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Prediction of students' learning outcomes by various variables in gamified online accounting courses

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Abstract

The study aims to examine student emotions and behavior in a Gamified Learning Environment (GLE) in detail. In the study, in order to reveal the behavior (dynamics) and feelings (emotions) that emerge within the framework of the mechanics applied in the GLE process, it is within the scope of the main objectives of the study to determine how perceived learning, academic achievement and GLE scores, which we accept as learning outcomes of the process, are predicted by various variables. For this aim, a scale was applied. In the study, non-experimental correlational and comparative designs were used together. The participant group of the study consisted of forty students enrolled in the Accounting 2 course at the Faculty of Economics and Administrative Sciences. The Kahoot system was used as a tool for the GLE. According to the results of the study, the 'expected outcome' and 'engagement' variables predict 'perceived learning'. It was also revealed that the 'expected outcome' variable predicts academic achievement. A low-level correlation was found between the students' participation level and their scores in the GLE. A moderate correlation was found between their participation level and the GLE scores before the midterm. Contrary to this, no corelation was found between these variables after the midterm. It was found that students with a high perception of engagement could solve quiz questions faster in a GLE. Among the contributions of the GLE, it was mainly stated that the application was practical, fun, and reinforcing. Among the limitations of the GLE, it was stated that there was an inability to see the questions, as well as a limited answer time.

Keywords Gamified learning environments · Accounting education · Academic achievement · Perception

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1 Introduction

Gamification is the application of game design elements to non-game contexts (Deterding et al., 2011; Domínguez et al., 2013; Yildirim, 2017). Gamification, which can be applied in various contexts, has started to be widely used in educational environments since it enhances students' participation and motivation (Jamaluddin et al., 2020). Using gamification in educational environments provides learning responsibility and motivation, influencing student behavior by encouraging teamwork (Gómez & Monroy, 2018). It plays a mediating role in helping students achieve learning goals at different cognitive levels (Signori et al., 2018). Additionally, when considered a pedagogical concept, gamification does not necessarily involve using an actual game or information technology (IT). Instead, it integrates design elements or activity patterns traditionally found in games into educational contexts (Buckley & Doyle, 2016). Indeed, while schools essentially separate students from each other and the outside world, games bring players together competitively and cooperatively within the context of social community (Shaffer et al., 2005). Although it is not mandatory to embed IT tools in the integration of the gamification process, it offers teachers new possibilities for the teaching-learning process (Martínez-Jiménez et al., 2021). Throughout the Covid-19 era, web-based gamification applications emerged as a beneficial tool for increasing student participation in distance learning (Nasu et al., 2021).

One of the areas where gamification tools are used in education is accounting courses. Considering the characteristics of students of accounting courses, it can be seen that certain students are not motivated to do their homework or tasks (Rosli et al., 2019) and have trouble grasping the fundamentals of accounting (Jaijairam, 2012; Moncada & Moncada, 2014). When teachers use chalk and a chalkboard to present lessons from books, they highlight essential parts, and students listen to them while taking notes on important points (Jaijairam, 2012). These traditional methods prevent students' thinking skills, applications, and problems from being addressed fluently in the classroom. However, students need to quickly grasp the terminology and fundamentals of the discipline to properly understand and apply concepts (Moncada & Moncada, 2014). The Accounting Education Change Commission (AECC) and the American Institute of Certified Public Accountants (AICPA) recognize the need for change in accounting education, and support accounting instructors in incorporating active learning opportunities and the creative use of technology into the curriculum, particularly in the introduction to accounting courses (Fratto, 2011). Moreover, as accounting theory and practice evolve, educators must do more to adapt to the rapid advancement of the business world. The solution is expected to be a student-centered approach that combines the Internet, social media, video, and games with current teaching methods to provide a rich and meaningful learning experience for the student (Jaijairam, 2012). Stakeholders in the discipline encourage accounting educators to give opportunities for active learning, incorporate the creative use of technology into the curriculum, and promote learning by doing (Fratto, 2011). Accordingly, games and Gamified Learning Environments (GLE) can

contribute to solving the problems in accounting education and encourage students to engage in active learning. Fajczak-Kowalska and Misztal (2021), who used gamification in accounting education, revealed the contributions and limitations of gamification to teaching processes in their research in which they determined students' perspectives. They stated that gamification contributed the following: increased students' participation in the teaching process; provided faster information exchange; allowed for better communication with the lecturer; established closer interpersonal communication; promoted learning from group friends; allowed students to get more pleasure from the learning process; and performed additional readings on the subject. Within the framework of the limitations of gamification, increasing competition, misunderstanding of gamification used in the education process, and concerns regarding final grades came to the fore.

The literature on gamification in accounting education was examined, and it was seen that the 'Kahoot' application, or an application developed by the authors, were generally used in studies. One of the studies was a literature review, while the others were qualitative, quantitative, and mixed research designs. It was determined that academic achievement, perception, entertainment, participation, motivation, attitude, ease of use, satisfaction, classroom interaction, and flow variables were included in the studies. Table 1 comprehensively summarizes the literature on gamification in accounting education.

1.1 Rationale and significance

Gamification is defined as applying components used in game design in non-game content. Although gamification applications are frequently used in the literature, they are considered a new field of research in accounting education (Özdoğan et al., 2018). There is little limited relevant literature on academic research into the effects and advantages of gamification in accounting education. (Rosli et al., 2019). In addition, although gamification applications provide positive effects at many points, it is stated in the literature that their effectiveness largely depends on the context in which gamification is applied and the users who use it (Hamari et al., 2014). For this reason, since gamification is not frequently used in accounting education, it is necessary to evaluate its use in different course contents/contexts in various aspects. In addition, considering accounting students' features, it was observed that a number of students lacked the motivation to complete their assignments or responsibilities. At the same time, others were too shy to explain their responses in class, and struggled with 'how' and 'why' questions (Rosli et al., 2019). To provide solutions to these problems, the use of gamification applications comes to the fore. When well-designed and effectively structured, gamification activities to support accounting courses are a teaching alternative, and they provide opportunities to elaborate on specific topics (Yaşar & Alkan, 2019). Additionally, educational technology tools should be used to improve the education of prospective professional accountants (Nasu et al., 2021). In this direction, organizing

