

# Video games and learning in university education: a systematic review

## Videojuegos y aprendizaje en la etapa universitaria: una revisión sistemática

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### **Abstract**

Video games offer interactive educational opportunities in the sphere of university education that contribute to acquiring knowledge and developing skills. In this regard, this study aims to identify supporting evidence from research papers on the pedagogical use of video games at this educational stage. To this end, the procedure for a systematic literature review was followed rigorously, with full adherence to the standards of the PRISMA 2020 protocol. Specifically, this review involves the selection and analysis of scientific papers on studies that investigate the use and impact of video games in higher education over the last seven years. The final study sample comprised 64 papers found in the Science Direct, Dialnet, Springer Link and Scopus databases, which were published during 2016–2022. The findings gathered encompass learning outcomes generated with the use of video games – especially serious games – in the context of

university education, with the majority of these findings coming from studies conducted with students in the academic domain of the Social Sciences and Law. These learning outcomes are evidenced in relation to knowledge acquisition, increased motivation and student engagement with the learning process. Moreover, the promotion of other learnings generated with the use of video games in university education is noteworthy, with relatively fewer studies focusing on behaviour change, cognitive and perceptual skills, social and soft skills and physiological skills. Although there has been a significant increase in research on this subject, there are only a few such studies within certain academic domains, and there is a dearth of research on the use of video games in the university setting that investigate its impact on improvements in knowledge assimilation –in the sphere of specific subjects – and improvements in the development of fundamental skills for the proper practice of the profession for which the students are being trained.

*Keywords:* video games, game-based learning, learning, higher education, learning outcomes.

### **Resumen**

Los videojuegos ofrecen oportunidades educativas interactivas en el ámbito de la Universidad, contribuyendo a la adquisición de conocimientos y al desarrollo de destrezas. En este sentido, este estudio pretende identificar evidencias de artículos basados en el uso didáctico de videojuegos en esta etapa educativa. Para ello, se ha seguido rigurosamente el proceso de una revisión sistemática de literatura, siguiendo los estándares del protocolo PRISMA 2020. En concreto, esta revisión se apoya en el análisis y selección de artículos científicos que abordan el impacto y uso de videojuegos en Educación Superior en los últimos siete años, contando con una muestra final de 64 artículos publicados en las bases de datos Science Direct, Dialnet, Springer Link y Scopus, durante el período comprendido entre 2016 y 2022. Los hallazgos obtenidos recogen resultados de aprendizaje generados con el uso de videojuegos, y, en especial, con serious game, en el ámbito de la etapa universitaria, siendo la mayoría procedentes de estudios planteados con estudiantes de la rama de Ciencias Sociales y Jurídicas. A su vez, se evidencian resultados de aprendizaje relacionados con la adquisición de conocimientos, seguido del fomento de la motivación e implicación del alumnado con su proceso de aprendizaje. Por su parte, es destacable la promoción de otros aprendizajes generados con el uso de videojuegos en la etapa universitaria, siendo inferiores los estudios donde se trabaja el cambio de comportamiento, las habilidades cognitivas y perceptuales, las habilidades fisiológicas y las habilidades sociales y blandas. Aunque existe un incremento significativo de investigaciones sobre la temática, hay pocos estudios en algunas ramas de conocimiento y una falta de investigaciones sobre uso de videojuegos en el contexto universitario, que aborden las mejoras que se producen en la

asimilación de conocimientos de materias específicas y en el desarrollo de habilidades fundamentales para el adecuado ejercicio de la profesión.

*Palabras clave:* videojuegos, aprendizaje basado en juegos, aprendizaje, educación superior, resultados de aprendizaje.

## Introduction

Video games are tools with educational potential and are one of the main entertainment options for youth (Herder & Rau, 2022; Martí-Parreño *et al.*, 2018; Martín-Martín *et al.*, 2022; Sierra-Daza *et al.*, 2023). In this context, video games can be used as an educational resource at different educational stages (Amores-Valencia & De Casas-Moreno, 2019; Cantó, 2020; Herrero *et al.*, 2020; Martín, 2015, 2019; Martínez *et al.*, 2022), and several studies highlight the need to utilise these media in teaching-learning processes (Adedoyin & Soykan, 2020; Rapanta *et al.*, 2020; Zhu & Liu, 2020).

