redie
Revista Electrónica de Investigación Educativa
Vol. 26
2024 / e08
ISSN: 1607-4041 | redie.uabc.mx

Analysis of a Digital Game-Based Learning Experience

Análisis de una experiencia de aprendizaje basada en juegos digitales

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How to cite: Amaya-Olarte, N., Torres-Barreto, M. L., & Plata-Gómez, K. R. (2024). Analysis of a digital game-based learning experience. *Revista Electrónica de Investigación Educativa, 26*, e08, 1-18.
https://doi.org/10.24320/redie.2024.26.e08.5031

Abstract

As interest grows in new teaching and learning alternatives, digital game-based options are emerging. This research provides empirical evidence of high school students' perceptions of their intention to use educational video games, by testing a model including variables from the unified theory of acceptance and use of technology 2 and game elements. The data were collected from an online questionnaire administered to a sample of 407 Colombian high school students between 14 and 18 years of age. Partial least squares structural equation modeling was employed. The results identified factors that have a positive influence on intention to continue playing and perceived enjoyment, which may help achieve success in similar experiences in the future.

Keywords: educational games, ICT, education, statistical analysis, high school

Resumen

Frente al creciente interés en nuevas alternativas de enseñanza y de aprendizaje surgen aquellas que se basan en juegos digitales. Esta investigación aporta evidencia empírica sobre la percepción de estudiantes de secundaria respecto a su intención de usar videojuegos educativos. Para ello, se puso a prueba un modelo que integra variables de la Teoría Unificada de Aceptación y Uso de la Tecnología versión 2, y elementos del juego. Los datos se recogieron a través de un cuestionario en línea aplicado a una muestra de 407 estudiantes colombianos de secundaria, de 14 a 18 años de edad. Se utilizó un modelado de ecuaciones estructurales de mínimos cuadrados parciales. Los resultados permitieron identificar los factores que tienen influencia positiva en la intención de continuar jugando y en el disfrute percibido, los cuales podrían conducir al éxito en experiencias futuras similares.

Palabras clave: juego educativo, TIC, educación, análisis estadístico, enseñanza secundaria

(Received: March 13, 2021; Accepted: November 16, 2021)

I. Introduction

The habits and lifestyles of modern-day societies have been transformed by the continuous development of digital technologies (Castells, 2006). This has led academic institutions to adopt alternative, online methods of teaching, while the COVID-19 pandemic also compelled the whole world to migrate towards a virtual education model (Moreno-Correa, 2020). However, it is clearly not sufficient simply to integrate information and communication technology (ICT); rather, students need to be provided access to a positive learning experience that includes cognitive, performance, and entertainment aspects (Andrade & Law, 2018). This prompted our interest in understanding the underlying factors in positive teaching and learning experiences when digital games are used in educational contexts.

In the literature, various names are given to digital games used in school contexts and some terms are even reported as synonyms, given that there is no specific classification (Braghirolli et al., 2016; Londoño & Rojas, 2020). The most popular of these terms are *gamification*, *serious games*, and *digital game-based learning*.

Gamification involves using game elements in serious or formal contexts with the goal of improving the user's learning experience (Werbach & Hunter, 2012). At the same time, serious games are developed with an explicit educational objective and are not intended to be played for fun, although that does not mean they cannot be entertaining (Djaouti et al., 2011). In addition, serious games may or may not be computerized tools (Londoño & Rojas, 2020). Lastly, digital game-based learning is understood as the "coming together" of interactive entertainment and formal learning through digital games, with a focus on promoting student learning by means of a digital game (Anastasiadis et al., 2018). Similarly, Cheng et al. (2013) note that digital game-based learning is a combination of educational content and digital games that aims to stimulate student interest and thus enhance their learning effectiveness.

Educational videogames are among the most relevant digital game-based learning (DGBL) alternatives due to their appeal in young people (Bourgonjon et al., 2010). Previous research has shown that educational games increase student motivation and learning commitment (Anastasiadis et al., 2018). However, their acceptance among younger learners cannot simply be taken as given. There is a need to identify the factors that drive students to accept, or not to accept, educational games, while also identifying which elements provide them with a positive learning experience (Cheng et al., 2013). An inquiry into these factors may prove useful to properly design and introduce alternative methods of teaching in the future. Consequently, this study sought to answer the following questions: "Which factors have a positive impact on the acceptance of an educational video game?" and "Which elements of games have a positive impact on the perceived enjoyment of an educational video game?".

Previous theory indicates that user acceptance of software tools, specifically video games, has been associated with intention to continue playing, and in that respect several different variables have been studied, the most representative of which are included in the unified theory of acceptance and use of technology version 2 (UTAUT2). One notable variable studied is hedonic motivation, which is conceptually equivalent to perceived enjoyment and is also related to continuity of use (Venkatesh et al., 2012) and associated with the game elements that serve as the basis for gamification (Seaborn et al., 2017).

Although few studies have included variables from two classifications (UTAUT2 and game elements), collectively they complement existing models and offer a broad view of educational games (Marham & Saputra, 2019; Merikivi et al., 2017), in addition to encouraging their continued use. Together, they enable the creators and investors of these initiatives to make useful decisions and select appropriate game elements, avoiding waste of resources.

Consequently, the objective of this research was to provide empirical evidence on the perception of students in the last year of lower secondary education regarding the continued use of educational video games and game elements that enhance their enjoyment, through an extended UTAUT2 model and by defining a model of relationships. Accordingly, in the first phase of the study, a literature review was conducted on tools associated with educational games in order to generate a theoretical model of relationships between the different factors. This enabled the second phase of the research: designing and administering a measuring instrument, which was validated and administered in the third phase, in which a partial least squares structural equation model was applied. The last phase involved analysis of the results and future outlooks.