Table 1 Summary of literature on gamification in accounting education

Source	Purpose	Course title	Method	The number of participants	Countries	Software	Variables in the studies									
							Academic achievement	Perception	Entertainment	Participation	Motivation	Attitude	Ease of use	Satisfaction	In-class interaction	Flow
Fajczak-Kowalska and Misztal (2021)	The ability to utilize gamification to teach accounting fundamentals	Fundamentals of Accounting	Quantitative	-	Poland	MS Teams and Moodle	√	√			√					
Faresqi (2021)	Using gamification to increase accounting master students' course participation and motivation	-	Qualitative	6	Indonesia	Custom developed software					√					
Grávalos-Gastaminza et al. (2022)	The effect of Kahoot application on the Financial Accounting course	Financial Accounting I	Quantitative	-	Spain	Kahoot		√	√	√	√			√	√	

Table 1 (continued)

Source	Purpose	Course title	Method	The number of participants	Countries	Software	Variables in the studies									
							Academic achievement	Perception	Entertainment	Participation	Motivation	Attitude	Ease of use	Satisfaction	In-class interaction	Flow
Gómez and Monroy (2018)	Using gamification for undergraduate students of the Distance Accounting Education Program	Accounting II, Accounting, Finance, and Public Budgets	Qualitative	64	Colombia	Kahoot					√					
Jamaluddin et al. (2020)	The effect of gamification on motivation in accounting education	Financial Accounting II	Quantitative	51	Malaysia	'Accounting on the Block'				√	√					
Martínez-Jiménez et al. (2021)	Kahoot's impact on academic performance	8 different courses taught in the Business Management department	Quantitative	414	Spain	Kahoot	√									

Table 1 (continued)

Source	Purpose	Course title	Method	The number of participants	Countries	Software	Variables in the studies									
							Academic achievement	Perception	Entertainment	Participation	Motivation	Attitude	Ease of use	Satisfaction	In-class interaction	Flow
Moncada and Moncada (2014)	To give guidelines for designing educational games by outlining the historical development of games as a teaching tool	Introduction to Accounting	Literature Review	-	USA	Hollywood Squares® and Milton Bradley Connect Four®										
Nasu et al. (2021)	Perceptions of Accounting students regarding Kahoot! Usage	Accounting for Diverse Entities	Quantitative	76	Brazil	Kahoot				√			√	√	√	
Özdoğan et al. (2018)	The supplementary use of gamification applications in accounting education	Basic Concepts of Accounting	Qualitative	-	Turkey	-										

Table 1 (continued)

Source	Purpose	Course title	Method	The number of participants	Countries	Software	Variables in the studies									
							Academic achievement	Perception	Entertainment	Participation	Motivation	Attitude	Ease of use	Satisfaction	In-class interaction	Flow
Rosli et al. (2019)	The effect of gamification on critical thinking and problem-solving skills	Entrepreneurship and accounting	Mixed methods	49	Malaysia	Board game	√	√								
Silva et al. (2021)	The effect of game-based learning on motivation, success, attitude, flow and learning	-	Quantitative	816	Portugal	Special software called AccountingGame		√			√	√				√
Sugahara and Cilloni (2021)	The effect of gamification in accounting education on learning perceptions	Management Accounting	Quantitative	146	Italy	LEGO simulation game		√								

Table 1 (continued)

Source	Purpose	Course title	Method	The number of participants	Countries	Software	Variables in the studies									
							Academic achievement	Perception	Entertainment	Participation	Motivation	Attitude	Ease of use	Satisfaction	In-class interaction	Flow
Yasar and Alkan (2019)	Raising awareness of the effectiveness of digital games and the necessity for educational strategies to exceed traditional patterns	-	Literature review	-	Turkey	-										

gamification applications on current technologies can meet the needs of today's young people, who are also called digital natives (Yaşar & Alkan, 2019).

In terms of accounting education, gamification has been found to increase academic achievement (Fajczak-Kowalska & Misztal, 2021; Martínez-Jiménez et al., 2021; Rosli et al., 2019), motivation (Faresqi, 2021; Gómez & Monroy, 2018), entertainment (Grávalos-Gastaminza et al., 2022) and students' participation in courses (Nasu et al., 2021). However, there are no studies on how students' perceptions of the concepts among the elements and outcomes of gamification are affected. It is stated in the literature that students' perceptions are affected by critical concepts, such as competition, entertainment, engagement, expected outcomes, perceived learning, and intention to utilize a GLE (Baydas & Cicek, 2019). In this regard, determining which variables affect students' perceptions of learning can effectively reveal the main concepts in creating gamification contexts. In the literature, it is frequently stated that gamification increases academic achievement (Aşıksoy, 2018; Barrio et al., 2015; Çakıroglu et al., 2017; Jurgelaitis et al., 2019; Tsay et al., 2018; Yildirim, 2017; Zainuddin 2018). In addition, identifying the gamification elements that influence students' academic achievement may shed light on the elements that must be examined to improve achievement in a GLE. In addition to increasing academic achievement levels, identifying the gamification concepts that affect students' academic achievement can help highlight the issues that need to be considered to increase success in a GLE. In addition, the literature emphasizes that a GLE increases students' participation in a course (Bouchrika et al., 2019; Davis et al., 2018; Ding, 2019; Ding et al., 2018; Huang et al., 2019; Tsay et al., 2018). Although students' participation in a course increases in a GLE, it is essential to determine how much this participation affects their achievement in the weekly subject content. Considering that the purpose of classroom practice is to develop academic knowledge, it would not be desirable for a GLE to increase participation only because it increases the perception of entertainment. In addition to all these things, students' speed at answering the quiz questions in a GLE may be affected by their GLE perception levels. Determining the effect of these variables on students' speed at answering questions may contribute to gaining information regarding student behavior within the framework of the dynamics in a GLE.

1.2 Theoretical framework for the design of a gamification context

Robson et al. (2015) provide principles of gamification that create an effective gamified experience. These principles involve mechanics, dynamics, and emotions.

Mechanics refer to the decisions designers make to determine the goals, rules, context, environment, and types of interaction to be implemented in a gamification process. Robson et al. (2015) highlight three types of mechanics; setup, rule, and progress mechanics. In setup mechanics, the required elements for gamification and distribution among players are defined (Elverdam & Aarseth, 2007). For example, a decision needs to be made about the opponent a player will face. Is the opponent known or unknown? Is this a single opponent or a group? (Robson et al., 2015). In rule mechanics, the objectives in a GLE are specified (Elverdam & Aarseth, 2007).