In the context of university education, the utilisation of game-based learning (GBL) is outstanding at fostering student engagement with the learning process (Chung-Shing *et al.*, 2020; Corsi *et al.*, 2019). GBL involves the use, creation and/or adaptation of games – including digital games, video games and apps for educational purposes – in a classroom context, such that the games become facilitators of learning (Del Moral, 2020). Several studies present evidence of the potential of GBL in educational settings, with reports of a positive correlation between gaming activities and learning (Backlund & Hendrix, 2013; Vandercruyssen *et al.*, 2012). Specifically, the methodological strategy underpinning GBL entails constant feedback, which allows students to understand their progress in light of preset goals, bringing the approach closer to a reflective assessment of what the students need to achieve the preset objectives and how the activity guides them by turning them into players. The effectiveness of GBL is facilitated by the integration of five key elements – (1) motivation: the game affects the will to learn, (2) fun learning: the game promotes learning through enjoyment, (3) autonomy: the game encourages independent exploration, (4) authenticity: the game fosters a concern for learning, and (5) experiential learning: learning by doing through play (Pérez-Manzano & Almeda-Baeza, 2018; Perrotta *et al.*, 2013). In this regard, several studies highlight the benefits of GBL for improving student participation in the

learning process and for acquiring transversal competencies (Fernández-Sánchez *et al.*, 2020; González-González, 2014).

Furthermore, the incorporation of video games into education holds significant potential as teaching material in higher education, as it would facilitate the assimilation of content from various curricular areas and promote the development of the skills in the syllabi of university courses (Corsi *et al.*, 2019; Guenaga *et al.*, 2013; Muñoz *et al.*, 2021a, 2021b), which are relevant resources for acquiring and developing competencies necessary for the 21st century (Fernández *et al.*, 2017; García Varela *et al.*, 2014; Romero & Turpo, 2015). Regarding this educational stage, four lines of research on video games can be found in the literature: (1) the use of video games for content learning (De Castro *et al.*, 2018; Smith & Chan, 2017); (2) the design and development of serious games (educational games) or their use in classrooms (González & Martín, 2016); (3) the use of commercial video games in education (Rama *et al.*, 2012); and (4) analysis of the educational possibilities inherent in video games and their introduction to the classroom (Cantó, 2020).

Among video games, those categorised as serious games are some of the most widespread pedagogical resources in educational contexts, including the university, acting as a relatable medium that encourages student involvement and commitment, through which they can work on challenges that can be approached systematically and train in professional and transversal competencies via experimentation (Alonso & Navazo, 2019; Erhel & Jamet, 2019; Hallinger *et al.*, 2020). Several studies on the use of serious games in the classroom have reported results that point to increased student motivation regarding the learning process, which contributes positively to improvement in their academic performance (Lamb *et al.*, 2018; Molina-Carmona & Llorens-Largo, 2020; Nazry *et al.*, 2017). In particular, serious games (e.g., digital games) simulate scenarios that bring players into close approximations of real-world problems and situations, with the objective of developing a deep understanding of the processes and factors in play in those situations (Zhonggen, 2019). All of this is linked to natural learning, which extends beyond the formal education environment, thus providing opportunities to connect and transfer what is learned to real situations (Goldberg & Cannon-Bowers, 2015). In this sense, serious games, via simulated environments, facilitate the development of social skills such as empathy and assertiveness and contribute to collaborative learning while promoting the acquisition of key

competencies for proper professional practice, such as problem-solving, decision-making and cooperation (Cuenca & Martín, 2010) – in addition to serving as suitable means for developing soft skills and/or essential knowledge (Zabala-Vargas *et al.*, 2020).

In recent years, some literature review studies have identified very specific aspects of the relationship between the use of video games or digital games in university contexts and certain learning outcomes. Agudelo-Londoño, González *et al.* (2019) focus on the relationship between learning effectiveness and the design criteria for serious games in medicine. Zabala-Vargas *et al.* (2020) examine the dimensions of student behaviour in relation to the types of games and teaching methodology employed in teaching mathematics. In addition, a particular review focuses on the effect of simulators and highlights the achievement of learning objectives (De Smale *et al.*, 2016). Furthermore, a study by Vlachopoulos and Makri (2017) presents evidence of affective, cognitive and behavioural learning using digital games and simulators.

This systematic literature review (SLR) builds on a previous study by Boyle *et al.* (2016), which addresses the educational use of video games and collates data on the impact and primary learning outcomes reported in studies published during 2009–2016 without focusing on any specific particular stage of education. Specifically, this research aims to provide a current review of the impact of the educational use of video games on learning – in this case – among university students from the time of completion of the Boyle *et al.* (2016) study to the present.

## Methods

This study adopts the approach of an SLR, with the objective of analysing the educational use of video games and the learning outcomes achieved in university settings. To this end, we apply the standards of the PRISMA 2020 protocol (Page *et al.*, 2021) in our research, including the following elements, in sequential order: research questions; eligibility criteria; database search strategies; selection of research papers; and the collection, extraction and analysis of potential papers on the research topic. To mitigate methodological bias, our review uses the study by Boyle *et al.* (2016) as a reference and has well-defined inclusion and exclusion criteria for selecting the most relevant papers.