1.1 Unified theory of acceptance and use of technology version 2

UTAUT2 was proposed by Venkatesh et al. (2012) based on the contributions of the preceding theory (UTAUT) put forward by Venkatesh et al. (2003). The difference between them is that UTAUT2 adds the variables "hedonic motivation," "price-value relationship," and "habit," alongside "performance expectancy," "effort expectancy," "social influence," and "facilitating conditions," moderated by gender, age, whether use is voluntary or compulsory, and users' prior experience. UTAUT2 unifies various popular models and theories to establish a conceptual basis in the literature and explain the influence of factors on a user's intention to continue using a technological innovation. These theories and models are the technology acceptance model, the motivational model, the theory of planned behavior, the combined technology acceptance model and theory of planned behavior, the model of PC utilization, innovation diffusion theory, and social cognitive theory. This interest in the factors that drive continuity of use of an innovation stems from a desire to understand the necessary characteristics for innovations to be successful.

In UTAUT (Venkatesh et al., 2003), performance expectancy refers to the degree to which the user of an innovation/technology believes that using it will yield a gain in job performance. On the other hand, effort expectancy is the degree of ease of use of the technology; social influence is the degree to which users perceive that others see or judge them for using the technology; and lastly, facilitating conditions are the degree to which users believe they have the tools, knowledge, and values that will help them to adopt the system.

As for the variables included in UTAUT2, Venkatesh et al. (2012) note that hedonic motivation, also called perceived enjoyment, is a set of motivations associated with users' enjoyment or pleasure as they use the technology; the price-value relationship is associated with the impact of the price on the perceived benefit of using the technology; and lastly, habit refers to automatic behaviors by individuals as they use the technology, in the belief these behaviors have now been learned.

Both UTAUT and UTAUT2 provided a deeper understanding of the acceptance and use of innovations and were considered a starting point for extended models like the one used in this research.

1.2 Game elements

This study focuses on "game elements." To date, there is no accepted standard classification of game elements (Dicheva et al., 2015), but various categories exist within the literature. One popular classification is that of Werbach and Hunter (2012) who divide game elements into mechanics, dynamics, and components.

For Werbach and Hunter (2012), mechanics enable the game to function and include, for example, challenges, feedback, and rewards. Dynamics execute the mechanics and motivate users, and they include narratives, progression, and constraints. Lastly,

components are the resources and tools used to implement educational games, the most widely used being badges, points, and leaderboards (Acosta-Medina et al., 2020; Rapp, 2017). Table 1 presents the definitions of these game elements.

Table 1. Game element definitions

Game elements	Examples	Definitions
Mechanics	Challenges	Tasks that pose a challenge
	Feedback	Interpretation of a player's progress
	Rewards	Benefit gained by an achievement
Dynamics	Narratives	Ongoing story that supports the learning process
	Progression	User/player development
	Constraints	Limitations of scope
Components	Avatars	Visual representation of the player
	Badges	Visual representation of achievements
	Quests	Challenges that contain objectives and rewards
	Levels	Different phases of progress and/or difficulty
	Points	Visual representation of a player's individual progression
	Leaderboards	Visual representation of a player's progression with respect to others

Note. Information adapted from Acosta-Medina et al. (2020) and Rapp (2017).

Although there is a widespread tendency to believe that all game elements by their nature provide fun, this is not always the case, and this fact should not be overlooked (Mekler et al., 2017). Similarly, the perception of a game's creator may not always align with that of the end user. That said, it is necessary to make games fun for users, as this allows them to unwind and enhances their learning capacity (Filippou et al., 2018).

1.3 Research model and hypothesis

ICT and educational games have become an opportunity for renewal both inside and outside the classroom, but at the same time, pose a challenge for educators, who have opted to use video games based on their supposed appeal for young people. It is, therefore, deemed essential to understand the influence of a set of variables on young people's intention to continue playing an educational video game. Replaying educational video games has an impact on the achievement of educational goals. Replaying games becomes an enjoyable experience, while increasing the likelihood of student learning.

Equally, it is necessary to understand which game elements have an impact on players' perceived enjoyment to establish which elements should be included in or excluded from educational games. Each of these elements requires substantial investment, effort, and development, and could fail if it does not fulfill the expectations envisioned by educators as part of the project and design.

Consequently, a set of factors from UTAUT2, deemed to be decisive in achieving user acceptance of educational games, were selected based on a literature review. In other words, we selected a set of factors that facilitate positive experiences and learning and should theoretically prolong continuance intention. In addition, we include a set of game elements that are determinants of perceived enjoyment. Below we describe the factors and relationships established as part of the hypotheses in this study.

Quests. Quests are a set of tasks or challenges that users face in order to accomplish an objective or obtain a reward (Werbach & Hunter, 2012), for example completing the construction of a certain number of buildings or reaching a specific progress target or a given amount of resources. Quests have been recognized as one of the most important predictors of perceived enjoyment in various environments (Hernández, 2011; Merikivi et al., 2017) because, among other reasons, the level of difficulty of a quest can affect the player's

motivation. Highly complex quests can frustrate players, who believe they are impossible to complete. On the other hand, quests that are too easy can be disincentivizing, as players may not feel the experience is appealing enough (Merikivi et al., 2017). The importance of designing and including quests in educational games gave rise to our first hypothesis:

H1: Quests in an educational video game have a positive effect on the player's perceived enjoyment.

Badges, performance statistics, and levels. Badges and performance statistics have been associated with player enjoyment as the most widely used elements in educational games (Mekler et al., 2017; Phillips et al., 2018). Badges are awards or visual benefits granted for achievements (Werbach & Hunter, 2012) and are usually aligned with the theme of the game. They are also seen as acknowledgments that elicit a positive feeling or enjoyment in the player. In a video game, the badges received by players for their achievements can take forms ranging from a medal to a given amount of a valuable resource.

Meanwhile, performance statistics measure players' progress and in this research, they took the form of points and leaderboards. Points measure a player's individual progress in a game, whereas leaderboards measure progress with respect to other players, giving the user a ranking (Werbach & Hunter, 2012). Progress is associated with enjoyment as good performance brings satisfaction.

