for players. Lee and Hammer (2011) emphasised that video games motivate players because they affect their cognitive, emotional and social skills. Video games also provide a fictional context in narrative, graphical and musical forms and thus maintain the player's constant attention (Watson, Mong, & Harris, 2011). Video games increase motivation for the exploration of new areas of interest beyond entertainment. Studies have revealed that video games have many potential advantages that can promote instant feedback, efficient learning, self-regulated learning or team collaboration in education (Rosas et al., 2003).

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Results of this study were partially presented at the 10th and 11th International Computer and Instructional Technologies Symposiums held in Turkey.

In current educational studies, researchers tend not to focus on using video games in education but on the external reflection of video games in educational contexts where games are not used. Thus, descriptions of gamification have been proposed not only for educational settings. As a newly developed strategy, the concept of gamification refers to systems that use game mechanisms and game design dimensions effectively in an interactive system but without a complete game with all its functions (Deterding, 2012; Deterding, Dixon, Khaled, & Nacke, 2011; Hamari, Huotari, & Tolvanen, 2015). Within the framework of these systems, gamification implementations in various virtual platforms are associated with commercial achievements. Gamification has arisen as a means of fostering a strong link between a platform and its users, increasing the popularity of the platform and guiding the behaviour of its users (Domínguez et al., 2013). The concept of gamification developed as a game design in non-game contexts has been used to direct people's motivations (Hamari et al., 2015). As a result, this concept is used to refer to an interactive system that aims at increasing the concentration and motivation of players through the use of game elements and mechanics (Seaborn & Fels, 2015). These significant potential advantages of gamification, which are particularly highlighted in the existing literature, can be used to overcome motivation problems resulting from limited interaction between teachers and students (Liaw, 2008). To build a gamification system that enhances student motivation, it is necessary to focus on the mechanics that make up the basic elements of video games that appeal to students (Domínguez et al., 2013). These game mechanics can help increase motivation in active learning processes (Domínguez et al., 2013).

One of the most common and important mechanics used in gamification processes are badges (Hamari, Koivisto, & Sarsa, 2014), since when receiving positive feedback, people often feel that they should respond within the framework of social norms (Hamari & Koivisto, 2015). The outcomes of the gamification process depend on the individual characteristics of players as well as on the type of badges (Hakulinen, Auvinen, & Korhonen, 2013); therefore, the effective selection of badges is of obvious importance. During the gamification process, individual members who exhibit a positive attitude towards the group strive to be part of the group, to satisfy the group and to survive among the members of the group (Lott & Lott, 1965). Thus, the effort they engage in to belong to and survive in the group in virtual platforms is reflected in the scoring activities in the gamification mechanics.

Many experimental and theoretical studies on gamification applications in education have been conducted and the literature relevant to the current study includes various studies that address gamification applications in educational processes. An overall review of these studies is presented in Table 1.

The literature search has shown that there are many experimental and theoretical studies on the use of gamification in education. These studies generally focus on the effects of gamification on learning settings (Chapman & Rich, 2017; Çakıroğlu, Başıbüyük, Güler, Atabay, & Memiş, 2017; Hakulinen et al., 2013; Hanus & Fox, 2015; Song et al., 2017; Yıldırım, 2017). Although studies often address such variables as students' motivation, student engagement, class satisfaction, academic achievement, student performance, class socialisation, entertainment and competence, there is also a considerable amount of work on gamification principles and the effectiveness of gamification elements (Hamari, 2017; Robson, Plangger, Kietzmann, McCarthy, & Pitt, 2015). In addition, the gamification literature also involves research that theoretically analyses educational gamification studies (Robson et al., 2015; Seaborn & Fels, 2015).

In the existing literature, many positive approaches to gamification and even expectation with no scientific basis have been discussed (IEEE, 2014). Biddiss and Irwin (2010) reported unconvincing results concerning the increased gamification activities. These non-scientific results lead to the distortion and questioning of the concept of gamification and its effect on truly motivated people (Gartner, 2012). Thus, the reports of the positive results obtained in gamification applications are examined by meta-analysis. However, there is a lack of useful contextual approaches and psychological effects that are important in the understanding of gamification studies (Hamari et al., 2014).

Table 1. Summary of the gamification literature.