This is the process of prescribing to players what they can and cannot do within the confines of a gamified experience. Finally, the progress mechanics decide the tools used in a gamified setting (Elverdam & Aarseth, 2007). In a GLE, scores, progress bars, or levels are set, while achievement rewards, which are virtual and tangible, can also be among the tools chosen (Robson et al., 2015).

Players' behavior when they enter a gamified environment is called dynamics. This emerges in adhering to the mechanics defined by the game designers. Dynamics may change if there are observers or spectators in the environment. For instance, if players are aware that others are watching them, they may attempt to cover their embarrassment by behaving more competitively, or they may feel as if they are under pressure to do well. In such situations, predicting the dynamics in a gamified experience is challenging as unexpected behavior may develop.

Emotions are a player's responses and emotional states while participating in a gamified environment. In a GLE, players create dynamics by following mechanics. Emotions develop in this entire process. Robson et al. (2015) state that emotions could emerge in positive (excitement, entertainment, and others) and negative (disappointment, sadness, and others) ways. A visual form of gamification principles is presented in Fig. 1.

The theoretical framework of the current study is based on the gamification principles of Robson et al. (2015). The researchers used the Kahoot application to create the GLE for the study. The mechanisms of this GLE are explained in detail in the procedure section of this research.

1.3 Research objectives and research questions

The study's purpose is to examine student emotions and behavior in a GLE in detail. In this respect, as stated in the theoretical framework, the expected learning outcomes of a GLE depend on effective and appropriately designed mechanics. The

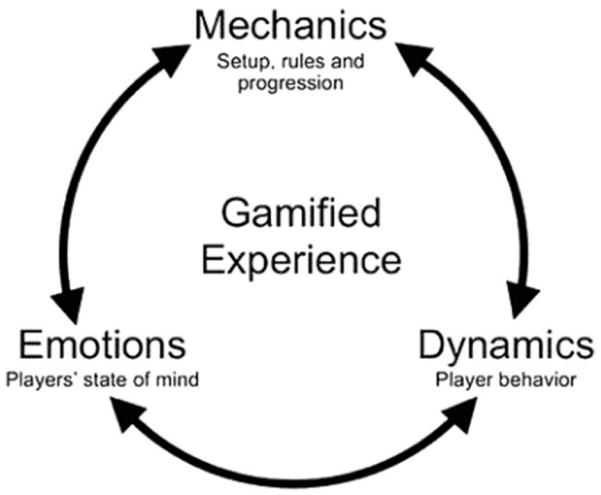

Fig. 1 Gamification principles (Robson et al. 2015)

GLE process applied within the mechanics framework is explained in the procedural section of the method. In the study, in order to reveal the behavior (dynamics) and emotions (feelings) that emerge within the framework of the mechanics applied in the GLE process, it is within the scope of the main objectives of the study to determine how perceived learning, academic achievement and GLE scores, which we accept as learning outcomes of the process, are affected/predicted by various variables. Within the scope of this purpose, five sub-problems are identified. The first one aims to determine the perception levels of the participants towards the elements of a GLE, and to reveal the predictive levels of these variables on perceived learning. Second, the academic achievement levels of the participants after their experiences in the GLE are determined, and the predictive levels of perception towards this environment on academic achievement are revealed. Third, the students' GLE scores and participation levels are examined, and the predictive status of the levels of participation before and after the midterm is determined. Fourth, how students' perceptions of a GLE affect their response speed to quiz questions are revealed. In addition, students' opinions of a GLE in online accounting education are determined in this study. According to these aims, the research questions are presented below. In addition, Fig. 2 presents the dependent/independent variables and analyses employed following the research designs indicated within the scope of the study.

1. What are the students' levels of perception of a GLE regarding competition, entertainment, engagement, expected outcome, perceived learning, and intention to use it in gamified online accounting courses?

    1.1 Does competition, entertainment, engagement, and expected outcome variables predict perceived learning?

2. What are the students' levels of academic achievement in gamified online accounting courses?

    2.1. Do students' perceptions of a GLE predict academic achievement?

3. What are the students' GLE scores and the participation levels of those enrolled in gamified online accounting courses?

    3.2. Is there a relationship between the students' GLE scores and their participation levels in a GLE?
    3.3. Do students' pre-midterm and post-midterm participation levels in a GLE predict their pre-midterm and post-midterm GLE scores?

4. Does the students' perception of a GLE affect their quiz question response speed in gamified online accounting courses?
5. What are the students' opinions of a GLE in gamified online accounting courses?