Similarly, levels refer to the stage or phase that players find themselves at; they constitute different degrees of progress, with varying difficulties as players advance in the game (Werbach & Hunter, 2012). In the same way, enjoyment has been associated with the emotion experienced by players when they reach successive levels or encounter a new difficulty. This led us to formulate the following hypotheses:

H2: Performance statistics in an educational video game have a positive effect on the player's perceived enjoyment.

H3: Levels in an educational video game have a positive effect on the player's perceived enjoyment.

H5: Badges in an educational video game have a positive effect on the player's perceived enjoyment.

Narratives. Narratives are the ongoing story that supports the learning process (Werbach & Hunter, 2012), that is, they enable communication between the interface and the player, and they play a fundamental role in design esthetics and enjoyment (Aldemir et al., 2018; Marham & Saputra, 2019). In this research, narrative was understood as the common storyline (written content) together with the visual image and sound, given that modern technology tends to combine all three when conveying a message. The importance of the narrative is rooted in the idea that if the story does not make a strong enough impact to connect with, entertain, and amuse players, simply including a wide range of options and characteristics will be insufficient. As a result, the following hypothesis was established:

H4: Narratives in an educational video game have a positive effect on perceived enjoyment.

Effort expectancy. This variable refers to the perceived ease of use in relation to the effort involved in using a technology (Venkatesh et al., 2012). It has been associated with perceived enjoyment in the sense that innovations that are easy to understand allow users to focus on their experience, resulting in enjoyment and learning. If, on the other hand, players are required to concentrate on understanding the innovation, they may feel frustrated and disgruntled (Marham & Saputra, 2019; Zhou, 2011). This led us to propose the sixth hypothesis:

H6: The effort expectancy of an educational video game has a positive effect on perceived enjoyment.

Performance expectancy. This is defined as the degree to which a person believes that using an innovation will improve his or her performance and yield a benefit. In other words, this is associated with the user's perceived usefulness of the innovation (Compeau et al., 1999). It has been established that performance expectancies are associated with continuance of use (Marham & Saputra, 2019; Venkatesh et al., 2003; Venkatesh et al., 2012), as users will want to access an innovation again if using it provides utility and the innovation thus becomes relevant for them. This leads to our seventh hypothesis:

H7: The performance expectancy of an educational video game has a positive effect on the intention to continue playing.

Facilitating conditions. This variable measures the degree to which users perceive the technology as compatible with their values, capabilities, and knowledge (Moore & Benbasat, 1991). It is associated with continuance of use on the basis that having the necessary resources and feeling an affinity for the innovation leads players to believe that using it is meaningful and instills a desire to continue doing so (Marham & Saputra, 2019; Venkatesh et al., 2003; Venkatesh et al., 2012). Accordingly, we formulated our eighth hypothesis:

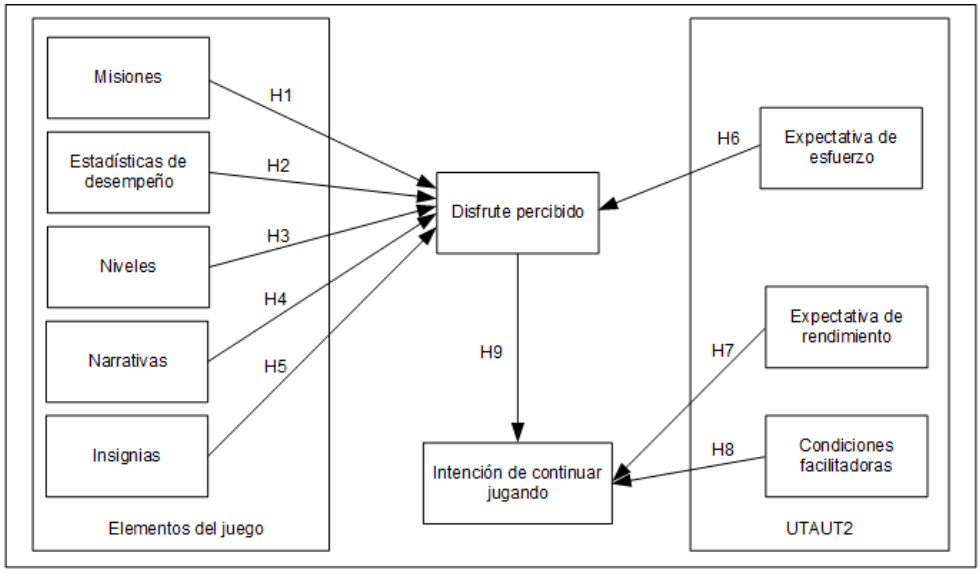
H8: The facilitating conditions of an educational video game have a positive effect on the intention to continue playing.

Perceived enjoyment. Also referred to as hedonic motivation, this is the effect of pleasure or enjoyment experienced by users of a technology (Venkatesh et al., 2012). This factor influences intention to continue using an innovation as it encourages players to engage and remain focused, or, in other words, it keeps them entertained. Perceived enjoyment is considered one of the most influential variables in continuance of use (Al-Azawei & Alowayr, 2020; Chung et al., 2019; Marham & Saputra, 2019). On this basis, we proposed a ninth hypothesis:

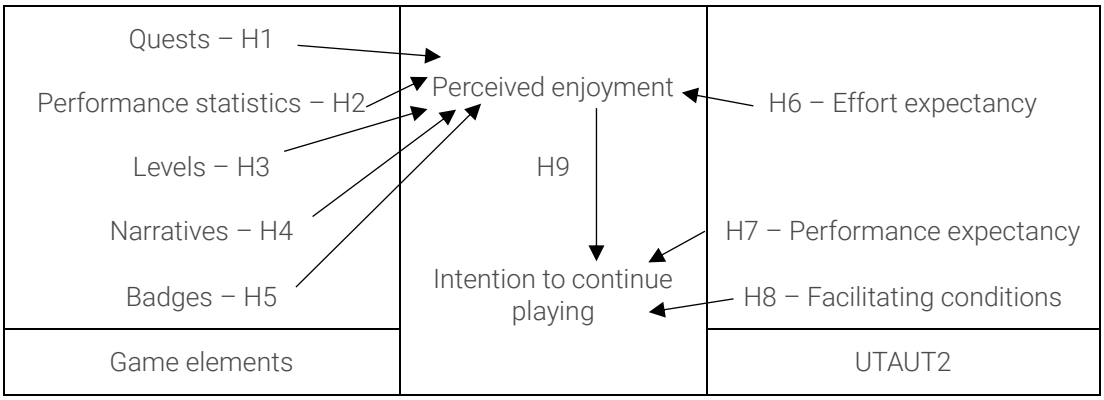
H9: Perceived enjoyment has a positive effect on the intention to continue playing an educational video game.