Source	Purpose	Theoretical/ experimental	Sample size/age group	Results
Chapman & Rich (2017)	To determine the types of motivation in educational gamification	**Experimental**	184/university students (ages between 18 and 41)	Four motivational styles were identified in educational gamification: (1) Personal Progress; (2) Competition and Praise; (3) Individual Assignments; and (4) Group Work.
Çakıroğlu, Başıbüyük, Güler, Atabay, & Memiş (2017)	To reveal the effect of gamified instructional process on student engagement in a real classroom and the relationship between engagement/effort and academic performance	**Experimental**	37/pre-service teachers (ages between 18 and 24)	The game elements in educational processes have a positive effect on students' engagement, thus directly contributing to their academic performance.
Hakulinen, Auvinen, & Korhonen (2013)	To analyse the gamification effect on time management, attention and achievement of learning goals	**Experimental**	281/university students	Although they do not have an effect on achievement scores, achievement badges can be used to positively contribute to students' behaviour. Although this is not the case in all success badges, some types of badges lead to statistically significant differences in students' behaviour. In addition, students' responses to badges are different in two different courses.
Hamari (2015)	To reveal the effects of badges on gamification	**Experimental**	1579/university students	Considering the final scores in the sample group exposed to gamification, there are significant differences in all the use-related dependent variables.
Hanus & Fox (2015)	To test the variables including students' motivation, social comparison, effort, class satisfaction, learner empowerment and academic performance within the scope of two courses during a 16-week period	**Experimental**	80/university students	Students are socially comparable in the gamified course. Students have lower intrinsic motivation scores in the gamified course. Class satisfaction scores are lower in the gamified course. The effort in the gamified course is less than that in the non-gamified course. Learner empowerment in the gamified course is lower. Students' levels of intrinsic motivation have an indirect effect on their final exam scores.
Jackson (2016)	To describe the concept of gamification and the rapid integration into education, with a literature review, and to provide educators with a perspective of how they can integrate the gamification principles into the current curriculum	**Theoretical (Review)**	—	Gamification can be effectively integrated into education to increase student motivation and promote learning. However, there is a need for a detailed analysis of the students, course materials, learning objectives and the holistic nature of learning experiences. In addition, the mechanics and elements to be used in gamification in a meaningful learning setting should be identified.
Rashid & Suganya (2017)	To present a new perspective towards gamification applications in education	**Experimental**	55/university students	Gamification can increase students' participation in classroom activities.
Robson, Plangger, Kietzmann, McCarthy, & Pitt (2015)	To understand gamification principles	**Theoretical**	-	The gamification principles include mechanics, dynamics and emotions.

(*Continued*)

Table 1. (Continued).

Source	Purpose	Theoretical/ experimental	Sample size/age group	Results
Sailer, Hense, Mayr, & Mandl (2017)	To investigate the effect of different game design elements used in an online simulation setting on students' psychological needs	**Experimental**	419/university students (average age 22)	Badges, leaderboards and performance graphs positively influence 'competence need satisfaction' and 'perceived task meaningfulness'. Avatars, meaningful stories and teammates also positively influence 'social relatedness'. However, perceived decision freedom is not affected as intended. Researchers interpret the findings as follows: gamification is not effective alone; however, specific game design elements have specific psychological effects.
Seaborn & Fels (2015)	Academic literature on gamification: a systematic examination of conceptual and theoretical aspects of gamification	**Theoretical (Review)**	-	Although the term gamification has been used inconsistently, it has slowly increased in focus and a standard definition is appearing. The research suggests the collective use of the primary/basic frameworks based on psychological theories such as self-determination theory, and intrinsic and extrinsic motivation.
Song, Song, Ju, Xu, Pinto, & Yu (2017)	To encourage students to ask questions and give answers more often in learning settings through use of the point element in gamification in education	**Experimental**	50/college students (ages between 17 and 19)	Education gamification is particularly effective in the engagement of bashful or distractible students in the education process. Students are also more easily integrated into socialisation.
Yıldırım (2017)	To determine the effects of gamification-based learning practices on students' academic achievement and attitudes towards the course of instruction	**Experimental**	97/sophomores	Gamification-based learning practices have a positive effect on students' academic achievement and attitudes towards the course of instruction.

In a report by IEEE (2014), it is suggested that the number of gamification studies will increase significantly in the coming years. In particular, there is a need to present the outcomes of qualitative and quantitative dimensions of new gamification contexts. While the innovative effect of gamification may result in gains in the short term, there is a lack of evidence on the long-term effects of gamification (Hamari & Koivisto, 2015). Meta-analyses, on the other hand, have shown that gamification is spreading rapidly; however, there are several shortcomings in studies in terms of the sample size and survey durations (Hamari et al., 2014). Accordingly, the debates on gamification are still at divergent levels. There is a particular need to investigate gamification through long-term observations and reveal the gamification mechanics and dynamics, especially how the individual player's mood is affected by gamification. Thus, the variability of the gamification outcomes for different player characteristics can be revealed. There is also a need for survey studies with established validity and reliability in order to obtain large sample outcomes for gamification.

Within this context, the current study has both qualitative and quantitative dimensions in order to determine the effects of educational gamification on players. In this way, through the development of a scale based on qualitative data, the study aims to identify the factors that may affect the gamification process in undergraduate education. It is expected that this scale will contribute to the work on the effect of gamification in undergraduate education and guide researchers who design gamified educational settings.

Theoretical framework

In the literature, there are several frameworks describing the gamification principles, elements, needs and values. Among these, self-determination theory (Deci & Ryan, 1985) and a value-based gamification framework (Sakamoto, Nakajima, & Alexandrova, 2012) focused on the intrinsic motivation in the gamification process and Robson et al. (2015) explained the gamification principles in their framework.

Deci and Ryan (1985) emphasised that three main universal needs should be met in the gamified learning environment (GLE) to particularly increase the intrinsic motivation. These needs are *relatedness* (for interaction and being connected with others), *competence* (for being effective and overcoming the problems in the setting) and *autonomy* (to manage one's own life). The more these needs are satisfied, the higher the level of intrinsic motivation arises in a gamification process.

