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Psychometric study of a scale on the use of video games for the initial training of teachers

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The present study is focused on analyzing the properties and psychometric characteristics of the Questionnaire about the use of video games in Higher Education. Specifically, in this work we focus on the use of a classic video game, such as Lemmings, to work on the curriculum of the Early Childhood Education stage. The instrument was created *ad hoc*, based on a Likert scale of 5 response options and three dimensions: student/player profile, quality of the video game and assessment of the video game as a teaching resource. Regarding validity, two studies have been carried out, one with an exploratory nature with half of the sample, 131 participants; and another confirmatory with the total number of the participants, 261 students from the Early Childhood Education Degree at the University of Córdoba (Spain), considering the convergent and discriminant validity coefficients. Lastly, a correlational study was also carried out to clarify the relationships established between the different dimensions of the questionnaire. The results achieved demonstrate that the instrument obtained had a coherent and adequate internal structure with the theoretical assumptions initially raised, as the goodness-of-fit indexes of the confirmed model were high, at the same time showing high validity and reliability.

KEYWORDS

validity, questionnaire, video game, childhood education, initial teacher training

Introduction

The use of the ICT in the classrooms has slowly but steadily become a reality for students and teachers, with its introduction promoted by their high use in every part of society and its great consumption at home (Marín Díaz and Martín-Párraga, 2014).

Currently, among the technological resources most utilized by the young population, we find videogames, defined as a game with an electronic component, whose aim is to entertain players, submersing them in 2D and 3D environments (Quwaider et al., 2019). They can be employed in various platforms such as videogame consoles, computers,

mobile phones, tablets, etc. (Martín del Pozo, 2013), and adapted to different tastes, which grants them with a great ability to be marketed (López, 2017).

Given their extensive use, many research studies have been conducted to analyze their efficiency at the educational level, among these studies, we find the study by Asociación Española de Distribuidores y Editores de Software de Entretenimiento (aDeSe) (2012), which conducted a study at the national level about the use of videogames for teaching, concluding that their use in this sector helped with the learning of specific subjects, the development of psychomotor and cognitive skills, and personal, social and moral skills as well. In turn, if their characteristics were analyzed in detail, their relationship with the structure utilized when designing an educational activity in the classroom could be visualized (Glover, 2013):

- Establishment of objectives. Just as with educational activities, where a series of objectives are set to be achieved by the student, or a competency to be acquired is defined, all the videogames define a series of objectives to be reached for the player to achieve victory, overcoming a series of obstacles for this.
- Awards. Different manners for recognizing the merits reached by the players are utilized, such as classifications, prizes, etc.; and if transported to the education arena, digital badges can be utilized that allow granting recognition to the students who behaved well, who had done the class activities well, etc. (Gibson et al., 2013).
- Progress. In every videogame, it is necessary to inform the player about which phase he is in as regard to progress, indicating the objectives achieved and those that remain. This also occurs in educational contexts, where feedback is essential, as the learners should be aware of the activities that are completed, and they should be guided with recommendations that help them in their learning process.

All of these characteristics make possible their use at the educational level, allowing for the development of aspects such as problem resolution, making of decisions, search and organization of information, etc. Also, learning through games is attractive for the students, especially in the first stages, when motivation during their use and a positive attitude during the work phase are generated, at the same time that it helps with the development of computational thinking (Carenys et al., 2017; Sampedro Requena et al., 2017; Morales Díaz, 2018; Garneli and Chorianopoulos, 2019). Likewise, they can enrich the initial process of reading in the first stages (Jiménez Porta and Diez-Martínez Day, 2018), and are an instrument for promoting the inclusion and collaboration among the learners (Marín, 2016; Sampedro Requena et al., 2017).

At the legislative level in Spain, the presence of videogames is mentioned in the Royal Decree (2006) 1630/2006, from

December 29th, which regulates the minimum teachings in the second cycle of Early Childhood Education. It establishes the student's familiarization with this resource; and Organic Law (2006) 2/2006, from the 3rd of May, on education, which mentions the need for education administrations to foment experiences related to the ICT during the first cycle of Early Childhood Education.

Their presence at the curricular level and the benefits reported describe their usefulness as a resource that should be kept in mind for teaching, and this is why they are being utilized in teacher's initial training, with positive assessments by the students, despite their pointing out of deficiencies in competencies when using them as a teaching resource (Aznar-Díaz et al., 2017; Correa et al., 2017; Marín-Díaz et al., 2019), as the attitude of the teacher towards these types of resources has an influence on the efficacy and the degree of acceptance observed in the learner (Martí-Parreño et al., 2018).