## Research questions and coding

Beginning with the primary objective, this review aims to answer the four research questions presented in Figure I, following the indicated coding.

FIGURE I. Research questions and coding

Research questions	Coding
P1. What video games have been used the most in Higher Education considering its main objective in its original design?	Main objective of the video game: 1=Serious game; 2= Game for entertainment
P2. What academic domains of university degrees have developed experiences with video games?	Academic domains of university degrees: 1=Arts and Humanities; 2=Sciences; 3=Health Sciences; 4=Social Sciences and Law; 5=Engineering and Architecture
P3. What are the learning and behaviour outcomes generated with video games in Higher Education?	Learning and behaviour outcomes (Boyle et al., 2016): Knowledge acquisition or comprehension of content; affective and motivational; cognitive and perceptual skills; behaviour change; physiological skills; social and soft skills. 1=yes, there are improvements; 2=No, there are no improvements; 3=Not indicated in this regard.
P4. What are the learning and behavioural outcomes depending on the academic domains of the university degrees?	Learning and behavioural outcomes and academic domains (the previous coding is adopted)

Source: Compiled by authors.

## Eligibility criteria

As inclusion criteria, the studies considered had to be scientific journal articles published in the last seven years (2016–2022) in Spanish, English and Portuguese. In particular, papers that provide empirical evidence on the impact and outcomes of the use of video games in higher education

were included. Furthermore, references to all types of video games or digital games (e.g., serious games, video games, digital games) were considered, and studies conducted with university students (undergraduate, master's, and doctoral students) were also inclusion criteria. Finally, a full-text version of the paper must be available for perusal and extraction of the necessary data for analysis.

Regarding the exclusion criteria, theses, books, book chapters, conference papers, research reports and studies published before 2016 were excluded. In addition, papers published in languages other than those indicated were not included. Furthermore, theoretical studies and didactic proposals in which no empirical evidence is presented and systematic reviews were excluded. Research papers that refer to board games or non-digital games, as well as studies conducted on educational stages other than university (e.g., early childhood education, primary education, secondary education), were not included. Finally, studies aimed at training university faculty were not considered.

## Search strategies

The four international databases searched for this SLR are those most relevant to the fields of education, educational technology and higher education: Science Direct, Dialnet, Springer Link and Scopus. Specifically, multiple searches were conducted in each database using combinations of terms in English, Spanish and Portuguese, with each concept associated with digital games or video games looked up alongside another term related to university education.

Due to the extensive volume of papers on the use of video games in education, Boolean operators were used to filter searches, incorporate terms with quotes and use the AND and OR operators. Specifically, the search terms for video games or digital games in English, Spanish and Portuguese were: «serious game» or «digital game» or «videogame» or «video game» or «game-based learning» or «educational game» or «computer games»; «serious game» or «juego digital» or «videojuego» or «juego serio» or «game-based learning» or «juego educativo» or «juegos de ordenador»; «serious game» or «jogo digital» or «videojogo» or «jogo sério» or «game-based learning» or «jogo educativo» or «jogo educacional» or «jogo de computadora». These concepts were searched together with

the following terms related to university education (depending on the language): «higher education» or «undergraduate» or «postgraduate»; «educación superior» or «universitario» or «postgrado» or «posgrado»; «educação superior» or «universitário» or «mestrado» or «pós-graduação».