Figure 1 illustrates the proposed conceptual model.

Figure 1. Proposed model



Translation:



II. Method

This research employs a quantitative methodology, exploring the association between variables quantified through a sample producing solid, repeatable data. The data collection techniques were based on a formally validated instrument. The data analysis and interpretation techniques were based on a structural equation model. Contrasting this model yielded results that were used to draw conclusions about the research question by applying mathematical criteria and common sense. Various institutions of different kinds (educational, business, environmental, electronic, artistic, and commercial) assisted with the research to gain insight into student acceptance of educational video games. From a population of 530 students, we obtained a sample of 407 students in the last year of lower secondary education in three public schools in the city of Bucaramanga, Colombia. Students interacted from home with a video game on economic and financial education, FINATIC, in November 2020, in gaming sessions of between one and three hours each.

FINATIC is set in a city that needs the player's help to improve its economic and financial stability. To achieve this, players must complete a series of missions that involve constructing buildings, collecting and managing resources, and answering associated questions and problems. By accomplishing missions, players earn points that measure their progress. They are also awarded insignia (medals) at the end of each level. As players advance in the game, the level of difficulty of the necessary economic and financial knowledge increases as the built-up areas in the city expand.

In order to measure the relationships established in the research hypotheses, we designed a questionnaire with 32 items, two of which pertain to gender and age with a limited set of answers. The remaining 30 items relate to factors in our research, with answers on a 5-point Likert scale with the following options: (1) Totally disagree, (2) Disagree, (3) Neutral, (4) Agree, and (5) Totally agree. The average response time for the questionnaire was 20 minutes. It was shared with teachers from each institution in a Google Form, so that they could then distribute it via their school platforms over a period of one week.

Before answering the questionnaire, the students and their guardians completed the corresponding consent and authorization forms to take part in the study. Students answered the questionnaire asynchronously from home, without supervision by teachers or researchers given the COVID-19 emergency measures in place. Participating students also received a reward in exchange for their voluntary, anonymous contribution.

The questionnaire employed to collect the data was prepared from items in instruments previously proposed by various authors, which were adapted depending on their characteristics or the information needs of this study. The number of items per variable, the names used to refer to the variables in the rest of the study, the objective of the variables, and references are all presented in Table 2. (The full questionnaire can be found in Appendix I.)

Table 2. Structure of the questionnaire used

Variables	Items	Objective	References
Demographic data	2	Obtain gender and age.	-
Intention to continue playing (IC)	3	Estimate intention to continue using an educational video game.	Nguyen (2015); Zhou, (2011)
Perceived enjoyment (PE)	3	Explain the effect of enjoyment procured by participants when using an educational video game.	Nguyen (2015); Zhou, (2011)
Performance expectancy (PX)	3	Estimate to what extent users believe that an educational video game improves their performance or provides a benefit.	Ab. Rahman et al. (2018); Compeau et al. (1999)
Effort expectancy (EX)	3	Review to what extent users consider an educational video game easy to use.	Davis (1989); Venkatesh et al. (2003)
Facilitating conditions (FC)	2	Estimate to what extent users perceive an educational video game as suited to their knowledge and values.	Moore & Benbasat (1991); Venkatesh et al. (2003)
Quests (Q)	3	Gain insight into participants' perception of the challenges or tasks they face in an educational video game.	Nguyen (2015); Seaborn et al. (2017)
Performance statistics (PS)	4	Identify participants' perception of the visual representations of progress in an educational video game (points and leaderboard).	Alabbasi (2017)
Levels (L)	2	Estimate the user's interest in advancing to a stage/phase with a different level of progress and/or difficulty in an educational video game.	Seaborn et al. (2017)
Narratives (NA)	5	Gain insight into the perception of the ongoing story that supports learning in an educational video game (situations, image, and sound).	Nguyen (2015)
Badges (B)	2	Identify participants' interest in receiving an award/benefit for an achievement in an educational video game.	Alabbasi (2017)

After the questionnaire had been developed, a focus group was conducted with experts in education to review the wording and structure of the instrument and determine the relevance of each item based on the construct being measured. A pilot test was performed with a total of 21 students, selected by convenience from one of the supporting institutions in the study and who therefore shared the same characteristics as the students in the sample. The objective of this pilot test was to confirm that the students understood the questionnaire. Based on both these reviews, the necessary adjustments were made to ensure that each statement in the questionnaire would be clearly understood by the participants and useful for our research.

Partial least squares structural equation modeling (PLS-SEM) was employed to analyze this data. This method was deemed appropriate because it had been used and recommended by previous authors like Nguyen (2015), Marham and Saputra (2019), and Merikivi et al. (2017), but also because it was well suited to the needs and characteristics of this study.

PLS-SEM is based on an analysis of variance and is more flexible in its parameters and the distribution of data; in addition, it is appropriate for exploratory research but also suitable for explanatory studies (Martínez & Fierro, 2018). The software used to conduct the analysis was SmartPLS 3, which offers a practical interface for PLS-SEM.