The inclusion of videogames in initial training programs for educators can be conducted through education technology courses, where it is possible to use them as a didactic resource. An example of this is the course within which the study is framed, named "Media education and education dimension of the ICT", taught in the second year of Early Childhood Education at the University of Córdoba, which seeks the development of the following competences:

- CU2 Know and understand the level of the user in the area of ICT.
- CE7 Know the educational implications of the information and communication technologies, and in particular, of the television in early childhood.
- CM3.4 To critically analyze and incorporate the more relevant matters of current society that affect family and school education; social and educational impact of the audiovisual languages and the screens; changes in gender and inter-generational relationships; multiculturality and interculturality; discrimination and social inclusion and sustainable development.
- CM6.3 Address field analysis through an observational methodology using information, documentation and audiovisual technologies.
- CM7.2 To know about international experiences and examples of the innovative practices in Early Childhood Education.
- CM8.9 Foment experiences of initiation to information and communication technologies.
- CM10.5 Analyze the audiovisual languages and their educational implications. CM11.CM11.3 Monitor and keep track of the educational process, and, in particular, of teaching and learning through the mastery of the techniques and strategies needed.
- CM11.4 Relate theory and practice with the reality of the classroom and center.

Faced with the potential shown by the videogames, the present study sought to verify the usefulness of the videogame "Lemmings" for future teachers. For this, an instrument was designed starting from the benefits reported previously, and two instruments that had already been validated, which will allow the collecting of information about the usefulness of any type of videogame.

The first instrument used as the reference (Lorca-Marín et al., 2019), was comprised by 41 items distributed in 5 dimensions, which addressed aspects related to factors of affiliation, attitudes towards the game-oriented use of videogames, attitudes on the use of the videogame as a teaching resource, concepts about its game-oriented or teaching-oriented use. The instrument includes open-ended and close-ended questions, and has a high interjudge agreement (M = 3.5 over 4), a Kappa index of 0.843, and reliability of.649, as measured with Cronbach's Alpha.

As for the second instrument (Muñoz González et al., 2015), it is a Likert-type questionnaire with 5 response options, ranging from total disagreement to total agreement; it is composed by a total of 23 dependent variables that provide information about: if the creation of videogames with the CourseLab application helps in the inter-relation processes among the students, as well as their collaboration, communication and establishment of new relationships. It measures the difficulties and usefulness of the application for working on the curriculum and its efficiency for promoting motivation and autonomy, among other aspects. Lastly, it also includes independent variables relative to gender, age, possession electronic devices, and about the most-common place for internet access of the student. This instrument was validated through an analysis of internal consistency with Cronbach's Alpha, with a result of 0.866.

Ultimately, the aim of this study was to validate an instrument of measurement, which can be used with any type of videogame, which will allow us to gather information about the usefulness of the videogame "Lemmings", as perceived by future teachers of Early Childhood Education.

Methodology

To analyze the objective described above, the technical characteristics of the Questionnaire on the use of videogames in Higher Education, created *ad hoc* were validated and analyzed in order to gather data on the gamer profile of the individuals surveyed, the quality of the "Lemmings" game, and the assessment of its use as a teaching resource in the Early Childhood Education stage.

In total, two studies were conducted, one exploratory with half of the sample, and another confirmatory with the total sample selected for the research study, utilizing a cross-sectional, quantitative survey methodological approach and a deductive research strategy.

Lastly, the aim of this study was to validate a measuring instrument that allows for the collection of information about the usefulness of the videogame "Lemmings" perceived by future teachers of the Early Childhood Education stage.

Sample

For the selection of the sample, a probabilistic or convenience sampling method was utilized (Otzen and Manterola, 2017), as the students who the researchers taught during the academic year 2020-2021 were selected for the study.

The first study counted with a total of 131 participants, all of which were enrolled in the Early Childhood Education Degree. The age interval established was 18 years old to older than 26, with the following gender distribution observed (Table 1).

The second study counted with the participation of 261 participants, also enrolled in the Early Childhood Education Degree. Their ages ranged from 18 years old to older than 26, with the following gender distribution (Table 2).

TABLE 1 Distribution relationship between age and gender.

Age	Women	Men	Total
18 to 20 years old	96.3%	3.7%	41.2%
21 to 23 years old	94.1%	5.9%	38.9%
24 to 26 years old	100%	0%	11.5%
Older than 26	90.9%	9.1%	8.4%
			100%

TABLE 2 Distribution according to gender and age.