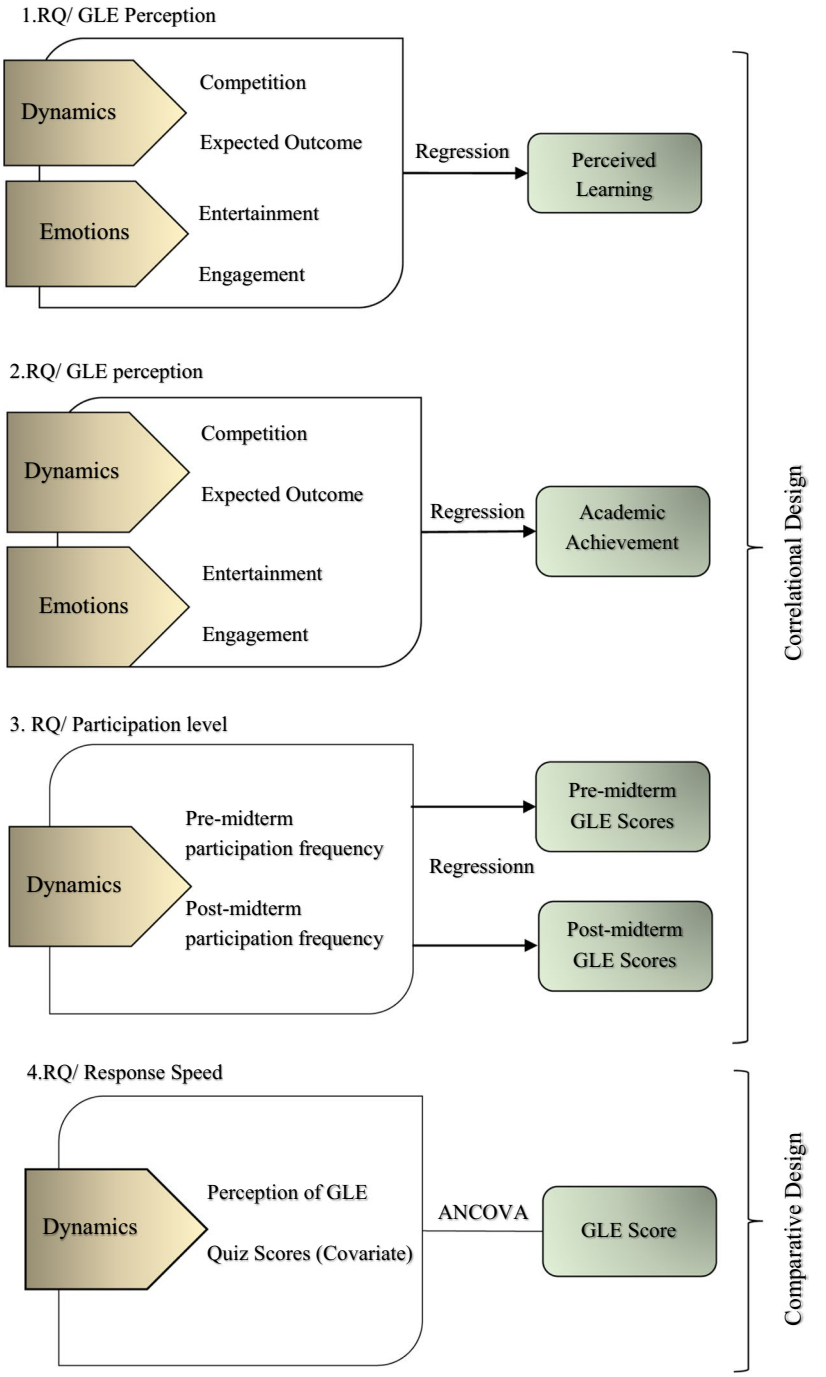

Fig. 2 The visual form of dependent/independent variables and analysis according to research designs and research questions

2 Method

2.1 Research design

Non-experimental correlational and comparative research designs are used in the study. Firstly, the study uses a correlational design to determine a relationship between two or more variables (McMillan & Schumacher, 2010). The study's correlational design phase includes determining students' perception of a GLE in accounting education and examining how this variable predicts perceived learning. The prediction level of the 'outcome expectancy' variable for academic achievement is revealed within the scope of the study's second and third research questions. In addition, the correlation levels between the students' GLE scores and participation levels in GLE are determined. In order to address the fourth research question, a comparative design is used to examine the differences between two or more groups concerning certain variables (McMillan & Schumacher, 2010). Students' perception levels of a GLE are categorized at this stage, and their impact on the speed with which they answered GLE questions is disclosed. Finally, simple descriptive research, which is qualitative design, is utilized for the fifth research question.

2.2 Participants

The study participants were forty students enrolled in an Accounting 2 course at the Faculty of Economics and Administrative Sciences. A convenient sampling method was applied in the study. The participants experienced a GLE for the first time. Although there are seventy-seven students in the Business Administration and Economics departments, students who retake the course do not have to attend the course. Only forty students, twenty from the Business Administration and twenty from the Economics Departments, participated in the online course. Of these, nine were female, and thirty-one were male. The number of students who participated in the GLE, once or twice each week, was found to be seven, while the number of students who participated practically every week (nine to eleven times) was eleven. Table 2 provides specific information regarding the characteristics of the participants.

2.3 Data collection tool

The GLE perception scale was utilized in the study to measure how students perceive a GLE. The Kahoot system was used as a tool for the GLE. Each week, the quiz questions uploaded to the Kahoot system related to the subject were measured and GLE scores obtained. Additionally, an academic achievement test was used in this study.

2.3.1 GLE perception scale

The study used the scale Baydas and Cicek (2019) developed to measure students' perceptions of the GLE. The scale was prepared in a 5-point Likert (strongly agree 5, strongly disagree 1) type. The scale consists of twenty-three items and six factors. The factors in the developed scale are 'perceived learning'

Table 2 Demographic characteristics of the participants

		f	%			f	%
Gender	Female	9	23.10	Participation level in the GLE	1–2 times	7	17.5
	Male	31	76.9		3–4 times	7	17.5
Department:	Business Administration	20	50		5–6 times	8	20.0
	Economics	20	50		7–8 times	7	17.5
Age	19–20	10	25.6		9–10 times	8	20.0
	21–22	15	38.4		11 times	3	7.5
	23–24	10	25.6				
	25 and above	4	10				

(five items, $\alpha = 0.87$), 'expected outcomes' (five items, $\alpha = .86$), 'intention' (four items, $\alpha = .87$), 'entertainment' (three items, $\alpha = .84$), 'engagement' (three items, $\alpha = .82$), and 'competition' (three items $\alpha = .67$). The reliability analysis result of the entire scale was determined as $\alpha = .93$. In this study when the reliability of the whole scale was taken into consideration, it was seen that reliable results emerged with $\alpha = .88$. In the literature, reliability coefficient values of around .90 are accepted as excellent, those of around .80 are accepted as good, and those of around .70 are considered acceptable (Kline, 2011).

2.3.2 GLE score and quiz scores

In the study, four questions related to the subject content of each week were prepared, and a quiz score was calculated, where each question was evaluated over twenty-five points. Badges (bronze, silver, and gold) were awarded to students, based on the number of correct answers, regardless of their answering speed. The GLE scores provided by the system were also considered according to the speed at which students answered the quiz questions correctly. While calculating the GLE scores, the Kahoot system performs the following computation in the background:

$$1 - \text{(Response time/Question time)}\ /2 \times \text{Possible score}$$

2.3.3 Academic achievement test

Two exams, a midterm and a final exam, were administered throughout the eleven-week academic semester in which the study was carried out, to measure academic achievement. These exams and the GLE questions were developed to be the same as, or comparable to, the questions in national examinations, including banking exams, public accounting exams, financial advisory exams, public personnel selection exams, and specialty and auditor exams for specific ministries.

2.4 Process

While creating a gamified learning environment, the study prepared a detailed syllabus at the beginning of the semester. The course objectives, context, interaction type, and rules for creating gamification mechanics were detailed.