## Selection process

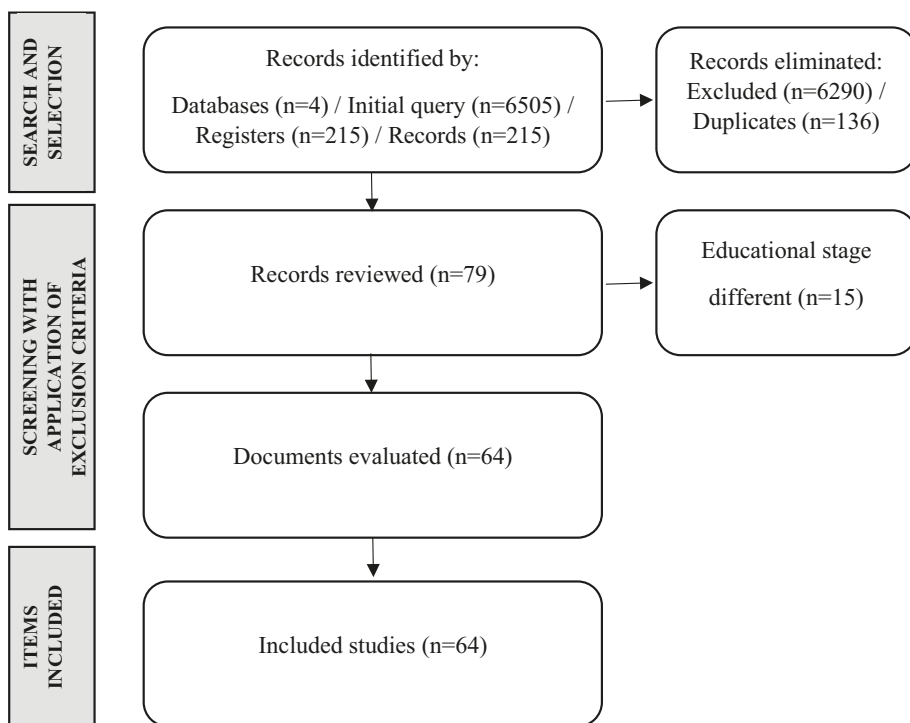
This SLR was conducted for a period of one year between 2021 and 2022, and the procedure followed comprised four phases. The first phase was an initial planning phase in which the inclusion and exclusion criteria for the study were formulated. The second phase involved searching the selected databases using various search term combinations. In this second phase, the papers in the search results were filtered, with the application of inclusion criteria such as the year of publication (2016–2022), document type (scientific paper), language (English, Spanish and Portuguese), content (empirical study) and availability of full-text papers. In general, a total of 6,505 results were obtained from the searches conducted in the Science Direct (n = 1960), Dialnet (n = 261), Springer Link (n = 2970) and Scopus (n = 1314) databases. Subsequently, the papers were reviewed as a function of their titles and abstracts, and 215 papers that met the review criteria were selected (Figure II). The selected papers are, therefore, on the use of video games and learning outcomes generated with video games, with university education as the setting.

In the third phase, screening was performed through independent peer evaluation of the studies, which eliminated 136 duplicates, leaving 79 papers. In the fourth phase, a review of each collated full-text paper was conducted after assessing the possibility of excluding or including them in the study sample, depending on whether they met the determined inclusion criteria and were supported by the exclusion criteria, resulting in 64 papers comprising the final study sample of the SLR.

Overall, the final sample of papers primarily addresses the use of serious games applied individually and collaboratively in the classroom with students from various university degree programmes. Regarding the origin of the papers as a function of searched databases: 13 papers were obtained from Science Direct, 13 from Dialnet, 5 from Springer Link and 33 from Scopus. Pertaining to the language of the papers, 7 are in Spanish and 57 are in English (with 3 also available in Portuguese). As for the year of publication, 11 papers were published in 2016, 13 were



FIGURE II. PRISMA diagram of SLR development



Source: Compiled by authors.

published in 2017, 12 were published in 2018, 12 were published in 2019, 12 were published in 2020, 2 papers were published in 2021, and 2 papers were published in 2022.

## Data collection, extraction and analysis

Data collection, extraction and analysis in this SLR are based on the coding of relevant aspects of studies on the use of video games in university education with which the assessed papers were aggregated in a database created specifically for this research. In the research database, the papers were indexed according to the source database and search keywords in a folder containing the full-text papers. Thus, specific information could be

pulled from the papers, such as source database, language, author's full name, year of publication, scientific journal and author's reference data. The complete coding of the final sample of papers can be downloaded via the following link: <https://doi.org/10.5281/zenodo.10656904>

Subsequently, relevant aspects of the studies regarding the use of video games in university education were analysed, allowing us to answer the research questions of the study. These relevant aspects include the following: the original design purpose of the video games, which comprised serious games (Michael & Chen, 2006) and entertainment games (Meyer & Sørensen, 2009); specific degrees pursued by students in the study sample; the academic domain of the degree (per the classification of the Registry of Universities, Centres, and Titles of the Spanish Ministry of Science, Innovation and Universities); and learning outcomes. The coding is presented in Figure I.

Descriptive analyses of the data were performed to yield frequencies and percentages. Furthermore, the dependent variables related to the learning outcomes were analysed together with the independent variable of the academic domain of the studies pursued by the study participants. Overall, the analysis of the papers was performed by assigning codes and values to information associated with the data pulled from the collated papers.