Age	Women	Men	Total
18 to 20 years old	97%	3%	38.3%
21 to 23 years old	96.2%	3.8%	39.8%
24 to 26 years old	100%	100%	14.2%
Older than 26	90%	10%	7.7%
			100%

Data collection instrument

For the collection of data, a questionnaire was created *ad hoc*, using as a reference the benefits reported by videogames in the literature reviewed and two already-validated instruments (Muñoz González et al., 2015; Lorca-Marín et al., 2019). This questionnaire was administered and completed by the students online and anonymously. It

was poly-thematic and counted with a series of close-ended questions with a Likert-type answer scale. This scale ranged from 1 to 5, with 1 indicating complete disagreement, and 5 complete agreement, for the three dimensions that shaped it: "Student/player profile", "Quality of the videogame" and "Assessment of the videogame as a teaching resource". In total, it was composed by 16 items structured in three dimensions (Table 3):

- Student/player profile: This dimension, composed by 3 items, is focused on collecting information such as if the individual surveyed likes to play videogames, if this is done habitually, and if he or she has played many videogames.
- Quality of the game: This dimension encompasses a total of 5 items that address aspects related to the quality of the videogame, to verify if it is entertaining and motivating, if it offers enough options for playing and for interaction with the user, and if it is able to maintain the players' attention.
- Assessment of the videogame as a teaching resource: This dimension is composed by 8 items destined to clarify if the videogame allows for the development of the objectives and contents of the curriculum in this stage, if it helps in the acquisition of abilities/skills for problem resolution, and in working with psychomotricity, and if it promotes the development of values, imagination and creativity, as well as the coordination between the students.

Lastly, the instrument also includes a series of independent variables related with the sociodemographic characteristics (age, sex), the game devices habitually used (PC, tablet, videogame console, smartphone, various), the manner of playing the videogames (alone, with another person, with two people, or online), the place where the videogames are usually played (home, friend's house, faculty, other places) and the time spent by the user for playing the videogame "Lemmings" in a day and in a week.

Procedure

The instrument described was constructed starting from the benefits of videogames reported in the literature reviewed, and also from two instruments used as references (Muñoz González et al., 2015; Lorca-Marín et al., 2019).

From the first instrument (Lorca-Marín et al., 2019), the following were taken into consideration, which were re-formulated in the Questionnaire on the use of videogames in Higher Education:

- Item 9. How many hours a week do you play? Its selection was due to the need to analyze if the time spent playing the videogame "Lemmings" had an influence when analyzing it.
- Item 11. In what device? This was used as a reference to see if the device used habitually by the student influenced the assessment of the videogame object of study.
- Item 14. How do you usually play? It was chosen to analyze the habits of the player.
- Item 32. Choose what aspects you believe promote or decrease the use of videogames from an overall point of view. In this item, elements are collected that are linked with motivation, interaction, ability to resolve problems, ability to make decisions, etc., with these elements taken into account when designing the questions in the questionnaires.

TABLE 3   Dimensions and items of the questionnaire.

Dimension	Items
Factor 1. Student/player profile	1. I like to play videogames.
	2. I habitually play videogames.
	3. I have played many videogames.
Factor 2. Quality of the game	4. The videogame is fun.
	5. The videogame captures all my attention.
	6. The videogame has a high degree of interaction (player/user).
	7. The videogame poses enough play options.
	8. The videogame is motivating.
Factor 3. Assessment of the videogame as a teaching resource	9. The videogame facilitates the acquisition of abilities/skills for the resolution of problems.
	10. The videogame promotes personal autonomy.
	11. The videogame facilitates the development of values.
	12. The videogame contributes to the development of psychomotricity.
	13. The videogame promotes the student's coordination.
	14. The videogame promotes creativity and imagination.
	15. The videogame allows the development of some of the objectives established in the education stage's curriculum.
	16. The videogame allows the development of some of the contents established in the education stage's curriculum.

With respect to the second instrument (Muñoz González et al., 2015), the following items were assessed:

- Item 9. Promotes interactions and collaboration among students. It has served as the reference for constructing the item that addresses the coordination ability among the students.
- Item 23. Videogames help develop the different proposed targets on the core curriculum for Primary Education established in Royal Decree 1,513. This was utilized as the model to establish the two items that mention the contribution of the videogame "Lemmings" for developing the objectives and contents of the curriculum in the stage of Early Childhood Education.

Once the instrument was created, the learning exercise designed was performed, which was comprised by the following phases:

- Initial contact with the videogame "Lemmings": As it is a classic videogame, launched in 1991, it is completely unknown to the students. Therefore, the first part consisted in getting to know the game's environment, the objective and its main characteristics.
- The adoption of the player role: in this phase, the students are asked to adopt the role of videogame player so that they can play various times. This will allow them to get to know the elements in depth, as well as the strategies, abilities and skills that are needed to achieve the object of study.
- Adoption of the teacher role. In this last phase, once the students fully understood the aspects and characteristics of the videogame, they were asked to take on the role of teachers. Thus, they were asked to analyze the objectives, contents, competencies and evaluation criteria established by the curriculum in this learning stage and to design a teaching proposal, whose activities refer to the videogame learned.

At this time, it should be taken into account that these phases required a considerable period time, so that the learners needed to have enough time to understand the videogame and to design the activities. More specifically, in the study, the total time employed was 15 in-person hours.