In total, 407 valid questionnaires were received. This is an adequate number of participants for structural equation modeling (SEM), based on Jackson's (2003) recommendation of a minimum sample size of 200 for any SEM. Of these participants, 61.67% (251) were female, 37.84% (154) were male, and 0.49% (2) preferred not to disclose their gender. The most frequent age was 16 years, at 43.24% (176), followed by 17 years, at 31.94% (130). Ages 15 and 18 or over accounted for 12.29% (50) and 11.79% (48), respectively. Lastly, just 0.74% (3) of the sample were 14 years old.

III. Results

An internal consistency analysis was conducted to check item reliability by verifying that factor loadings exceeded 0.7; all items met this condition. This enabled us to infer that each indicator was strongly related to its corresponding construct and therefore could be accepted as part of said construct. Moreover, Cronbach's alpha and composite reliability (CR) measurements were used to determine the reliability of the constructs, yielding values greater than 0.7 and thus allowing us to conclude that all the constructs were reliable. In other words, the indicators showed good consistency in measuring the construct they pertained to. Our analysis of convergent validity produced average variance extracted (AVE) values greater than 0.5 in all constructs, supporting the idea that the indicators for each construct did indeed measure that construct, that is, they were correlated.

However, when estimating discriminant validity, a correlation was found between indicators from the constructs "quests," "performance statistics," and "badges" and those from "narratives," so it became necessary to eliminate two items from the variables "quests" and "narratives" in order to remove correlation between indicators from different constructs and achieve adequate levels of discriminant validity, thus ensuring that the indicators measured only that construct to which they pertained.

Lastly, an assessment of multicollinearity found that the variance inflation factor (VIF) of the indices was adequate, except for one item in effort expectancy, which was found to be outside the acceptable range with a value greater than 3.3. It was determined that this could have occurred because one item was similarly worded to another, so the item was eliminated. The results of all measurements are shown in Tables 3 and 4.

Table 3. Measurements

Variable	Items	Loadings	VIF	Alpha	AVE	CR
				0.793	0.827	0.905
FC	FC1	0.888	1.759			
	FC2	0.930	1.759			
				0.789	0.705	0.877
PE	PE1	0.896	2.167			
	PE2	0.896	2.146			
	PE3	0.714	1.358			
				0.871	0.720	0.911
PS	PS1	0.845	2.185			
	PS2	0.868	2.435			
	PS3	0.850	2.761			
	PS4	0.830	2.564			
				0.791	0.827	0.905
EX	EX1	0.904	1.751			
	EX2	0.915	1.751			
				0.858	0.778	0.913
PX	PX1	0.863	2.077			
	PX2	0.898	2.323			
	PX3	0.885	2.095			
				0.889	0.900	0.948
B	B1	0.950	2.786			
	B2	0.948	2.786			
				0.841	0.759	0.904
IC	IC1	0.864	1.941			
	IC2	0.854	1.905			
	IC3	0.895	2.210			
				0.853	0.872	0.931
Q	Q2	0.932	2.233			
	Q3	0.935	2.233			
				0.866	0.882	0.937
L	L1	0.940	2.404			
	L2	0.938	2.404			
				0.831	0.664	0.887
NA	NA1	0.823	1.882			
	NA2	0.820	1.885			
	NA3	0.845	1.930			
	NA5	0.769	1.572			
Criterion		> 0.7	< 3.3	> 0.7	> 0.5	> 0.7

Notes: VIF = variance inflation factor; AVE = average variance extracted; CR = Composite reliability; FC = Facilitating conditions; PE = Perceived enjoyment; PS = Performance statistics; EX = Effort expectancy; PX = Performance expectancy; B = Badges; IC = Intention to continue playing; Q = Quests, L = Levels; NA = Narratives.

Table 4. Discriminant validity

	FC	PE	PS	EX	PX	B	IC	Q	L	NA
FC	0.909									
PE	0.703	0.840								
PS	0.683	0.719	0.849							
EX	0.747	0.665	0.632	0.910						
PX	0.661	0.739	0.728	0.634	0.882					
B	0.642	0.734	0.735	0.582	0.645	0.949				
IC	0.717	0.806	0.707	0.657	0.669	0.729	0.871			
Q	0.613	0.718	0.762	0.572	0.665	0.656	0.651	0.934		
L	0.581	0.674	0.767	0.535	0.649	0.727	0.678	0.698	0.939	
NA	0.753	0.778	0.788	0.696	0.737	0.779	0.743	0.746	0.733	0.815

Notes: FC = Facilitating conditions; PE = Perceived enjoyment; PS = Performance statistics; EX = Effort expectancy; PX = Performance expectancy; B = Badges; IC = Intention to continue playing; Q = Quests, L = Levels; NA = Narratives.

The dependent variables "intention to continue playing" and "enjoyment" both displayed good explanatory power for the constructs relating to the variables ($R^2 > 0.67$) and have predictive relevance ($Q^2 > 0$). See results in Table 5.

Table 5. Power of dependent variables

Variable	R^2	Q^2
PE	0.698	0.477
IC	0.697	0.521

Notes: PE = Perceived enjoyment; IC = Intention to continue playing.

Still to be determined are the results of our hypotheses. Table 6 presents the estimated parameters of the path coefficient (β), the *t* value, and the *p* value. A *t* value greater than 1.96 and *p* value smaller than 0.05 are needed to support a hypothesis.

Table 6. Hypothesis testing

Hypothesis	B	*t* value	*p* value	Result
FC -> IC	0.277	5.677	0.000	Supported
PE -> IC	0.556	10.759	0.000	Supported
PS -> PE	0.041	0.708	0.479	Rejected
EX -> PE	0.191	4.084	0.000	Supported
PX -> IC	0.075	1.183	0.237	Rejected
B -> PE	0.232	3.655	0.000	Supported
Q -> PE	0.215	3.993	0.000	Supported
L -> PE	0.048	0.778	0.437	Rejected
NA -> PE	0.236	3.597	0.000	Supported
Criterion		>1.96	<0.05	

Notes: FC = Facilitating conditions; IC = Intention to continue playing; PE = Perceived enjoyment; PS = Performance statistics; EX = Effort expectancy; PX = Performance expectancy; B = Badges; Q = Quests, L = Levels; NA=Narratives

Three of the nine hypotheses were rejected. These rejected hypotheses were that performance statistics and levels in an educational video game have a positive effect on perceived enjoyment, and that performance expectancy of an educational video game has a positive effect on intention to continue playing.