In their value-based gamification framework, Sakamoto et al. (2012) defined five values that especially increase the intrinsic motivation in a GLE: (1) *informative value* that refers to the provision of adequate information for a user to make decisions; (2) *empathetic value* that concerns creating a virtual character for social engagement; (3) *persuasive value* that means offering feedback information to display the future effect of a user based on his/her current situation; (4) *economic value* that refers to providing ownership to the users; and (5) *ideological value* that is related to assisting the users to remember abstract concepts such as friendship and justice. Lastly, Robson et al. (2015) described gamification principles as mechanics, dynamics and emotions, which together create a gamified experience. They explained these three principles as follows:

Mechanics are defined as the decisions made by the designers to determine the goals, rules, context, environment and interaction types to be applied in a gamification process. These mechanics are stable for all players in the game setting. Robson et al. (2015) took three types of mechanics into consideration. In *setup mechanics*, the required objects and the distribution of those objects among players are shaped (Elverdam & Aarseth, 2007). For instance, 'the setup mechanics will determine who a player is playing against: Is the competitor known or unknown, internal or external, a single competitor or a group?' (Robson et al., 2015, p. 415). In *rule mechanics*, the concepts or goals to be followed in the GLE are determined (Elverdam & Aarseth, 2007). The characteristics of these rules may be different. They can be based on time or objective. Furthermore, the game players should be

informed about what they are and are not allowed to do in that particular gamified experience. Lastly, in *progression mechanics*, the various instruments to be used in a gamified setting are shaped (Elverdam & Aarseth, 2007). Most applied instruments in a GLE are achievement rewards (Robson et al., 2015), which may not only be virtual such as scores, progress bars or levels, but may also be real rewards, e.g. currency. They emphasised that in particular, badges, leaderboards and trophies are strong progression mechanics in such settings.

Dynamics are defined as types of player behaviour which appear when the players engage in the gamified experience. Dynamics are generated by the way players pursue the mechanics determined by game designers. According to Robson et al. (2015), these dynamics may vary when spectators or observers participate in the gamified environment. For instance, if the players are aware of being watched by others, they may try to hide their feeling of embarrassment by acting more competitively. Since unexpected behaviours or actions might occur in such situations, it is very hard to predict the dynamics in a gamified experience.

Emotions refer to the reactions and mental situations that occur when the players enter into a gamified experience. In a GLE, the players pursue the mechanics, constitute the dynamics; thus, emotions are produced in that process. As Robson et al. (2015) commented, these emotions might occur in both negative (disappointment, sadness etc.) and positive (excitement, amusement etc.) forms. Figure 1 presents a visualisation of the gamification principles.

From the gamification principles of Robson et al. (2015), the theoretical framework of the current study was constructed and the game-based student response system called Kahoot! (Wang, 2015) was used by the researchers to create the GLE for the study. The mechanics of this GLE are explained in details in the procedure section of this paper. The dynamics and emotions that occurred during the study were observed by the researchers and are reported in the findings section.

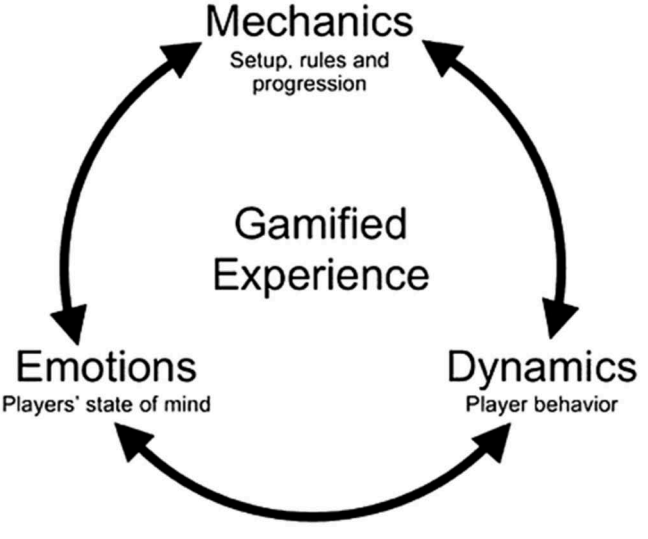

Figure 1. Gamification principles (Robson et al., 2015, p. 416).

Method

Research design

A sequential exploratory mixed method was used in this study. Creswell (2014) emphasised that applying this type of research design reveals adequate results particularly in scale development

studies. In this method, first, the qualitative data were collected, analysed and utilised as a basis to construct the quantitative phase. The qualitative data were collected through unstructured observations in a GLE to examine the factors affecting that process. Then, the themes derived from the qualitative data and related literature were used to develop a scale to collect the quantitative data. Finally, the validity and reliability analyses were conducted using the gathered data.