Data analysis

The analysis process encompasses two studies:

a) Study 1. It is based on the pilot application of the questionnaire so that it could be adapted and contextualized to the target population. The pilot test allowed for the analysis of its factorial structure and the detection of possible problems of comprehension of some of its items, as well as its index of discrimination. The questionnaire was completed by the students through the Google Forms software, after they tried the videogame "Lemmings". With the data collected, the normality of the sample was verified with the Kolmogorov-Smirnov test, obtaining a value of $p > 0.05$, making its normalization unnecessary (García et al., 2010). Afterwards, an exploratory factorial analysis (EFA) was performed with the statistical programs SPSS 23 and Factor Analysis (10.8.04), utilizing Pearson's correlation matrices, along with the "Optimal implementation of parallel analysis" (PA) (Timmerman and Lorenzo-Seva, 2011) to determine the number of factors, and the "robust non-weighted squares" with "Promin" rotation procedure (Lorenzo-Seva, 1999).

b) Study 2. After the end of the first study, a confirmatory analysis was performed starting with the total research sample, with was selected following the same procedures described for study 1. In this case, the normalization of the sample was needed, and this was done through the elimination of outliers using the Mahalanobis test (AMOS 23), which reduced the size of the sample from 261 participants to 255. The sample was comprised of 246 women and 9 men, with an average age of 19.1 and a standard deviation of .911. Afterward, the same software was utilized for the creation of structural equation models, in order to assess the adjustment of the model through the use of the following statistics tests: $\chi 2$/degrees of freedom (Schumacker and Lomax, 2004), comparative fit index (CFI), incremental fit index (IFI), normed adjustment index (NFI), the Tucker-Lewis index (TLI) (Byrne, 1994, 2001; Hu and Bentler, 1999), the root mean square error of approximation (RMSEA) (Hu and Bentler, 1998) and the expected cross validation index (ECVI). The validity and reliability of the instrument was also analyzed through the use of the software cited, through the following indices: Reliability coefficient H (MaxR(H)), Average Variance Extracted (AVE), Maximum Shared Variance (MSV) and Compound Reliability (CR). With these data, the convergent and discriminant validity of the instrument designed was found. Lastly, the existing relationships between the dimensions of the instrument was verified through a correlational analysis.

Results

Once the analysis was completed, the results obtained and structured from the studies performed for the validation of the

TABLE 4 Matrix of rotated factors.

Variable	F 1	F 2	F 3
V 1	0.810		
V 2	0.906		
V 3	0.776		
V 4		0.793	
V 5		0.936	
V 6		0.568	
V 7		0.596	
V 8		0.516	
V 9			0.473
V 10			0.541
V 11			0.684
V 12			0.744
V 13			0.619
V 14			0.436
V 15			0.984
V 16			0.957

Questionnaire on the use of videogames in Higher Education will be described below.

Study 1

The EFA conducted allowed us to analyze the internal structure of the instrument with the theoretical structure from its initial version, obtaining important data for the study of the validity of the construct that allow us to improve the questionnaire starting with the information collected. For this, its viability was confirmed through the determination of a correlation matrix of 0.00; KMO = 0.851; Bartlett's Sphericity test with a significance of 0.000 and a root mean square residual = 0.0485.

After these criteria were verified, the EFA was applied to the original version of the questionnaire, with 16 items and 3 dimensions, adjusting the factors to be extracted to 3. The analysis shows that the factors extracted explained 50.27% of the variance, with commonalities that oscillated between 0.380 for item 6 to 0.826 for item 15. At the same time, if the matrix of rotated elements and the weight of each factor is viewed (Table 4), their correspondence with each of the dimensions taken into account in the study, with loads higher than 0.3 in each item, is visualized.

As for the internal reliability of the instrument, Cronbach's Alpha coefficient was utilized (Merino-Soto, 2016), for the instrument in general (α = 0.876), as well as for the three factors extracted (α = 0.878 for factor 1; α = 0.814 for factor 2 and α = 0.877 for factor 3) to

determine their internal consistency, with a high reliability obtained.

Study 2

To compare and contrast the data from the previous study, a confirmatory factor analysis (CFA) was performed with the Maximum Likelihood method, with which the following results were obtained (Figure 1).

Afterwards, the goodness-of-fit of the model was verified, with the $\chi 2$/degrees of freedom test, the comparative fit index (CFI), the incremental fit index (IFI), the Tucker-Lewis index, the root mean square error of approximation (RMSEA) and the expected cross validation index (ECVI). The results obtained were the following (Table 5).

Based on the indices showed on the table, the results are deemed to be adequate, as the $\chi 2$ has a probability of.00, with values lower than.06 in the RMSEA, and higher than.90 in CFI, IFI, NFI and NNFI (Byrne, 2005; Arias, 2008). These data allow guaranteeing the validity of the construct of the instrument designed, confirming the model of factors proposed.

As for the coefficients of reliability and validity found through the analysis of the standardized regression loads and the correlations obtained with the AMOS 23 program, it could be stated that the results were adequate, taking into consideration the items that comprise each factor (Table 6), Reliability: CR > 0.7; Convergent Validity: CR < AVE, AVE > 0.5; Discriminant validity: MSV < AVE and MaxR (H) $\geq$ 0.70.