2.4.1 Objective

The purpose of the GLE preparation was to increase students' interest and motivation in the course and to reinforce its content. Nasu et al. (2021) state that students' usage of gamification in accounting education aids the interaction of the educational process, encourages more class participation, supports attention, and partially improves academic achievement.

2.4.2 Context

A fourteen-week curriculum was first planned. In the design of the GLE, the Kahoot online quiz tool was preferred. For eleven weeks, four quiz questions, based on each week's subject, were uploaded to the Kahoot system; this was not done in the first week, official holiday week, and last week. Although Kahoot is an online tool, applications have also been developed for mobile systems. The following steps were followed in preparation:

- The instructor generated four questions for the online Kahoot system, which were presented online.
- For each question, suitable response times are allotted, based on the verbal or numeric condition of the questions displayed on Kahoot based on the subject matter. The students were told that the system was only accessible within the specified period.

2.4.3 Interaction types

This developed gamification process has student-student, student-teacher, and student-system interface interactions. Students were in direct competition with one another during the student-to-student interaction; this meant they could not interact while answering questions. After each question, they compared their scores with their peers. At the end of the answer time of each question, the Kahoot system gave the correct answer. In addition, the system provided data on the number of individuals who selected each answer option. After completing each question, the instructor highlighted any incorrect answers and ensured the student-teacher interaction. Students downloaded the Kahoot application to their mobile phones and interacted directly with the application interface.

2.4.4 Rules

After the implementation of gamification, the system generated the correct answer statistics for the whole class. Students could score one hundred points weekly, with each correct answer worth twenty-five points. The conditions for incorporating gamification outcomes into the grading system were as follows:

1. The Kahoot system assigned each student a score based on their response speed and the number of correct answers. Considering the scores obtained for each class, the student with the highest score was selected as 'student of the week'.
2. The student of the week was shared by way of the 'e-course' learning management system.
3. Students who had been a student of the week four times had five points added to their final grade.
4. Each week, those who answered all four questions correctly in the quiz questions on the Kahoot system were given gold badges, those who answered three questions were given silver badges, and those who answered two questions were given bronze badges. At the end of the semester, the weekly badges collected by each student were calculated.
5. Each bronze badge earned was worth 0.5 point, a silver badge 1 point, and a gold badge 1.5 points.
6. One of the questions on Kahoot every week was also asked in the midterm and final exams. Among the questions, six questions in the midterm exam and seven in the final exam were similar to the Kahoot questions. Therefore, approximately 30% of the midterm and final questions were similar to the quiz questions on Kahoot.
7. A further one point was awarded for each entry into the Kahoot system and participation in the questions on the midterm and final examinations. Consequently, six points for the midterm and seven points for the final were awarded to students who participated in Kahoot every week in class.
8. The grade took into consideration the following arrangement:

$$\begin{aligned}\text{Midterm Exam} = {} & (\textbf{\textit{twenty questions, six of which are similar to the Kahoot questions}}) \\ & + \textit{Kahoot} \text{ participation (up to five points)} + \text{badge scores (up to nine points)}\end{aligned}$$

$$\begin{aligned}\text{Final Exam} = {} & (\textbf{\textit{twenty questions}}, \text{ including seven questions similar to Kahoot}) \\ & + \textit{Kahoot} \text{ participation (up to six points)} + \text{badge scores (up to eleven points)} \\ & + \text{being the student of the week four times (up to fifteen points)}\end{aligned}$$

2.5 Data analysis

The first research question in the study, students' perception levels of the GLE, were determined by descriptive statistical methods (mean, standard deviation, and so on). The multiple regression method was used to determine to what extent competition,

entertainment, engagement, and expected outcome variables predict perceived learning. The relationships were checked in the multiple regression method, and no relationship above 90% was determined. There was no multicollinearity problem between independent variables (Tolerance = 0.518, 0.701, 0.780, 0.579; VIF = 1.929, 1,427, 1,281, 1,726). Additionally, one extreme data point was eliminated from the study owing to a problem with the 'expected outcome' factor's normality values. Therefore, analyzes were carried out on thirty-nine scores. The normality of the data was checked, and the skewness and kurtosis values were determined within the appropriate value ranges: for competition, Skewness = − 0.825, Kurtosis = − 0.356; for entertainment, − 0.603,-0.693; for engagement − 1.335, 1.820; for expected outcome − 1.551, 1.984; for intention to use, -1.012, − 0.390; and for perceived learning, − 0.757,-0.622. To ensure that the skewness and kurtosis coefficients met the normality assumption, a range of + 2 to -2 was considered (Field, 2009).

Following the second research question, descriptive statistical techniques (mean, standard deviation, and so on) were used to show the academic achievement levels of the GLE students. The level of academic achievement predicted by the 'expected outcome' variable was determined using an 'exponential regression' analysis. When the kurtosis/skewness values of the academic achievement variable (Skewness = − 0.125, Kurtosis = 0.651) were considered, they were within the appropriate value ranges.

Following the third research question, since the students' GLE scores (Skewness = 0.050, Kurtosis = 253) and their participation level in the GLE (Skewness = − 0.043, Kurtosis= -1.125), showed a normal distribution, Pearson correlation analysis was used to reveal the correlation between them. Analyses were conducted by combining the GLE's mean values with the total participation level. In order to reveal the relationship between the GLE pre/post midterm participation level (Skewness = − 0.186/0.095, Kurtosis= -1.417/ -1.091) and the pre/post midterm GLE scores obtained from this environment (Skewness = − 0.043/ − 0.119, Kurtosis = − 0.493/0.065), Pearson correlation was used, while for estimation analyzes, a curve estimate was applied, and the 'inverse' regression model was preferred in the pre-midterm students' GLE scores and their participation level in the GLE.