Participants

The required data were recruited from 91 freshmen and sophomores who were pre-service teachers studying at the Department of Computer Education and Instructional Technologies in a state university in Turkey. The study was carried out during 'Principles and Methods of Instruction (PMI)' and 'Introduction to Education Science (IES)' courses taught by one of the researchers. In this case, the convenient sampling method was used to access the sample of the study. Most of the participants were male (n = 60), and their ages ranged between 18 and 21. The number of the participants that had taken each course were close to each other. The demographics of the participants are presented in Table 2.

Table 2. Demographics of the participants.

	IES course Freshmen	PMI course Sophomore	Total
Male	29	31	60
Female	13	18	31
Total	42	49	**91**

IES: Introduction to Education Science, PMI: Principles and Methods of Instruction

Data collection instruments

One of the data collection instruments used in this study was unstructured observation notes. According to Given (2008), 'Unstructured observation is characterised by emergent research design, recognizing that what is observed may change as experience is gained in the setting' (p. 908). This method enables the examination of context and the research process in a continual manner, and provides extensive and rich data for research studies (Given, 2008). In this study, unstructured observations were conducted weekly by the researchers in order to examine the GLE.

The other data collection tool was a scale that measured the factors which affect the gamification process in a learning environment. This scale was created by the researchers in the light of observation notes and related literature. The items in this scale were created by considering the Kahoot! system. In other words, the features of this game-based platform shaped the scope of this scale. The first version of the scale included 26 items based on a 5-point Likert type with verbal anchors of 5 (*Strongly Agree*), 4 (*Agree*), 3 (*Neither Agree nor Disagree*), 2 (*Disagree*) and 1 (*Strongly Disagree*). During the scale development process, the views of two experts experienced in the field of technology integration in education were taken into account. Then, a language expert examined the grammar structure and compatibility of the scale for the target population. After the expert views were obtained, the scale was implemented, the required data were gathered and three items were eliminated after applying related explanatory factor analyses. Thus, the final version of the scale had 23 questions.

The procedure

Before creating the GLE, a syllabus including all details of the content and the process was prepared. The goals, context, interaction types and rules regarding the game mechanics were specified, and the participants were informed about all the steps during the gamification process.

The goals

The main reason for applying a gamification process during the related courses was to help the learners reinforce the course content. Besides, the aim was to increase the academic achievement of the learners by encouraging them to compete with each other. Lastly, it was expected that the learners, particularly those who had low motivation levels, would engage more in the course.

The context

Initially, the content of a 10-week course was organised. As already mentioned, the present study was conducted through two different courses. The classes consisted of 20 students on average. All courses were carried out in class sessions by the same instructor, and attendance in classes was required for both courses. Since all students took the courses for the first time, their academic background related to the course content could be assumed equal. When considering the socio-economic status of the students, all of them had at least one technological device, and they did not resist using technology during their instruction. All students had at least one social media account, therefore, one of those social media (Facebook) was applied for announcing the student of the week after related implementations were administered.

The researcher prepared PowerPoint presentations to introduce the content to the students throughout the course and used Kahoot! applications including questions related to the content presented in each week. The number of the questions ranged from 15 to 25 referring to the content intensity. Kahoot! is an online game-based platform allowing the educators to create game-based quizzes, and can also be used in mobile systems.

The Kahoot! applications developed for this study contain the steps as follows:

- The researcher displayed the questions in the Kahoot! platform during course hours, and the students responded to the questions using their smart phones/tablet PCs/laptops.
- The most of the students logged on to the game-based system through both the Internet network of the university and their mobile Internet.
- The duration of the presentation of each question was adjusted to its content, and the students were informed that they should have responded to each question within the specified duration. Answering each question lasted from 20 seconds to 60 seconds.
- Kahoot! plays different background sounds for each question. Even though the level of sound was sometimes decreased when the students were distracted, the most of the students preferred to have the background sounds.

The types of interactions

Student–student and student–instructor interaction types were used during this gamification process. In student–student interaction, since the students competed with each other to attain higher scores during the gamified course sessions, they did not interact with each other when answering the questions. However, they did discuss the answers/results after responding to each question.

In terms of the student–instructor interaction, after the allocated duration for each question ended, the Kahoot!-based system provided the correct answers and statistics concerning the responses; thus, the instructor was able to give feedback to the students who had responded incorrectly.

The rules

All the statistics related to the responses of questions were taken from the system in this GLE. Weekly responses were converted to a 100-point system. The rules for converting the grades were as follows:

(1) The Kahoot!-based system calculates the grades for each student regarding their pace and the number of correct answers. Thus, the student gaining the highest score for each course hour is announced by the system and this information appears on the leaderboard.
(2) The screenshot showing the name and score of the student of the week was posted on the group page of the course, which was created on Facebook.
(3) For the students who became student of the week for five times, five points were added to their final grade.
(4) After converting the grades, a gold medal was given to students who attained between 83 and 100 points, a silver medal for those achieving 76 to 82 points, and a bronze medal for those scoring 70 to 75 points.
(5) At the end of the semester, all the medal points were calculated and added to the students' midterm grades. One point was given for bronze medal, one and half points for a silver medal and two points for a gold medal.