To conclude, its internal consistency was analyzed in a general manner as well as in each of its dimensions through Cronbach's Alpha, and from the data obtained (Table 7), it is observed that each of the dimensions had a coefficient higher than.8, which allows the confirmation that in general, as well as in each of the dimensions, the instrument had a high internal consistency (Thorndike, 1997).

Correlational analysis

The existing correlation between the three dimensions that comprise the questionnaire was studied through Pearson's correlation. The data obtained can be observed below (Table 8).

The results found show that there is a relationship, although weak, between dimension 1 (Student/player profile) and dimension 2 (Quality of the videogame) and dimension 3 (Assessment of the videogame as a teaching resource) ($R = 0.29$ and $p = 0.00$; $R = 0.15$ and $p = 0.02$, respectively) (Mateo, 2004; Pérez et al., 2009). At the same time, there is a moderate correlation between dimension 2 (Quality of the videogame) and dimension 3 (Assessment of the videogame as a teaching resource) ($R = 0.56$ and $p = 0.00$).
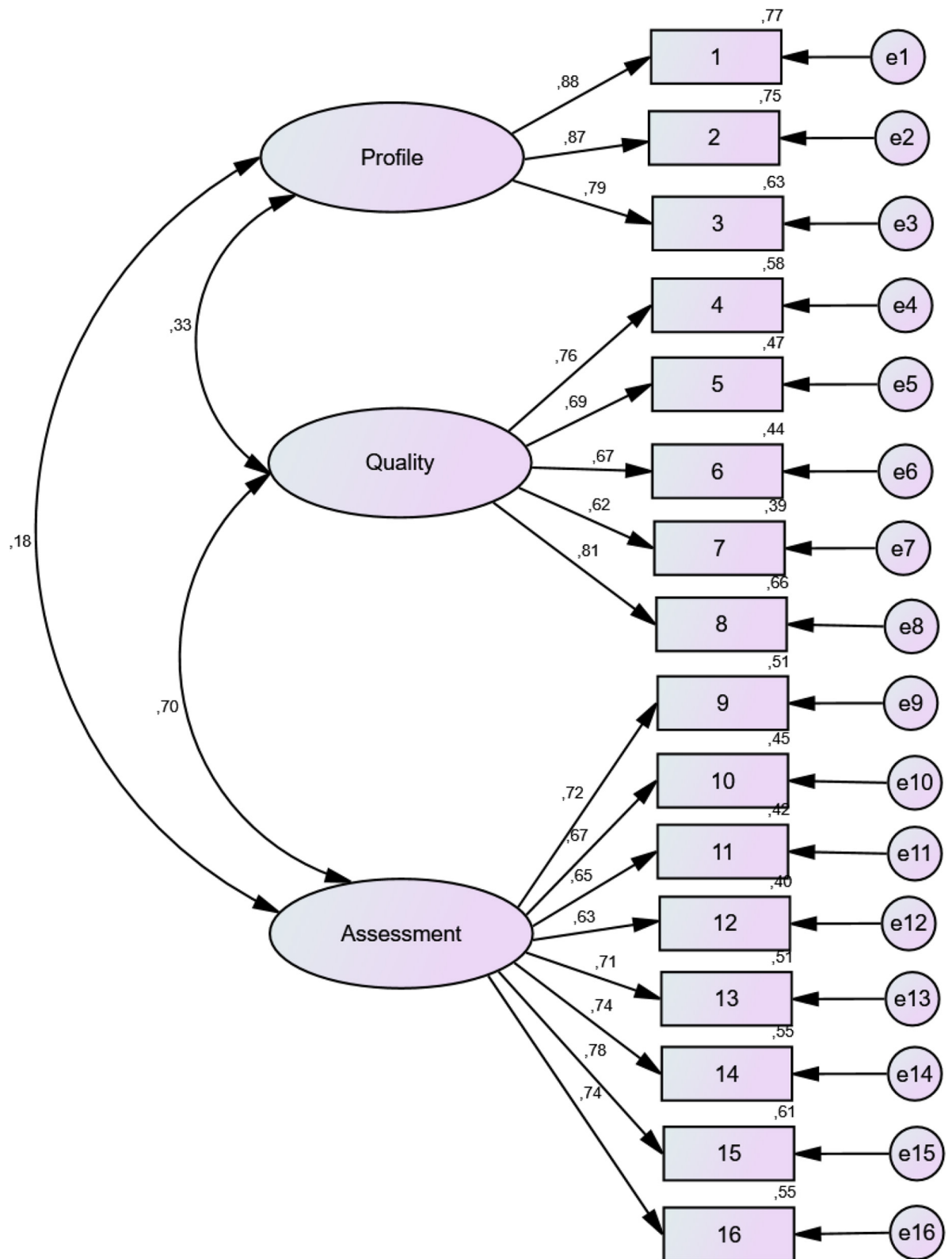
FIGURE 1
Three factor model (CFA).