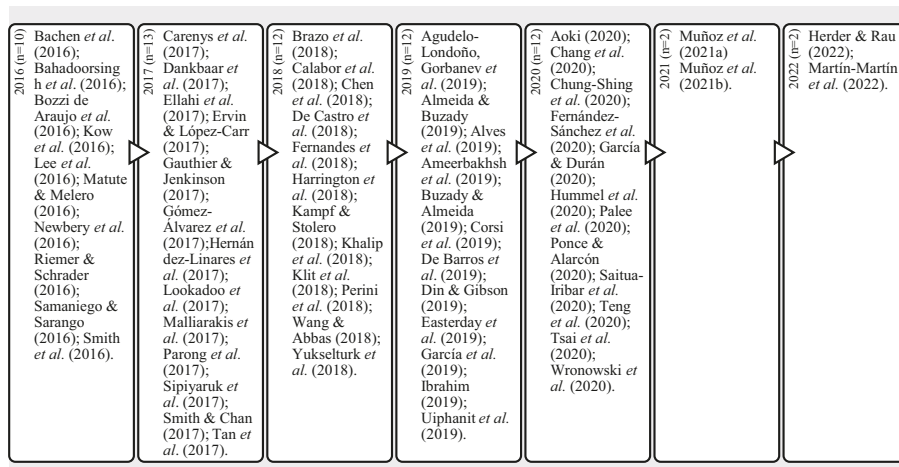
## Results

The results of the data collection, extraction and analysis obtained allow for achieving the central research objective: analysing the scientific literature on learning and skills acquired using video games in university education. The main findings are presented in relation to the relevant research questions.

### **Types of video games used – considering the primary objective of their original design**

Almost all the reviewed papers in the final study sample employ what are known as serious games ( $n = 63, 98.4\%$ ). A chronological view of the distribution of the publishing of these papers on serious games across the research period is presented in Figure III. As can be seen, the publication

FIGURE III. Studies using serious games by year of publication



Source: Compiled by authors.

trend was constant over the years until the last two years, during which there has been a decline in the number of publications on the subject. In addition, only a single study is identified in which entertainment video games or games for entertainment are utilised – specifically, the study by Peng *et al.* (2016). This aligns with the findings of the study by Martín (2015), which highlights the trend towards the use of serious games in educational contexts vis-à-vis entertainment video games, regardless of the educational stage at which they are utilised.

### Academic domains of university degree programmes with video game learning experiences

As seen in Figure IV, the majority of the papers in our final study sample fall under the following domains: the Social Sciences and Law (n = 25, 39.1%), Engineering and Architecture (n =18, 28.1%), and the Health Sciences (n = 12, 18.8%). Conversely, the smallest number of these studies fall under the Sciences (n = 6, 9.4%) and the Arts and Humanities (n = 7, 10.9%) domains. Most of the reviewed studies focus on students pursuing

FIGURE IV. Academic domains of the degrees pursued by the students in the study sample

Arts and Humanities (n=7; 10,9%)	Sciences (n=6; 9,4%)	Health Sciences (n=12; 18,8%)	Social Sciences and Law (n=25; 39,1%)	Engineering and Architecture (n=18; 28,1%)
<ul style="list-style-type: none"> <li>• Brazo <i>et al.</i> (2018); De Castro <i>et al.</i> (2018); Ervin &amp; López-Carr (2017); Ibrahim (2019); Muñoz <i>et al.</i> (2021a); Muñoz <i>et al.</i> (2021b); Ponce &amp; Alarcón (2020).</li> </ul>	<ul style="list-style-type: none"> <li>• Ameerbakishsha <i>et al.</i> (2019); Gauthier &amp; Jenkinson (2017); Herder &amp; Rau (2022); Lee <i>et al.</i> (2016); Lookadoo <i>et al.</i> (2017); Teng <i>et al.</i> (2020).</li> </ul>	<ul style="list-style-type: none"> <li>• Agudelo-Londoño <i>et al.</i> (2019); Alves <i>et al.</i> (2019); Bozzi <i>et al.</i> (2016); Chen <i>et al.</i> (2018); Dankbaar <i>et al.</i> (2017); Harrington <i>et al.</i> (2018); Kow <i>et al.</i> (2016); Martín-Martín <i>et al.</i> (2022); Palee <i>et al.</i> (2020); Sipiyaruk <i>et al.</i> (2017); Smith <i>et al.</i> (2016); Tan <i>et al.</i> (2017).</li> </ul>	<ul style="list-style-type: none"> <li>• Almeida &amp; Buzady (2019); Aoki (2020); Bachen <i>et al.</i> (2016); Brazo <i>et al.</i> (2018); Buzady &amp; Almeida (2019); Calabor <i>et al.</i> (2018); Careny <i>et al.</i> (2017); Chung-Shing <i>et al.</i> (2020); De Castro <i>et al.</i> (2018); Easterday <i>et al.</i> (2019); Ellahi <i>et al.</i> (2017); Fernandes <i>et al.</i> (2018); Fernández-Sánchez <i>et al.</i> (2020); Hummel <i>et al.</i> (2020); Kampf &amp; Stoloro (2018); Matute &amp; Melero (2016); Muñoz <i>et al.</i> (2021a); Muñoz <i>et al.</i> (2021b); Newbery <i>et al.</i> (2016); Parong <i>et al.</i> (2017); Peng <i>et al.</i> (2016); Riemer &amp; Schrader (2016); Saitua-Iribar <i>et al.</i> (2020); Wronowski <i>et al.</i> (2020); Yükseltürk <i>et al.</i> (2018).</li> </ul>	<ul style="list-style-type: none"> <li>• Bahadoorsingh <i>et al.</i> (2016); Chang <i>et al.</i> (2020); Corsi <i>et al.</i> (2019); De Barros &amp; Gama (2019); Din &amp; Gibson (2019); García &amp; Durán (2020); García <i>et al.</i> (2019); Gómez-Álvarez <i>et al.</i> (2017); Hernández-Linares <i>et al.</i> (2017); Khalip <i>et al.</i> (2018); Malliarakis <i>et al.</i> (2017); Möller Klit <i>et al.</i> (2018); Perinia <i>et al.</i> (2018); Samaniego &amp; Sarango (2016); Smith &amp; Chan (2017); Tsai <i>et al.</i> (2020); Uiphanit <i>et al.</i> (2019); Wang &amp; Abbas (2018).</li> </ul>