Our results supported the hypotheses that perceived enjoyment and facilitating conditions in an educational video game have a positive effect on intention to continue playing. Similarly, we confirmed that effort expectancy, badges, quests, and narratives in video games all have a positive impact on perceived enjoyment. These findings highlighted the relationship between perceived enjoyment and intention to continue playing, where a strong impact was shown.

IV. Discussion and conclusions

The results of this study offer a contribution to theoretical discussion on the adoption of educational video games inside and outside the classroom. Specifically, we analyzed acceptance of an educational video game by students in the last year of lower secondary education, using a model based on UTAUT2 that included game elements as potential predictors of perceived enjoyment. The model investigated the relationships that performance expectancy, facilitating conditions, and perceived enjoyment had with continuance intention, in addition to the relationships between, on the one hand, effort expectancy, quests, performance statistics, levels, narratives, and badges, and on the other, perceived enjoyment.

Our analysis of these variables is relevant as it has provided information that may be useful for designing and introducing alternative methods of teaching, such as educational video games. This information could also serve to inform decision-making on the design and structure of future educational games. This research supports the idea that a user's intention to continue playing educational video games must not be overlooked, and the effectiveness of game elements even less so.

For this study, we designed and validated an instrument that was shown to be reliable in measuring the dependent variables, with good explanatory power for associated variables and high predictive relevance. We also found that intention to continue playing is influenced by facilitating conditions and perceived enjoyment, but not by performance expectancy. This was a somewhat unexpected finding, as other studies have reported a strong influence in the relationship between these two variables (Bourgonjon et al., 2010; Davis, 1989; Ofosu-Ampong et al., 2020; Venkatesh et al., 2003; Zhou, 2011). Similarly, it makes sense to think that if users believe an innovation is useful and will help them to improve their performance, they will want to use it.

Our findings with respect to facilitating conditions are consistent with Zhou (2011) but not with Ofosu-Ampong et al. (2020). This may be due to external influences like cultural differences, or perhaps the educational aims of the countries where the studies were conducted. Furthermore, although the variable studied deals with the same concept, the items used by the authors of the previous studies cited differ to those of this research in both their number and the way they were worded.

By contrast, whereas for authors like Liu and Li (2011), perceived enjoyment did not influence continuance intention, we found this was the most representative factor, as in other studies (Marham & Saputra, 2019; Nguyen, 2015; Zhou, 2011). Similarly, it is also very important to provide a good user experience and ensure users can learn. This explains the interest in understanding the drivers of perceived enjoyment, which our research found were effort expectancy, quests, narratives, and badges. Performance statistics and levels showed no influence, as also found previously by Mekler et al. (2017). We confirmed that these factors cannot be relied upon to produce enjoyment simply because they are game elements or because they are the most widely used features in educational games.

As for effort expectancy, our study concluded that if educational video games are easy to use and understand, students will be able to enjoy them, supporting results reported by Merikivi et al. (2017), Nguyen (2015), and Zhou (2011). This is ideal because it allows players to focus on learning, rather than trying to understand how to use the technology. Meanwhile, quests were found to have an influence on perceived enjoyment in our study and that of Merikivi et al. (2017), but not in research by Nguyen (2015). This may be linked to the theme of the game and the level of complexity of the quests.

Research by Marham and Saputra (2019) shows no impact by narratives on enjoyment. However, such an influence was indeed shown to exist in our study, enabling user engagement as reported by Merikivi et al. (2017) and Nguyen (2015). Lastly, badges were

found to influence enjoyment, which is consistent with Fitz-Walter (2015) and Phillips et al. (2018). This is one of the most widely employed elements in gamification and constitutes an extrinsic motivation.

By way of conclusion, game designers and others with an interest in implementing educational video games should seek to ensure they align with the skills and capabilities of their target population. Students also need to be entertained and experience a sense of fun. This can be achieved by adding quests or badges. A good narrative and an appealing, user-friendly interface are also required.

We recommend that future research continues to explore extended UTAUT2 models together with other game elements not considered here. Similarly, it would be worth taking into account demographic information and measuring continuance intention at different stages of introducing an innovation, which would expand this analysis and provide further insights into appropriate considerations for those with an interest in this field. Including other game elements in studies could broaden understanding of these elements and help determine how appropriate it is to employ them.

Translation: Joshua Parker

Author contributions

Nathaly Amaya-Olarte: conceptualization, literature review, methodology, data collection and analysis, interpretation of results, and drafting.
Martha Liliana Torres-Barreto: conceptualization, drafting, and supervision.
Karen Rocío Plata-Gómez: drafting and supervision.

Declaration of no conflict of interest

The authors declare no conflict of interest.

Source of funding

This research did not receive funding.