TABLE 5 Adjustment indices of the model.

	$\chi 2$	*df*	*p*	X^2/df	CFI	IFI	NFI	NNFI (TLI)	RMSEA	ECVI
Values	133.98	79	0.00	1.69	0.98	0.98	0.95	0.96	0.05	1.12

TABLE 6 Validity and reliability coefficients of the 3-factor model.

	CR	AVE	MSV	MaxR(H)	Assessment	Quality	Profile
Assessment	0.889	0.502	0.484	0.893	0.708		
Quality	0.837	0.509	0.484	0.933	0.696	0.713	
Profile	0.883	0.716	0.107	0.957	0.179	0.327	0.846

TABLE 7 Internal consistency of the instrument.

Dimension	Reliability
Factor 1. Student/player profile.	$\alpha = 0.88$ ($n = 3$)
Factor 2. Quality of the videogame.	$\alpha = 0.84$ ($n = 5$)
Factor 3. Assessment of the videogame as a teaching resource.	$\alpha = 0.89$ ($n = 6$)
Total	$\alpha = 0.89$ ($n = 16$)

Discussion and conclusions

The questionnaires utilized as a reference (Muñoz González et al., 2015; Lorca-Marín et al., 2019), together with the literature highlighted in the introduction of the present article, have allowed the creation of the Questionnaire on the use of videogames in Higher Education. The results obtained, after the EFA and CFA performed, allowed confirming that this instrument is reliable for compiling information about the player profile of the students enrolled in the Early Childhood Education degree from the Faculty of Education at the University of Córdoba; as well as to evaluate the quality of a videogame, and to gather data about their

assessment on its use in the Early Childhood Education classroom.

As opposed to the two instruments that were utilized as the basis for its creation, this study has contributed data on the convergent and discriminant validity of the construct, through statistical data on composite reliability, average variance extracted, maximum shared variance (MSV) and reliability coefficient H (MaxR(H)). Likewise, a correlation analysis was performed between the three dimensions that comprised the questionnaire, verifying the existence of a relationship between them.

Lastly, as for the model confirmed, the structure of the instrument was composed by three dimensions:

- Dimension "Student/player profile". This dimension was composed by a total of 3 items, which measured if the student liked to play videogames, if the student did so habitually, and if the student had played many of them. It was created to detect the students' contact with it, as studies have been found which indicate that university students also spend time with this type of entertainment (Gómez-García et al., 2017; Lorca Marín et al., 2017; Dindar, 2018; Maja Ružić-Baf, 2018; Marín-Díaz et al., 2019), with their

TABLE 8 Results of the bivariate correlations of the items from the 3 dimensions of the questionnaire.

		Student/player profile	Quality of the videogame	Assessment of the videogame as a teaching resource
Student/player profile	N	255	255	255
	Pearson's correlation	1	0.29**	0.15**
	Sig. (two-way)		0.00	0.02
Quality of the videogame	N	255	255	255
	Pearson's correlation	0.29**	1	0.56**
	Sig. (two-way)	0.00		0.00
Assessment of the videogame as a teaching resource	N	255	255	255
	Pearson's correlation	0.15**	0.56**	1
	Sig. (two-way)	0.02	0.00	

**. The correlation is significant at.01 (two-way).

use being more common among men (Asociación Española de Videojuegos (AEVI), 2018; Dindar, 2018; Marín-Díaz et al., 2019).

- Dimension "Quality of the videogame". This was composed by 5 items which evaluated the quality of the videogame, referring to the entertainment it provides, the ability of capturing the player's attention, the degree of interaction offered to the user, if it has enough options of play, and if it is motivating for the student.
- Dimension "Assessment of the videogame as a teaching resource". This dimension was comprised by 8 items, which collected information on the assessment of the videogame by the students related to the acquisition of abilities and skills for problem resolution; the ability to promote autonomy, the development of values, psychomotricity, and creativity; and if it allows the development of objectives and contents of the curriculum of the Early Childhood stage. The aspects evaluated in this dimension correspond to the benefits contributed by the videogames to this educational stage, observing that they contribute, among other things, with the motivation of the learners and the development of attitudes of collaboration (Sampedro Requena et al., 2017). Likewise, future teachers highlight that they can be used in specific instances in the classrooms, thanks to the curricular competencies such as digital competency, mathematical competency and the basic competencies in science and technology allowing their integration into the curriculum (Aznar-Díaz et al., 2017). In fact, the videogame "Lemmings", utilized to validate this instrument, could be useful for working with the early childhood curriculum in a cross-disciplinary manner (Marín Díaz and Martín-Párraga, 2014).