Source: Compiled by authors.

degrees within a single academic domain; however, four studies (Brazo *et al.*, 2018; De Castro *et al.*, 2018; Muñoz *et al.*, 2021a, 2021b) span two different academic domains. Similar to the conclusions drawn by Boyle *et al.* (2016), these reviewed studies conclude that games facilitate learning across different themes and various fields.

## Learning outcomes linked to video game use in higher education

Notably, a single research study can contribute to the improvement of several different types of learning outcomes. In this regard, the majority of the studies in our study sample report knowledge acquisition or comprehension of content (n = 57, 89.1%) associated with curricular areas and/or basic knowledge areas within a profession (Figure V) that is facilitated by video games. Another noteworthy observation is the reported

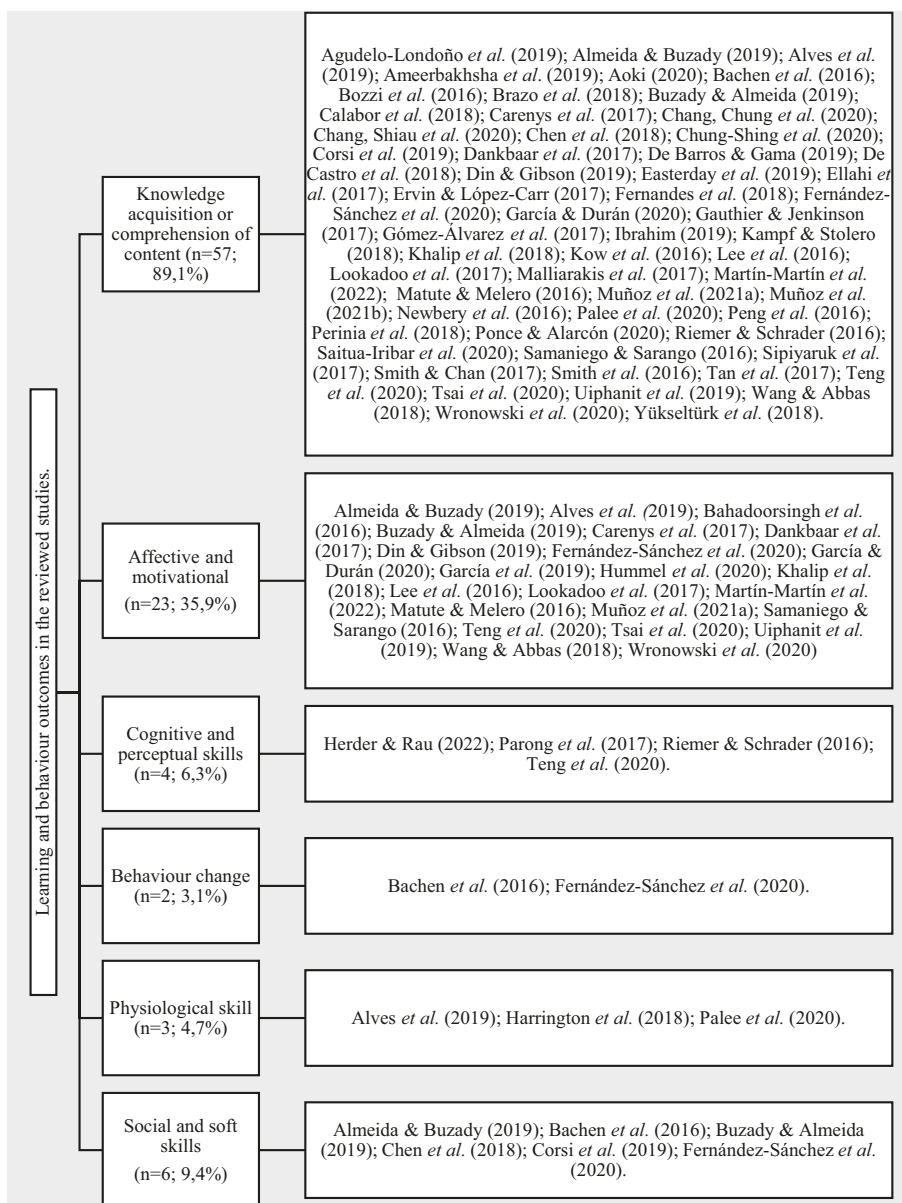
increase in motivation and student engagement with the learning process mediated by video games ( $n = 23$ , 35.9%). However, there are relatively fewer studies related to the acquisition of social and soft skills ( $n = 6$ , 9.4%) and cognitive and perceptual skills ( $n = 4$ , 6.3%). Specifically, the studies among the reviewed papers that investigate the development of cognitive and perceptual skills via video games fall within the domains of the Sciences and the Social Sciences and Law – predominantly psychology (Parong *et al.*, 2017; Riemer & Schrader, 2016; Teng *et al.*, 2020). In addition, physiological skills ( $n = 3$ , 4.7%) were among the least investigated skill sets, along with behaviour change ( $n = 2$ , 3.1%). These findings align with those of Boyle *et al.