During each week, the researcher acted as a background observer. In other words, she just appeared in the class to note down what was happening during each session. She took notes about the atmosphere, learning environment, physical characteristics of the setting, how participants reacted to the questions using the Kahoot! game-based environment and how they interacted with each other. In this way, the researcher aimed to develop a set of notes to describe the GLE in as much detail as possible. At the end of 10 weeks, all observation notes were analysed, and a scale including 26 items was developed by the researchers in the light of the results of observation and the related literature. Then, the quantitative data were collected using this scale.

The data collection procedure of the current study is demonstrated in Figure 2.

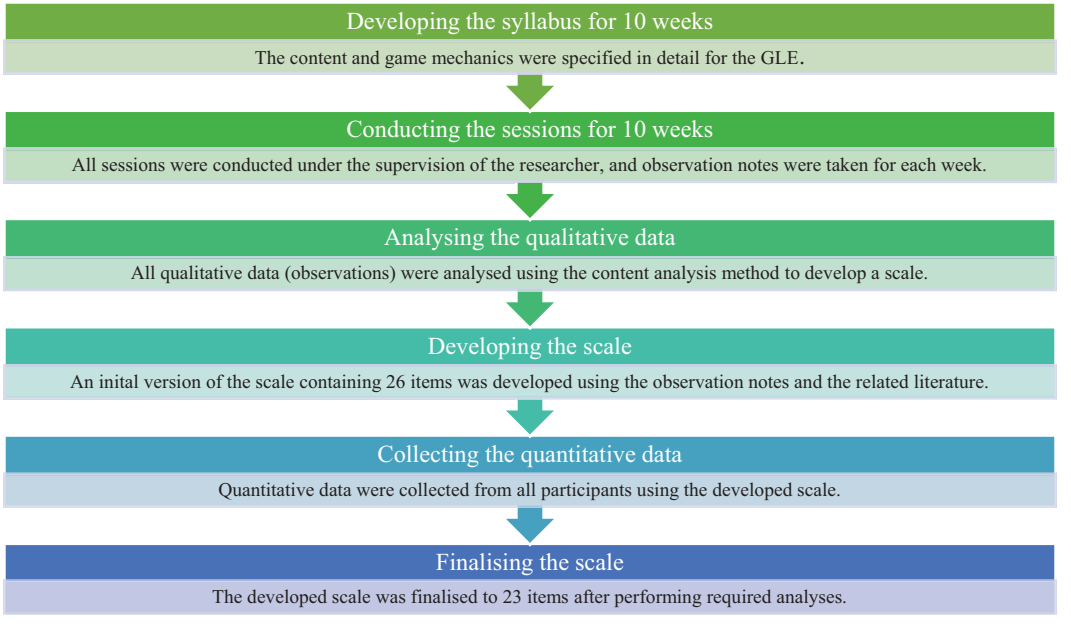

Figure 2. Data collection procedure.

Data analysis

The collected data were analysed under two phases: qualitative and quantitative. During this process, the content analysis method was applied. First, all the observation notes were entered verbatim into MS Word files, then all the data were rearranged to collate related parts. The next step was to carefully read all the statements and create relevant themes. By following these steps, all the qualitative data were categorised under six main themes.

For the quantitative data analysis, exploratory factor analysis (EFA) was utilised to explore the factor structure of the developed scale. Missing data, reversed items, outliers, the distribution of normality, the correlations between items, sample size and adequacy of sample (Kaiser-Meyer-Olkin [KMO] and Bartlett's sphericity test) were considered to conduct the required analyses (Field, 2009; Tabachnick & Fidell, 2007). In this case, since the data were collected online and all parts were completed by the participants, there were no missing data.

Findings

Findings of this study are reported twofold. While the qualitative findings are explained by using the observation notes describing the GLE in undergraduate courses, the quantitative findings are reported by applying the developed scale as shown below.

The observation notes regarding the gamification process

After analysing the observation notes using the content analysis method, the results were categorised under the following six main themes: learning effect, expected outcome, competition, entertainment, engagement and intention. The results concerning how much content the students had learned, how they reacted while learning the content in the GLE, the extent to which they were active in the class, how the learning environment was affected by using such a game-based learning tool, and how the learning process was affected by the feedback provided by the Kahoot!-based environment, were placed under the *learning effect* theme.

The *expected outcome* theme was created to indicate the results of how students were affected by the achievement criteria expected from the GLE. The effects of earning badges or those that appeared on leaderboards were also observed. The results under this theme were particularly shaped by the mechanics of the game-based platform.

Using the *competition* theme, the intention was to gather the results about how students were affected by the scores given via the Kahoot!-based learning environment for their correct answers. Moreover, the answers to questions, 'Did all students attempt to compete with each other? If not, why?' were placed under this theme.

The findings regarding the level of entertainment, the effects of duration, visual and audio components provided by the GLE, and the effects of entertainment on the students' social engagement were presented under the *entertainment* theme.

The *engagement* theme included the results of how/why/how much students engaged themselves in this GLE. How they managed their learning process, or how they behaved between the questions provided by the game-based online platform, were other issues considered within this theme.