Ultimately, the instrument assessed in the present study has been confirmed as a reliable means for compiling data related to the player/student profile and for assessing the quality and usefulness of a videogame in the Early Childhood Education stage. Nevertheless, given that the sample was concentrated in the Early Childhood Education Degree from a single university, its functioning with a large sample is unknown. Thus, its use with a greater sample which encompasses other universities, should be the focus of future research.

Data availability statement

The original contributions presented in this study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

Author contributions

MRE: conceptualization. JMG: investigation. CAC: methodology. MHA: writing. All authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The reviewer [BESR] declared a shared affiliation with the author [JMMG] to the handling editor at the time of review.

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References

Arias, B. (2008). "Desarrollo de un ejemplo de análisis factorial confirmatorio con LISREL, AMOS y SAS," in *Metodología en la Investigación Sobre Discapacidad*, eds M. A. Verdugo, M. Crespo, M. Badía, and B. Arias (Salamanca: INICO), 75–120.

Asociación Española de Distribuidores y Editores de Software de Entretenimiento (aDeSe) (2012). *Anuario de la industria del videojuego 2012*. Carmel: aDeSe.

Asociación Española de Videojuegos (AEVI) (2018). *La Industria del Videojuego en España. Anuario (2018)*. London: AEVI.

Aznar-Díaz, I., Raso Sánchez, F., and Hinojo Lucena, M. (2017). Percepciones de los futuros docentes respecto al potencial de la ludificación y la inclusión de los videojuegos en los procesos de enseñanza-aprendizaje. *Educar* 53, 11–28. doi: 10.5565/rev/educar.840

Byrne, B. M. (1994). *Structural Equation Modeling with EQS and EQS/Windows*. Thousand Oaks, CA: Sage Publications.

Byrne, B. M. (2001). *Structural Equation Modeling with AMOS. Basic Concepts, Applications, and Programming*. London: LEA.

Byrne, B. M. (2005). Factor Analytic Models: Viewing the Structure of an Assessment Instrument from Three Perspectives. *J. Pers. Assess.* 85, 17–32. doi: 10.1207/s15327752jpa8501_02

Carenys, J., Moya, S., and Perramon, J. (2017). Is it worth it to consider videogames in accounting education? A comparison of a simulation and a videogame in attributes, motivation and learning outcomes. *Rev. de Contab.* 20, 118–130. doi: 10.1016/j.rcsar.2016.07.003

Correa, R. I, Duarte, A., and Guzmán, M. D. (2017). Horizontes educativos de los videojuegos. Propuestas y reflexiones de futuros maestros y educadores sociales. *Educar* 53, 67–88. doi: 10.5565/rev/educar.849

Dindar, M. (2018). An empirical study on gender, video game play, academic success and complex problem solving skills. *Comput. Educ.* 125, 39–52. doi: 10.1016/j.compedu.2018.05.018

García, R., González, J., and Jornet, J. M. (2010). *SPSS: Pruebas no Paramétricas*. Valencia: Universidad de Valencia.

Garneli, V., and Chorianopoulos, K. (2019). The effects of video game making within science content on student computational thinking skills and performance. *Interact. Technol. Smart Educ.* 16, 301–318. doi: 10.1108/ITSE-11-2018-0097

Gibson, D., Ostashewski, N., Flintoff, K., Grant, S., and Knight, E. (2013). Digital badges in education. *Educ. Inf. Technol.* 20, 403–410. doi: 10.1007/s10639-013-9291-7

Glover, I. (2013). "Play As You Learn: Gamification as a Technique for Motivating Learners," in *Proceedings of EdMedia 2013–World Conference on Educational Media and Technology*, eds J. Herrington, A. Couros, and V. Irvine (Victoria: Association for the Advancement of Computing in Education (AACE)), 1999–2008.

Gómez-García, S., Planells de la Maza, A. J., and Chicharro-Merayo, M. (2017). ¿Los alumnos quieren aprender con videojuegos? Lo que opinan sus usuarios del potencial educativo de este medio. *Educar* 53, 49–66. doi: 10.5565/rev/educar.848

Hu, L. T., and Bentler, P. M. (1998). Fit indices in covariance structure modeling: Sensitivity to underparameterized model misspecification. *Psychol. Methods* 3, 424–453. doi: 10.1037/1082-989X.3.4.424

Hu, L. T., and Bentler, P. M. (1999). Cut off criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Struct. Equ. Model.* 6, 1–55. doi: 10.1080/10705519909540118

Jiménez Porta, A. M., and Diez-Martínez Day, E. (2018). Análisis del contenido de apps y videojuegos: Implicaciones en procesos cognitivos en la lectura inicial. *Apertura* 10, 71–87. doi: 10.32870/Ap.v10n1.1114

López, A. T. (2017). El poder educativo de los videojuegos. *Praxis Investig. ReDIE* 9, 130–141.