References

Acosta-Medina, J. K., Torres-Barreto, M. L., Paba-Medina, M. C., & Alvarez-Melgarejo, M. (2020). *Análisis de la gamificación en relación a sus elementos* [Analysis of gamification in relation to its elements]. Hal Open Science. https://hal.archives-ouvertes.fr/hal-02548860/document

Ab. Rahman, R., Ahmad, S., & Hashim, U. R. (2018). The effectiveness of gamification technique for higher education student's engagement in polytechnic Muadzam Shah Pahang, Malaysia. *International Journal of Educational Technology in Higher Education*, *15*(41). https://doi.org/10.1186/s41239-018-0123-0

Alabbasi, D. (2017). Exploring graduate students' perspectives towards using gamification techniques in online learning. *Turkish Online Journal of Distance Education*, *18*(3), 180–196. https://doi.org/10.17718/tojde.328951

Aldemir, T., Celik, B., & Kaplan, G. (2018). A qualitative investigation of student perceptions of game elements in a gamified course. *Computers in Human Behavior, 78*, 235–254. https://doi.org/10.1016/j.chb.2017.10.001

Al-Azawei, A., & Alowayr, A. (2020). Predicting the intention to use and hedonic motivation for mobile learning: A comparative study in two Middle Eastern countries. *Technology in Society, 62*, 101325. https://doi.org/10.1016/j.techsoc.2020.101325

Anastasiadis, T., Lampropoulos, G., & Siakas, K. (2018). Digital game-based learning and serious games in education. *International Journal of Advances in Scientific Research and Engineering, 4*(12), 139-144. https://doi.org/10.31695/IJASRE.2018.33016

Andrade, P., & Law, E. L. C. (2018, July 4–6). *User-based evaluation of gamification elements in an educational application.* Proceedings of the 32nd International BCS Human Computer Interaction Conference (HCI), Belfast, United Kingdom. https://doi.org/10.14236/ewic/HCI2018.27

Bourgonjon, J., Valcke, M., Soetaert, R., & Schellens, T. (2010). Students' perceptions about the use of video games in the classroom. *Computers & Education, 54*(4), 1145–1156. https://doi.org/10.1016/j.compedu.2009.10.022

Braghirolli, L. F., Ribeiro, J. L. D., Weise, A. D., & Pizzolato, M. (2016). Benefits of educational games as an introductory activity in industrial engineering education. *Computers in Human Behavior, 58*, 315-324. https://doi.org/10.1016/j.chb.2015.12.063

Castells, M. (Ed.) (2006). *La sociedad red: una visión global* [The network society: A global perspective]. Alianza.

Cheng, Y. M., Lou, S. J., Kuo, S. H., & Shih, R. C. (2013). Investigating elementary school students' technology acceptance by applying digital game-based learning to environmental education. *Australasian Journal of Educational Technology, 29*(1). https://doi.org/10.14742/ajet.65

Chung, C. H., Shen, C., & Qiu, Y. Z. (2019). Students' acceptance of gamification in higher education. *International Journal of Game-Based Learning, 9*(2), 1–19. https://doi.org/10.4018/IJGBL.2019040101

Compeau, D., Higgins, C. A., & Huff, S. (1999). Social cognitive theory and individual reactions to computing technology: A longitudinal study. *MIS Quarterly, 23*(2), 145- 158. https://doi.org/10.2307/249749

Davis, F.D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319–340. https://doi.org/10.2307/249008

Dicheva, D., Dichev, C., Agre, G., & Angelova, G. (2015). Gamification in education: A systematic mapping study. *Educational Technology & Society, 18*(3), 75–88. http://www.jstor.org/stable/jeductechsoci.18.3.75

Djaouti, D., Álvarez, J., Jessel, J. P., & Rampnoux, O. (2011). Origins of serious games. In M. Ma, A. Oikonomou & L. Jain (Eds.), *Serious games and edutainment applications* (pp. 25–43). Springer. https://doi.org/10.1007/978-1-4471-2161-9_3

Filippou, J., Cheong, C., & Cheong, F. (2018). A model to investigate preference for use of gamification in a learning activity. *Australasian Journal of Information Systems*, *22*, 1–23. https://doi.org/10.3127/ajis.v22i0.1397

Fitz-Walter, Z. J. (2015). *Achievement unlocked: Investigating the design of effective gamification experiences for mobile applications and devices* [PhD thesis, Queensland University of Technology, Australia]. QUT ePrints. https://eprints.qut.edu.au/83675/

Hernandez, M. D. (2011). A model of flow experience as determinant of positive attitudes toward online advergames. *Journal of Promotion Management, 17*(3)*, 315–326.* https://doi.org/10.1080/10496491.2011.596761

Jackson, D. L. (2003). Revisiting sample size and number of parameter estimates: Some support for the N:q hypothesis. *Structural Equation Modeling, 10*(1), 128- 141. https://doi.org/10.1207/S15328007SEM1001_6

Liu, Y., & Li, H. (2011). Exploring the impact of use context on mobile hedonic services adoption: An empirical study on mobile gaming in China. *Computers in Human Behavior, 27*(2), 890-898. http://dx.doi.org/10.1016/j.chb.2010.11.014

Londoño, L. M., & Rojas, M. D. (2020). De los juegos a la gamificación: propuesta de un modelo integrado [From games to gamification: A proposal for an integrated model]. *Educación y Educadores, 23*(3), 493-512. https://doi.org/10.5294/edu.2020.23.3.7

Marham, H., & Saputra, R. (2019, October 29–30). *User continuance in playing mobile online games analyzed by using UTAUT and game design*. Proceedings, 3rd International Conference on Informatics and Computational Sciences (ICICoS), Semarang, Indonesia.

Martínez, M., & Fierro, E. (2018). Aplicación de la técnica PLS-SEM en la gestión del conocimiento: un enfoque técnico práctico [Application of the PLS-SEM technique in knowledge management: A practical technical approach]. *RIDE Revista Iberoamericana para la Investigación y el Desarrollo Educativo, 8*(16), 130-134. https://doi.org/10.23913/ride.v8i16.336

Mekler, E. D., Brühlmann, F., Tuch, A. N., & Opwis, K. (2017). Towards understanding the effects of individual gamification elements on intrinsic motivation and performance. *Computers in Human Behavior*, *71*, 525–534. https://doi.org/10.1016/j.chb.2015.08.048

Merikivi, J., Tuunainen, V., & Nguyen, D. (2017). What makes continued mobile gaming enjoyable? *Computers in Human Behavior*, *68*, 411–421. https://doi.org/10.1016/j.chb.2016.11.070

Moore, G. C., & Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information Systems Research 2*(3), 192-222. https://doi.org/10.1287/isre.2.3.192