Lastly, the *intention* theme refers to clarifying whether the students were eager to use game-based learning tools such as Kahoot! in their future work/teaching. A summary of the findings related to each theme is given in Figure 3.

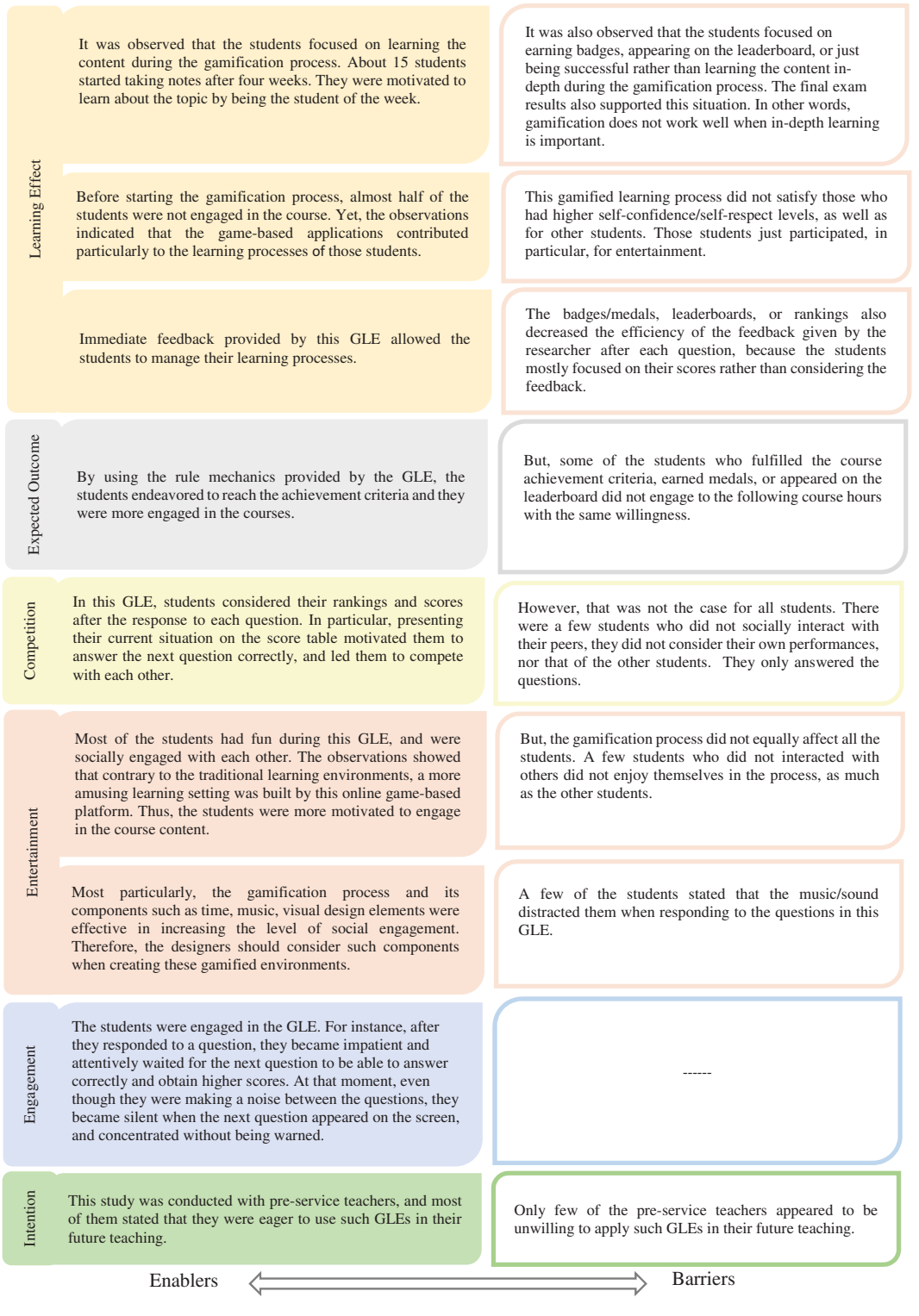

Figure 3. Observation findings regarding the gamification process.

Findings for EFA and reliability of developed scale

Initially, preliminary analyses including KMO and Bartlett's test were employed in order to check the adequacy of the sample size to implement the exploratory factor analyses. The KMO coefficient was calculated as .83, and Bartlett's sphericity test was found significant as $p < .01$. These results verified that the collected data were sufficient to employ the factor analyses.

The correlation matrix table was examined for the correlations between items. While considering those correlations, the p values of the items which might be problematic were also checked through the determinant of the correlation matrix table (Field, 2009). Moreover, because it was assumed that the factors included in the scale were correlated to each other, the oblique rotation method was used. In this regard, the Promax rotation method, one of the oblique rotation types, was applied.

All correlations between the factors were found significant ($p < .01$) and ranged between $r = .29$ and $r = .63$ (see Table 3).

The items with factor loadings were lower than .40 were removed from the scale. According to Pallant (2007), if an item has a value of common variance lower than .3, that item does not seem compatible with other items in the same factor. As can be seen in the Communalities column in Table 4, the common variance value of all items was greater than .3.