Following the fourth research question, the perception level, measured as ranking data of the GLE, was converted into categorical data. Accordingly, four and below four points were categorized as 'low level', four to five points as 'medium level' and five points as 'high level'. Six variables (competition, entertainment, engagement, expected outcome, intention to use, and perceived learning) with three levels were considered independent variables. The dependent variable was the scores that the students obtained from the GLE, in which the grading system was based on the student's speed of response if the question was correctly answered. In addition, quiz scores were received, based only on correct answers regardless of the answer speed. By identifying the scores obtained from the GLE as the dependent variable and the quiz scores as the covariant in this instance, the quiz scores' correct answer effect on the dependent variable was avoided. Accordingly, while determining the quiz scores (Skewness = − 0.286, Kurtosis = 0.223) as a covariant, the effect of perception toward the GLE on the speed of answering questions was revealed. Following the stated objective, an ANCOVA test was used, and six independent variables were subjected to separate analyses. Except for the 'competition'

variable, it was concluded that the variances were homogenous according to the test's assumptions: competition (F = 3.64, $p = .036$); entertainment (F = 0.719; $p = .494$); engagement (F = 2.17, $p = .129$); expected outcome (F = 0.748, $p = .480$); perceived learning (F = 0.833, $p = .443$); and intention to use (F = 0.396, $p = .676$). It was also found that the variables were normally distributed. The dependent and covariate variables have a continuous data structure.

Following the fifth research question, the participants' opinions of the GLE were collected and analyzed using content analysis.

3 Findings

The study determined the students' perception levels of the GLE in online accounting education and measured to what extent these predict perceived learning. In addition, the GLE perceptions' prediction level of academic achievement was stated. The relationship between the students' GLE scores and their participation level in the GLE was revealed, and the participation frequencies' prediction level of their GLE scores was determined. Finally, the impact of the GLE perception levels on response speed to the quiz questions was assessed, and the students' opinions were collected.

3.1 Students' perception levels of competition, entertainment, engagement, expected outcome, perceived learning, and intention levels in the GLE

The study revealed 'perceived learning' (M = 4.66) as the highest-scoring factor on the scale used to measure the students' GLE perceptions. On the other hand, 'competition' (M = 4.23) was the factor with the lowest mean value. Each variable was stated at the 'strongly agree' level. Detailed information is presented in Table 3.

3.1.1 The prediction level of competition, entertainment, engagement, and expected outcome variables on perceived learning in the GLE

The study determined prediction levels of competition, entertainment, engagement, and expected outcome variables on perceived learning. The 'intention to use' variable

Table 3 Students' perception levels of competition, entertainment, engagement, expected outcome, perceived learning, and intention

Variables	M	SD
Perceived Learning Levels	4.66	.37
Expected Outcome	4.65	.46
Entertainment	4.55	.43
Intention	4.50	.59
Engagement	4.42	.64
Competition	4.23	.77

Table 4 Significance levels of the independent variables' coefficients in the multiple regression model

	Unstandardized coefficients		Standardized coefficients	t	Sig.	F	Sig.	Adjusted Square R^2
	B	SE	Beta					
(Constant)	1.362	.574		2.37	.023*	9.81	.000**	.48
Competition	.025	.071		.34	.730			
Entertainment	.177	.110	.051	1.61	.117			
Engagement	.162	.074	.203	2.17	.037*			
Expected Outcome	.361	.119	.279	3.04	.005**			

*The mean difference is significant at the 0.05 level

**The mean difference is significant at the 0.01 level

in the students' perception levels of the GLE was not included in the regression analysis, since it would not have a theoretically significant effect on the 'perceived learning' variable. Accordingly, a multiple regression model was created. In the model, the 'expected outcome' and 'engagement' variables predict 'perceived learning' ($F = 9.81$, $p < .05$, $R^2 = 0.48$). Accordingly, these variables can explain 48% of the perceived learning in the model. Detailed information on this is presented in Table 4.

3.2 Academic achievement levels of the students in the GLE

In the study, the students' academic achievements were determined after the gamified online accounting course. According to this, the participant group's end-of-term academic achievement mean value was M = 59.56, SD = 16.7.

3.2.1 The prediction level of students' perceptions toward the GLE on academic achievement

The study examined how the participants' perceptions toward the GLE predict academic achievement through curve estimation and multiple regression. However, it was noted that only the 'expected outcome' variable predicted academic achievement. Subsequently, by using curve estimation, it was discovered that 'exponential' regression was the most appropriate model, and a statistically significant model was created ($F = 4.58$, $p < .05$, $R^2 = 0.09$). In the model, the 'expected outcome' predicts 'academic achievement' by 9%. Detailed information regarding the model is presented in Table 5.

Table 5 The prediction level of the 'expected outcome' variable for academic achievement in the exponential regression model

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	F	Sig.	Adjusted R Square R^2
	B	SE	Beta		(*p*)		(*p*)	
Expected Outcome	.244	.114	.332	2.140	.039*	4.58	.039*	.09
(Constant)	18.255	9.727		1.877	.068			

Ln (Academic Achievement)

*The mean difference is significant at the 0.05 level

3.3 Student's GLE scores and their participation level in the GLE

The mean score obtained from the GLE was M = 1432.75, SD = 701.697. At the end of eleven weeks, the participants' mean participation level in the GLE was M = 6.1, SD = 3.07.

3.3.1 The relationship between the students' GLE scores and their participation level in the GLE

In the online accounting education, the students' participation level in the GLE had a low correlation with the GLE scores (r = .36*, $p < 05$). Since the variables considered in the analysis met the normality assumptions, no extreme data inference was made. Analyses were performed on forty items of data.

3.3.2 The prediction level of students' pre-midterm/pre-final participation level in the GLE on the pre-midterm/ post-midterm GLE scores

There is a moderate correlation between the level of pre-midterm participation and the pre-midterm GLE scores in the gamified online accounting courses (r = .43**, $p < 05$). In addition, no correlation was found between the students' level of post-midterm participation and the post-midterm GLE scores (r = .32, $p > 05$). It was determined that six students did not participate in the GLE at all after the midterm.

The study investigated how the 'level of pre-midterm participation' variable predicts the pre-midterm GLE scores. Subsequently, by curve estimation, it was discovered that 'inverse' regression was the most appropriate model, and a statistically significant model was created ($F = 14.04$, $p < .05$, $R^2 = 0.25$). Detailed information about the model is presented in Table 6. In addition, it was also investigated to what

Table 6 The prediction level of pre-midterm participation level for the pre-midterm GLE scores in the inverse regression model

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	F	Sig.	Adjusted R Square R^2
	B	SE	Beta		(*p*)		(*p*)	
Pre- Midterm participation frequency	-1497.59	399.65	−0.519	-3.747	.001**	14.04	.001**	.25
(Constant)	2042.79	200.19		10.204	.000**			

**The mean difference is significant at the 0.01 level

extent the 'level of post-midterm participation' variable predicts the post-midterm GLE score, and no significant model can be proposed.