Moreno-Correa, S. (2020). La innovación educativa en los tiempos del Coronavirus [Educational innovation in times of coronavirus]. *Salutem ScientiaSpiritus, 6*(1), 14-26. https://www.researchgate.net/publication/340515328_La_innovacion_educativa_en_los_tiempos_del_Coronavirus

Nguyen, D. (2015). *Understanding perceived enjoyment and continuance intention in mobile games* [Master's thesis, Aalto University, Finland]. Information Systems Science. http://epub.lib.aalto.fi/fi/ethesis/pdf/14000/hse_ethesis_14000.pdf

Ofosu-Ampong, K., Boateng, R., Anning-Dorson, T., & Kolog, E. A. (2020). Are we ready for gamification? An exploratory analysis in a developing country. *Education and Information Technologies*, *25*, 1723–1742. https://doi.org/10.1007/s10639-019-10057-7

Phillips, C., Johnson, D., Klarkowski, M., White, M. J., & Hides, L. (2018, October 23). *The impact of rewards and trait reward responsiveness on player motivation* [Conference session]. Proceedings of the 2018 Annual Symposium on Computer-Human Interaction in Play, Melbourne, VIC, Australia. 393-404. https://doi.org/10.1145/3242671.3242713

Rapp, A. (2017). Designing interactive systems through a game lens: An ethnographic approach. *Computers in Human Behavior. 71*, 455–468. https://doi.org/10.1016/j.chb.2015.02.048

Seaborn, K., Fels, D. I., Bajko, R., & Hodson, J. (2017). Gamifying the media classroom: Instructor perspectives and the multidimensional impact of gamification on student engagement. *International Journal of Game-Based Learning*, *7*(4), 22–49. https://doi.org/10.4018/IJGBL.2017100102

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly 27*(3), 425–478. https://doi.org/10.2307/30036540

Venkatesh, V., Thong, J. Y. L., & Xu, X. (2012). Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology. *MIS Quarterly, 36*(1), 157–178. https://doi.org/10.2307/41410412

Werbach, K., & Hunter, D. (2012). *For the win: How game thinking can revolutionize your business* (1st ed.). Wharton Digital Press.

Zhou, T. (2011). Understanding mobile internet continuance usage from the perspectives of UTAUT and flow. *Information Development*, *27*(3), 207–218. https://doi.org/10.1177/0266666911414596

Appendix I. Instrument

Variable	Items	References	Scale
Items for general details			
Gender	a) Male, b) Female, c) Prefer not to say	-	Limited set of answers
Age	a) 14, b) 15, c) 16, d) 17, e) 18 or over	-	Limited set of answers
Items for dependent variables			
Intention to continue playing	IC1: I would like to be able to continue playing educational video games, rather than stop using them. IC2: If I could choose to continue to learn using educational video games or a traditional method, I would pick an educational video game. IC3: I would like to include an educational video game in my education.	Zhou (2011); Nguyen (2015)	Five-point Likert scale, where one: totally disagree; two: disagree, three: neutral; four: agree; and five: totally agree.
Perceived enjoyment	PE1: I feel like I'm having fun when I play educational video games. PE2: I find it exciting to be able to include an educational video game in my classes. PE3: I find playing educational video games entertaining (I lose track of time).	Zhou (2011); Nguyen (2015)	
Items for independent variables – UTAUT			
Performance expectancy	PX1: Using educational video games would improve my life and my performance in school. PX2: Using educational video games is useful for my learning. PX3: I think that if I use an educational video game, I will expand my knowledge.	Rahman et al. (2018); Compeau et al. (1999)	Five-point Likert scale, where one: totally disagree; two: disagree, three: neutral; four: agree; and five: totally agree.
Effort expectancy	EX1: I believe educational video games are easy to use. EX2: I find it easy to learn to use educational video games. EX3: I believe it is important that the way I interact with educational video games is clear and understandable.	Davis (1989); Davis et al. (1989); Venkatesh et al. (2003)	
Facilitating conditions	FC1: I have the necessary skills to use educational video games. FC2: I think educational video games are well suited to the way that I like to learn.	Moore & Benbasat, (1991); Venkatesh et al. (2003)	
Items for independent variables – Game elements			
Quests	Q1: Playing educational video games tests my knowledge and skills. Q2: I find the challenges/tasks/quests in educational video games interesting (constructing buildings, answering questions, among others). Q3: The tasks/quests in educational video games (constructing buildings, answering questions, among others) encourage me to continue playing.	Nguyen (2015); Seaborn et al. (2017)	Five-point Likert scale, where one: totally disagree; two: disagree, three: neutral; four: agree; and five: totally agree.

Variable	Items	References	Scale
Performance statistics	PS1: Making progress/advancing in educational video games entertains and motivates me. PS2: I find it interesting to see the progress I am making in educational video games – that is, the way I measure my own performance against myself. PS3: I would be more interested in competing if I could compare my performance in an educational video game with that of other students in a leaderboard. PS4: A leaderboard in which I could compare my performance with that of other students in educational video games would motivate me to improve and succeed.	Alabbasi (2017)	
Levels	L1: I want to reach the last level in educational video games. L2: I find it interesting to move up levels in educational video games.	Seaborn et al. (2017)	
Narratives	NA1: I find that the questions I am asked in educational video games are important. NA2: I find that the stories in educational video games are important. NA3: I find that feedback (information I receive when I answer a question or give my opinion) in educational video games is interesting and allows me to learn. NA4: I like it when educational video games are visually appealing. NA5: For me, it is important that the visual and sound elements in educational video games are pleasing.	Nguyen (2015)	
Badges	B1: Earning a badge (an award) in an educational video game would motivate me. B2: I find earning badges (awards) in educational video games interesting.	Alabbasi (2017)	
Additional questions in the pilot test			
Were all the statements clear to you?			Nominal scale (yes or no).
If you answered no, which statements were not clear? Please write the numbers of the statements that were NOT clear and the reason why.			Open-ended response.