Even though it was expected that the items would be placed under six factors, the first EFA results concluded that the 26 items could be categorised under five factors. Therefore, after the 'fix number of factors' method was applied and the items were fixed to six factors, another EFA was employed. Since three items appeared under unrelated factors, those items (items 4, 10 and 11) were excluded from the scale. Thus, the final version of the scale contained 23 items.

In addition, the alpha coefficient values for each factor and the entire scale were checked and ranged from .67 (competition) to .87 (perceived learning effect, and intention) for the factors. In regard to the reliability coefficients, values around .90 are accepted as excellent; those around .80, as good; and around .70, as acceptable (George & Mallery, 2003). Taking these cut-off points as a basis for reliability, it can be stated that the competition factor was acceptable ($\alpha = .67$). On the other hand, Kalaycı (2010) evaluated the reliability coefficient values which are larger than .80 as highly reliable, and for those between .60 and .80 as quite reliable. Thus, in this case, the competition factor can be considered as quite reliable. The alpha coefficient value for the entire scale was found to be .93 indicating high reliability, and the total variance explained by 23 items was calculated as 73.54. Lastly, the Average Variance Extracted (AVE) values for each factor were checked to assess the construct validity of the scale. The results indicated that AVE values ranged between .56 (competition) and .84 (intention), suggesting adequate convergence and the distinct validity of the scale was high enough (Fornell & Larker, 1981).

Table 4 presents the communalities, rotated factor loadings, percentages of variance and coefficient alphas for items of the scale developed for the current study.

Finally, according to the item statements given in Table 4, Factor 1 was labelled by the researchers as 'perceived learning effect' (5 items); Factor 2, 'expected outcome' (5 items); Factor 3, 'intention' (4 items); Factor 4, 'entertainment' (3 items); Factor 5, 'engagement' (3 items); and Factor 6, 'competition' (3 items).

Table 3. Factor correlations.

	Expected Outcome	Perceived Learning Effect	Engagement	Entertainment	Competition
Intention	.46**	.29**	.39**	.33**	.50**
Expected Outcome		.49**	.55**	.52**	.63**
Perceived Learning Effect			.61**	.38**	.38**
Engagement				.47**	.48**
Entertainment					.48**

**Correlation is significant at the 0.01 level (2-tailed).

Table 4. Communalities, rotated factor loadings, percentages of variance, and coefficient alphas for items of the developed scale

	Items	Communalities	Perceived Learning Effect	Expected Outcome	Intention	Entertainment	Engagement	Competition
19	I learned about the topic while playing in a Gamified Learning Environment (GLE).	.69	.83					
22	It contributes to my learning while getting immediate feedback for every question in a GLE	.68	.81					
20	Playing in a GLE helps me to achieve the learning goals.	.73	.80					
21	I feel that I make an effort to learn in a GLE.	.77	.78					
18	I feel more positive towards course topic while playing the game in a GLE	.70	.70					
16	I endeavor to reach the achievement criteria (medal system, the student of the week, etc.) in the GLE	.84		.79				
17	I struggle to appear at the top of the leaderboard of the GLE	.81		.78				
1	I am getting excited while competing against others in a GLE	.68		.75				
15	I struggle to appear on the platforms (social networks, boards, etc.) that display the game results.	.63		.73				
2	I have fun while competing against my friends in a GLE	.73		.61				
24	I intend to teach my future courses in a GLE.	.80			.94			
26	I suggest that in future my friends teach their courses in a GLE.	.77			.90			
25	I plan to use GLEs in my future course.	.84			.88			
23	I wish other instructors would also gamify their teaching.	.64			.67			
7	It is fun to play game in a GLE	.79				.89		
8	I become engaged with the components (background music, duration, visual design etc.) of a GLE.	.77				.80		
6	It is fun to play a game with my friends in a GLE	.68				.71		
13	I just focus on playing while playing in a GLE.	.81					.75	
12	Time passes so fast while playing in a GLE	.72					.72	
14	I engage myself while playing in a GLE	.74					.57	
3	I consider others' performance while playing in a GLE to feel better about my performance.	.62						.40
5	I am excited when I earn a badge over others while playing in a GLE.	.69						.78
9	Being informed about the scores after each stage in a GLE increases my excitement.	.69						.52
	Total variance explained 73.54%		38.5	11.1	8.0	6.3	4.9	4.5
	Cronbach alpha α=.93		.87	.86	.87	.84	.82	.67
	Average variance extracted		.61	.73	.84	.80	.68	.56

Discussion

The main purpose of this study was to develop a scale to measure the factors that affect gamification processes in undergraduate education. Initially, a 10-week course plan was prepared in order to conduct the study, and a GLE was created using Kahoot! Before developing the scale, unstructured observations were followed during each week. After the 10-week period, the data gathered from observations were analysed. Then, in the light of observation results and the related literature, a scale containing 26 items based on a 5-point Likert type was created. After required validity and reliability analyses, the scale was finalised to 23 items.