3.4 The effects of students' perceptions of the GLE on the response speed to quiz questions

The study grouped the students' perception levels of competition, entertainment, engagement, expected outcome, perceived learning, and intention to use into three categories. The students' perception levels of the GLE were categorized and deemed as an independent variable. The students' scores obtained from the environment were determined as the dependent variable. In the scores obtained from the GLE, the grading system was based on the student's speed of response if the question was correctly answered. In addition, quiz scores were received, based only on correct answers regardless of the answer speed of the students. By identifying the scores obtained from the GLE as the dependent variable, and the quiz scores as the covariant in this instance, the quiz scores' correct answers effect on the dependent variable was avoided. In this way, determining the quiz scores as covariants revealed to what degree students' speed of answering the questions was affected by their perceptions toward the GLE.

According to the results obtained, the students' response speed to the questions varies only according to the independent 'engagement' variable ($F = 3.80$, $p < .05$, $R^2 = 0.18$). The Benforroni test, which was used to determine the difference between the groups, revealed that there was a difference between the 'moderate' and 'high' level of engagement perception groups (MD = 109.838, $p < .05$). In the study, it was observed that there was no effect on the speed of response to the questions in the variables of competition, entertainment, outcome expectation, perceived learning and intention to use. Detailed information considering the overall data is presented in Tables 7 and 8.

Table 7 The mean scores of the students, as per the students' perception of engagement before/after the covariant variable, is included in the online quiz environment

Engagement levels	N	M	SD	M*	SD*
Low level	10	1634.625	656.36	1410.652	35.62
Moderate level	15	1283.578	649.99	1387.343	28.80
High Level	14	1448.374	792.91	1497.180	29.71

*Covariates appearing in the model are evaluated at the following values: Quiz = 44.83

Table 8 Students' response speed to questions according to their perception levels of engagement in the online quiz environment

Source	Type III Sum of Squares	df	Mean Square	F	Sig. (p)	R^2
Corrected Model	20267174.765	3	6755724.922	546.928	.000	.979
Intercept	56799.268	1	56799.268	4.598	.039	.113
Average of Quiz	19950083.338	1	19950083.338	1615.112	.000	.978
Engagement Levels	93899.820	2	46949.910	3.806	.032*	.179
Competition Levels	12686.634	2	6343.317	.437	.649	.024
Entertainment Levels	9555.978	2	4777.989	.327	.723	.018
Expected Outcome Levels	14319.942	2	7159.971	.490	.617	.027
Perceived Learning Levels	4254.357	2	2127.178	.144	.866	.008
Intention Levels	10816.049	2	5408.025	.371	.692	.020

*The mean difference is significant at the 0.05 level

* *The mean difference is significant at the 0.01 level

3.5 Students' opinions of the GLE in online accounting education

The students' opinions on the GLE in online accounting education were divided into two categories; the environment's contributions and constraints. Detailed information is presented in Table 9.

Table 9 Students' opinions regarding the GLE

Categories	Codes	*f*
Contributions	Beneficial	14
	Entertaining	11
	Reinforcer	9
	Motivating	2
	Pleasant	2
	Constructive	1
Constraints	Inability to see questions	3
	Response time limit	2
	Low number of questions	1

4 Discussion

The study measured how students' perceptions of the GLE in online accounting education predicted the perceived learning. In addition, it revealed the expected outcome variable's prediction level of academic achievement. The correlation between the students' GLE scores and their participation level in the GLE was determined. Finally, the impact of the GLE perception levels on the response speed to quiz questions was assessed, and the students' opinions were collected.

4.1 Students' perceptions of the GLE and the prediction level of their perceptions of the perceived learning

The 'perceived learning' variable was expressed at the highest level in the study's scale to assess the students' perceptions of GLE. The GLE established a positive perception that contributed to the learning process of the subject content. The endeavor to become the student of the week or to earn a badge by attaining success after each application motivated students to learn the subject material (Baydas & Cicek, 2019). All perception variables were expressed as 'strongly agree' in the study. 'Competition' is the factor with the lowest mean value. This may be because a number of the students may have yet to consider their peers' accomplishments as criteria for measuring their success, or because their self-esteem is high. Dominguez et al. (2013) argue that in a GLE, sometimes systems are not motivating enough for students to participate in class. In certain situations, the system is discouraging, and a few students do not find it entertaining to compete with their peers for a spot at the leadership table. However, the perception of competition is essential in gamification as it provides visible incentives for students to acquire positive behavior ((Zainuddin et al., 2020a).

In the study, the 'expected outcome' and 'engagement' variables predict 'perceived learning'. The time that has passed (engagement) and the goal of achieving the gamification mechanics (expected outcome) contributed to perceived learning in the GLE, where the students believed it to be beneficial to their learning. Within the context of the engagement variable, the literature suggests that intrinsic motivation will rise proportionally with student engagement ((Zainuddin et al., 2020b). The literature repeatedly states that students with greater course motivation have an excellent learning attitude (Matuga, 2009; Renchler, 1992; Zimmerman, 1990). In gamification, the 'expected outcome' variable represents students' efforts to meet the success criteria within the ruleset. Students can actively engage in the gamification process thanks to these rules derived from game mechanics (Baydas & Cicek, 2019). Therefore, active participation improves perceived learning.

It was also revealed that the perception of 'entertainment' and 'competition' does not affect perceived learning in a GLE. According to Dominguez et al. (2013), a number of GLE students did not find competing with their peers to move up the leaderboard entertaining. This circumstance explains why competition perception had no impact on perceived learning. On the other hand, Zainuddin et al. (2020a) claim that quizzes performed following sessions encouraged students to compete in

the classroom, resulting in improved grades or performance. Because of the belief that learning is a more serious endeavor, the perception of entertainment in a GLE did not directly affect perceived learning.

4.2 The prediction level of students' perceptions of the academic achievement

The study examined the degree to which academic achievement is predicted by the 'expected outcome' variable and developed the 'exponential' regression model. The game mechanics that the model designer developed, and how the students perceived and employed these mechanics in their internal processes, impacted the students' academic achievement. In practice, the students' academic achievement is directly impacted when the rules, such as receiving a badge or being rewarded as the student of the week, are implemented. Bicen and Kocakoyun (2018) state that students make more effort to be successful in a GLE. This effort is put into practice in line with the expected outcome.