* (2016), in that serious games are primarily employed for knowledge acquisition and the promotion of student motivation regarding the learning process. There is also a significant similarity to the Molina-Carmona and Llorens-Largo (2020) study, which highlights the motivational potential of these resources (i.e., video games) in the educational sphere. Generally, the acquisition of physiological and social skills is seldom attempted using commercial video games (Boyle *et al.*, 2016).

### Learning outcomes by academic domains

Overall, the majority of the studies analysed investigate knowledge acquisition. This trend is also reflected at the level of the academic domains under which the degrees fall, as this learning outcome (knowledge acquisition) is the most predominant among the reviewed studies across all domains (Figure VI): 23 studies out of a total of 25 in the Social Sciences and Law domain (92%), 15 out of 18 in Engineering and Architecture (83.3%), 11 out of 12 in Health Sciences (91.6%), 5 out of 6 in the Sciences (83.3%), and 7 out of 7 in the Arts and Humanities (100%). In addition, the next most investigated learning outcome across the different academic domains is motivation: 8 studies out of 25 in the Social Sciences and Law, 8 out of 18 in Engineering and Architecture, 3 out of 6 in the Sciences, and 1 in the Arts and Humanities.

Furthermore, there are studies with other learning outcomes in each academic domain. In the case of the Sciences, there are 2 studies with learning outcomes related to cognitive and perceptual skills (33.3%). Under the Social Sciences and Law, a variety of learning outcomes are investigated in addition to those already mentioned. In this sense, there

FIGURE V. Learning and behaviour outcomes in the reviewed studies



Source: Compiled by authors.

FIGURE VI. Academic domains of the degrees in the study sample and researched learning outcomes generated via video games in university education