Lorca Marín, A. A., Cuenca López, J. M., Vázquez Bernal, B., and Velo Ramírez, S. (2017). Actitudes de los docentes en formación inicial sobre videojuegos. *Digit. Educ. Rev.* 31, 39–60.

Lorca-Marín, A. A., Cuenca-López, J. M., and Vázquez-Bernal, B. (2019). Cuestionario sobre actitudes y concepciones en los videojuegos y su implicación didáctica en el aula de Ciencias (CVJ/AC): Características psicométricas. *Int. J. Educ. Res. Innov.* 11, 101–120.

Lorenzo-Seva, U. (1999). Promin: A method for oblique factor rotation. *Multivar. Behav. Res.* 34, 347–356. doi: 10.1207/S15327906MBR3403_3

Maja Ružić-Baf, H. T. (2018). Time Future Teacher Spend on Facebook and Playing Online Video Games. *TEM J.* 7, 543–547.

Marín Díaz, V., and Martín-Párraga, J. (2014). Can videogames be used to develop the infant stage educational curriculum? *N. Approach. Educ. Res.* 3, 20–25. doi: 10.7821/naer.3.1.20-25

Marín, V. (2016). ¿Hay posibilidades de trabajar la inclusión a través de los videojuegos? *Rev. del Salomé* 1, 67–87. doi: 10.32541/recie.2016.v1i2.pp67-87

Marín-Díaz, V., Morales-Díaz, M., and Reche-Urbano, E. (2019). Educational Possibilities of Video Games in the Primary Education Stage According to Teachers in Training. A Case Study. *J. N. Approach. Educ. Res.* 8:4249. doi: 10.7821/naer.2019.1.330

Martín del Pozo, M. A. (2013). Formación lingüística del profesorado universitario para la docencia en inglés. *Rev. de Docencia Univ.* 11, 197–218. doi: 10.4995/redu.2013.5526

Martí-Parreño, J., Galbis-Córdova, A., and Miquel-Romero, M. J. (2018). Students' attitude towards the use of educational video games to develop competencies. *Comput. Hum. Behav.* 81, 366–377. doi: 10.1016/j.chb.2017.12.017

Mateo, J. (2004). "La investigación 'ex post-facto'," in *Metodología de Investigación Educativa*, ed. R. Bisquerra (Madrid: La Muralla), 196–230.

Merino-Soto, C. (2016). Diferencias entre coeficientes alfa de Cronbach, con muestras y partes pequeñas: Un programa VB. *An. de Psicol.* 32, 587–588. doi: 10.6018/analesps.32.2.203841

Morales Díaz, M. (2018). Viabilidad del uso del videojuego en el aula: Opiniones prácticas de los maestros en pre-servicio. *Edmetic* 7, 78–91. doi: 10.21071/edmetic.v7i2.11101

Muñoz González, J. M., Rubio García, S., and Cruz Pichardo, I. M. (2015). Strategies of collaborative work in the classroom through the design of video games. *Digit. Educ. Rev.* 27, 69–84.

Organic Law (2006). *Organic Law (2/2006). State Official Newsletter, 106, From the 3rd of May, on Education*. Available online at: https://www.boe.es/eli/es/lo/2006/05/03/2

Otzen, T., and Manterola, C. (2017). Técnicas de muestreo sobre una población a estudio. *Int. J. Morphol.* 35, 227–232. doi: 10.4067/S0717-9502201700010 0037

Pérez, R., García, J. L., Gil, J. A., and Galán, A. (2009). *Estadística Aplicada a la Educación*. Madrid: Pearson Prentice Hall.

Quwaider, M., Alabed, A., and Duwairi, R. (2019). The Impact of Video Games on the Players Behaviors: A Survey. *Proc. Comput. Sci.* 151, 575–582. doi: 10.1016/j.procs.2019.04.077

Royal Decree (2006). *Royal Decree 1630/2006, From December 29th, Which Regulates the Minimum Teachings in the Second Cycle of Early Childhood Education. State Official Newsletter, 4, From 4rd of January of 2007*. Available online at: https://www.boe.es/eli/es/rd/2006/12/29/1630

Sampedro Requena, B. E., Muñoz González, J. M., and Vega Gea, E. (2017). El videojuego digital como mediador del aprendizaje en la etapa de Educación Infantil. *Educar* 53, 89–107. doi: 10.5565/rev/educar.850

Schumacker, R. E., and Lomax, R. G. (2004). *A beginner's Guide to Structural Equation Modeling, Second Edition*. Mahwah, NJ: Lawrence Erlbaum Associates. doi: 10.4324/9781410610904

Thorndike, R. M. (1997). *Measurement and Evaluation in Psychology and Education (6ª ed.)*. New York, NY: McMillan.

Timmerman, M. E., and Lorenzo-Seva, U. (2011). Dimensionality Assessment of Ordered Polytomous Items with Parallel Analysis. *Psychol. Methods* 16, 209–220. doi: 10.1037/a0023353