4.3 The prediction of students' participation level on their GLE scores

There is a low correlation between the level of student participation in the GLE and GLE scores. Separate analyses of pre-midterm and post-midterm processes were conducted in order to obtain a better understanding of participation behavior in the GLE. Accordingly, a moderate correlation was determined between students' pre-midterm participation level and their pre-midterm GLE scores. Conversely, there was no correlation between these variables after the midterm. This may be due to the innovative effect of the application. The innovative effect is manifested when the improvement in students' learning performance is not due to the quality of instruction and learning, but instead. After all, students are more motivated because they come across a new technology for the first time while applying the instructional method; therefore, this effect is temporary (Merchant et al., 2014). In essence, participation may have occurred initially to satisfy the gamification dynamics effectively.

In line with the determined correlation, it was determined to what degree the pre-midterm GLE scores were predicted by the level of pre-midterm participation. The developed 'inverse' regression model shows that while the pre-midterm participation was in line with the increase in the pre-midterm GLE scores, the same rate of increase was not observed as the participation level increased. Barrio et al. (2015) determined that while students' learning performance increased in a GLE, there was no difference in their class participation level. A number of studies indicate that gamification does not improve student participation and learning outcomes (Bouchrika et al. 2019). Ding et al. (2018) discovered that students' emotional and cognitive participation decreased in the middle of the semester in their GLE. This may be attributable to a difficulty obtaining badges or the workload volume during the semester. In contrast to these findings, using a GLE to improve student participation in the classroom environment is believed to increase student achievement

(Aşıksoy, 2018). Other studies have also shown that participation in learning activities positively relates to course performance (Tsay et al., 2018). Sánchez-Martin et al. (2017) determined a correlation between students' participation in a game and their academic achievement, and that those who participated tended to perform better. In addition, Cakiroglu et al. (2017) underline that effective management and gamification mechanics may considerably impact student participation. In addition, the practices that favorably impact student participation can contribute positively to academic achievement.

4.4 The effect of student perceptions of the GLE on the response speed to quiz questions

The study reveals the effects of students' perceptions of the GLE on their response speed to quiz questions. No significant difference was determined in other variables, except for the engagement variable. Subsequently, students with a low perception of engagement performed better than the other groups. Furthermore, it was revealed that after eliminating the influence of correct answers on the GLE score, the response speed of groups with low and high engagement perception was similar. Even though the groups had comparable response times, the group with low engagement perception was likelier to get a correct answer. This situation contributed to a decline in the perception of engagement in the GLE. In contrast, the engagement of the group with the highest GLE success tended to deliver the answers. The group with moderate engagement perception had the lowest GLE point scores. With the elimination of the correct answer influence on these scores, there was an increase in the scores obtained. It was discovered that the students' response speed rates were comparable to those of the group with a low perception of engagement. This condition can be explained by the increased perception of engagement with the GLE, and the increased speed in answering questions. Regarding the speed at which questions were answered, a statistically significant difference was identified between the groups with high and moderate levels of engagement. This may be since the group with a higher perception engagement toward the GLE responds more quickly by concentrating on the GLE system. All of these instances may result from the emergence of different dynamics, in different student characteristics, in response to the application of the GLE's mechanics. To be clear, only certain innovative method applications can have an identical impact on every student profile. For instance, the literature indicates that a GLE mainly affects moderately successful students (Ding et al., 2018). The study discovered that students with a moderate perception of engagement spent more time searching for the correct answer.

4.5 Students' opinions of the GLE

Within the context of its contributions and limits, student opinions of the GLE were explored. Among the contributions of the GLE in online accounting education, the application was deemed the most beneficial, entertaining, and reinforcing. The studies found that students enjoyed using the emojis provided as feedback regarding

entertainment and competition, their curiosity about their friends' performance was diminished, they were assertive regarding becoming the class leaders regarding grades, and they made specific evaluations (Göksün & Gürsoy, 2019). The constraints of a GLE include an inability to view the questions and only having a limited response time. In the Kahoot application, students view the questions from a screen and give their answers through a phone application. As a result, for an application to be efficient, at least two screens or devices must be used. In the remote accounting course included in the study, the students usually responded to Kahoot questions from a single device by listening to them without viewing them. Therefore, since the students could see the questions visually, the response time allowed for questions was viewed as limited, and the students stated this issue as a constraint. Since the Kahoot program has high hardware needs, and the questions and response options are presented over many screens, it distracts students (Göksün & Gürsoy, 2019).

5 Conclusion and recommendations

The study measured to what extent students' perception levels of a GLE in online accounting education predict perceived learning. In addition, the study found that the perceived learning in the GLE is influenced by time flow (engegament), and the need to fulfill the gamification mechanics (expected outcome). Additionally, it has been demonstrated that how students perceive and apply game elements in the GLE impacts their academic achievement. When considering the participation in the environment, pre-midterm participation increased in parallel with the increase in the pre-midterm GLE scores. However, it did not increase at the same rate as the increase in participation level. Finally, it was discovered that students with a high perception of engagement in the GLE could respond to quiz questions more quickly than those with a moderate perception. However, no significant difference was found between student groups with low and high-level perceptions of engagement. In light of these results, the following recommendations are presented:

- The expected outcome highly predicts the perceived learning. When creating the GLE design, creating and implementing mechanics is crucial. In essence, with the practical design and implementation of mechanics, an increase in the perception of expected outcomes would directly lead to a rise in perceived learning.
- The literature has no relatively consistent findings between participation level and performance outcomes in a GLE. Therefore, there is a strong need to conduct further research along similar lines by supporting them with qualitative data.
- There is a need to identify the factors influencing the speed at which different student profiles answer questions. It is conceivable for successful students to occasionally perform poorly in a GLE due to the time required to figure out the correct answer.
- The spread/popularization/extension/dissemination of a GLE in other courses requires research.

- There is a requirement for two devices in online environments while using the application. Adding the option to view questions on the Kahoot application would be advantageous, because only smartphones connect students to online classes.
- Although the literature claims that the Kahoot program is one of the most helpful gamification programs (Bicen & Kocakoyun, 2018), new research may be conducted using different gamification programs.
- Future research may compare a GLE online and a face-to-face accounting education.

Data availability The datasets used and analyzed during the current study are available from the corresponding author upon reasonable request.

Declarations

Conflict of interest None.

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