The unstructured observation results were categorised under the six main themes of (1) learning effect, (2) expected outcome, (3) competition, (4) entertainment, (5) engagement, and (6) intention. The results under the theme 'learning effect' demonstrated that the participants made an effort to become successful in the course; for example, some of them took notes during the presentation of the course content. Furthermore, this gamified learning process increased the motivation levels of students who had not been engaged in the previous courses. This result showed consistency with

the outcome of other studies in the literature (Yıldırım, 2017). Furthermore, the immediate feedback provided by the created GLE allowed the students to manage their learning processes since, as Lee and Hammer (2011) emphasised, feedback cycles can be shortened by gamification, students can see their failures as an opportunity.

It was also observed that the students focused on earning badges, gaining a place on the leaderboard or just being successful rather than engaging in learning the content in depth during the gamification process. This result might be related to the enticement feature of gamification as reported in Fitz-Walter, Tjondronegoro, and Wyeth (2011) and Montola, Nummenmaa, Lucero, Boberg, and Korhonen (2009) in that the students might be tempted to wander off the content only engaging in the game elements. The final exam results also supported this situation; that is, gamification does not work well when in-depth learning is important. The badges, medals and leaderboards also decreased the efficiency of feedback given by the researcher after each question, and the students mostly focused on their scores. In their study, Witt, Scheiner, and Robra-Bissantz (2011) concluded that gamification elements, such as leaderboards, points are not coherently effective or well received. This was also the case in the current study. Furthermore, this gamified learning process was not effective in relation to in-depth content learning for students who had higher self-confidence/self-respect levels, and this could also be the case for other students. These students just participated in this environment, particularly for entertainment. This result might be understood through personality differences (McCrae & John, 1992) and player types (Hamari & Tuunanen, 2014; Yee, 2006) in GLE.

On the other hand, with the help of rule mechanics provided by the GLE, the students endeavoured to reach the expected outcomes; thus, they did engage in the courses to a greater extent. However, some students, once they had achieved certain levels in the course, earned medals or appeared on the leaderboard, did not engage in the following sessions with the same level of motivation or interest. Domínguez et al. (2013) found similar results reporting that some students with higher initial motivation levels were less engaged in the courses, and performed inadequately in some of the course tasks. In addition, Hanus and Fox (2015) also reported that the motivation and satisfaction levels of the students in their studies decreased over time.

Furthermore, in the Kahoot! system, the students considered their rankings and scores after they had answered each question. In particular, displaying their current situation on the score table motivated them to try to answer the next question correctly and led them to compete with each other. However, that was not the case for all students; especially the students who did not socially interact with the others did not consider their own performance nor that of the other students. Competing with others was not enjoyable for those students. Therefore, in addition to the four types of players defined by Heeter, Lee, Medler, and Magerko (2011) in terms of performance and superiority levels of achievement goals, other player types in the gamification processes need to be identified as supported by Domínguez et al. (2013).

Despite some students being less engaged in the process, the majority of the students were entertained by this gamification learning process and were socially engaged with each other. The observations in the current study showed that contrary to the traditional learning environments, Kahoot! provided a more amusing learning setting but it is important that in the gamification process, designers should consider components such as time, music and visual design elements as being very important in terms of social engagement (Cunningham & Zichermann, 2011). For instance, in the current study, a few students stated that the music/sound distracted them when they were responding to the questions in this gamified learning process. Therefore, such GLEs should be personalised according to learners' expectations/preferences.

In the current study, the participation level of students was increased by the gamification elements as found in Rashid and Suganya (2017) and Çakıroğlu et al. (2017). For example, after the students answered a question, they were excited and waited attentively for the next question to try to answer it correctly and to obtain higher scores. At that time, even though the students

were making a noise between the questions, they became silent when the next question appeared on the screen, and concentrated without being warned.

Finally, the participants in this study were pre-service teachers, and most stated that they were eager to use such GLEs in their future teaching.

Conclusion

After taking all the observation results and related literature into consideration, a scale initially containing 26 items was developed and finalised to 23 items after the required analyses. The validity and reliability analyses revealed that the final version of the scale was remarkably valid and reliable to measure the factors affecting the gamification process in undergraduate education.

Considering the difficulties and the length of the experimental studies related to the gamification process in education, it is mostly challenging to access large sample sizes in such studies. This was also the case for the current study since the results were limited to responses of 91 participants; thus, based on the limitations and results of this study, the following noteworthy recommendations for further studies are presented:

- The students who reached the achievement criteria did not engage in successive courses with the same level of desire. Therefore, the achievement criteria in the gamification process need to be regularly improved and changed.
- The gamification process did not affect the students who were generally not socially engaged with others. Hence, it would be better to utilise some collaborative and social mechanics in these learning environments to increase the participation level of less sociable users.
- Despite the fact that the main focus of this study was not examining the effects of the gamification process on overall learning, the findings of this study under the 'learning effect' theme and the observations suggest that there is a need for conducting more research studies determining the effects of the gamification process on overall learning in different educational contexts.
- The validity of the scale can be increased by accessing larger sample sizes.
- Finally, the developed scale could be used in different GLEs for different courses and education levels to provide a wider range of results.

Disclosure statement

No potential conflict of interests was reported by the authors.

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