<p><b>Arts and Humanities</b> (n=7)</p>	<ul style="list-style-type: none"> <li>• <b>Knowledge acquisition or comprehension of contents</b> (n=7; 100%): Brazo <i>et al.</i> (2018); De Castro <i>et al.</i> (2018); Ervin &amp; López-Carr (2017); Ibrahim (2019); Muñoz <i>et al.</i> (2021a); Muñoz <i>et al.</i> (2021b); Ponce &amp; Alarcón (2020).</li> <li>• <b>Affective and motivational</b> (n=1; 14,3%): Muñoz <i>et al.</i> (2021a).</li> <li>• <b>Cognitive and perceptual skills</b> (n=0; 0%).</li> <li>• <b>Behaviour change</b> (n=0; 0%).</li> <li>• <b>Physiological skills</b> (n=0; 0%).</li> <li>• <b>Social and soft skills</b> (0; 0%).</li> </ul>
<p><b>Sciences</b> (n=6)</p>	<ul style="list-style-type: none"> <li>• <b>Knowledge acquisition or comprehension of contents</b> (n=5; 83,3%): Ameerbakhsha <i>et al.</i> (2019); Gauthier &amp; Jenkinson (2017); Lee <i>et al.</i> (2016); Lookadoo <i>et al.</i> (2017); Teng <i>et al.</i> (2020).</li> <li>• <b>Affective and motivational</b> (n=3; 50%): Lee <i>et al.</i> (2016); Lookadoo <i>et al.</i> (2017); Teng <i>et al.</i> (2020).</li> <li>• <b>Cognitive and perceptual skills</b> (n=2; 33,3%): Herder &amp; Rau (2022); Teng <i>et al.</i> (2020).</li> <li>• <b>Behaviour change</b> (n=0; 0%).</li> <li>• <b>Physiological skills</b> (n=0; 0%).</li> <li>• <b>Social and soft skills</b> (n=0; 0%).</li> </ul>
<p><b>Health Sciences</b> (n=12)</p>	<ul style="list-style-type: none"> <li>• <b>Knowledge acquisition or comprehension of contents</b> (n=11; 91,6%): Agudelo-Londoño <i>et al.</i> (2019); Alves <i>et al.</i> (2019); Bozzi <i>et al.</i> (2016); Chen <i>et al.</i> (2018); Dankbaar <i>et al.</i> (2017); Kow <i>et al.</i> (2016); Martín-Martín <i>et al.</i> (2022); Palee <i>et al.</i> (2020); Sipiyaruk <i>et al.</i> (2017); Smith <i>et al.</i> (2016); Tan <i>et al.</i> (2017).</li> <li>• <b>Affective and motivational</b> (n=3; 25%): Alves <i>et al.</i> (2019); Dankbaar <i>et al.</i> (2017); Martín-Martín <i>et al.</i> (2022).</li> <li>• <b>Cognitive and perceptual skills</b> (n=0; 0%).</li> <li>• <b>Behaviour change</b> (n=0; 0%).</li> <li>• <b>Physiological skills</b> (n=3; 25%): Alves <i>et al.</i> (2019); Harrington <i>et al.</i> (2018); Palee <i>et al.</i> (2020).</li> <li>• <b>Social and soft skills</b> (n=0; 0%).</li> </ul>
<p><b>Social Sciences and Law</b> (n=25)</p>	<ul style="list-style-type: none"> <li>• <b>Knowledge acquisition or comprehension of contents</b> (n=23; 92%): Almeida &amp; Buzady (2019); Aoki (2020); Bachen <i>et al.</i> (2016); Brazo <i>et al.</i> (2018); Buzady &amp; Almeida (2019); Calabor <i>et al.</i> (2018); Carensys <i>et al.</i> (2017); Chung-Shin <i>et al.</i> (2020); De Castro <i>et al.</i> (2018); Easterday <i>et al.</i> (2019); Ellahi <i>et al.</i> (2017); Fernandes <i>et al.</i> (2018); Fernández-Sánchez <i>et al.</i> (2020); Kampf &amp; Stolero (2018); Matute &amp; Melero (2016); Muñoz <i>et al.</i> (2021a); Muñoz <i>et al.</i> (2021b); Newbery <i>et al.</i> (2016); Peng <i>et al.</i> (2016); Riemer &amp; Schrader (2016); Saitua-Iribar <i>et al.</i> (2020); Wronowski <i>et al.</i> (2020); Yükseltürk <i>et al.</i> (2018).</li> <li>• <b>Affective and motivational</b> (n=8; 32%): Almeida &amp; Buzady (2019); Carensys <i>et al.</i> (2017); Buzady &amp; Almeida (2019); Fernández-Sánchez <i>et al.</i> (2020); Hummel <i>et al.</i> (2020); Matute &amp; Melero (2016); Muñoz <i>et al.</i> (2021a); Wronowski <i>et al.</i> (2020).</li> <li>• <b>Cognitive and perceptual skills</b> (n=2; 8%): Parong <i>et al.</i> (2017); Riemer &amp; Schrader (2016).</li> <li>• <b>Behaviour change</b> (n=2; 8%): Bachen <i>et al.</i> (2016); Fernández-Sánchez <i>et al.</i> (2020).</li> <li>• <b>Physiological skills</b> (n=0; 0%).</li> <li>• <b>Social and soft skills</b> (n=4; 16%): Almeida &amp; Buzady (2019); Bachen <i>et al.</i> (2016); Buzady &amp; Almeida (2019); Fernández-Sánchez <i>et al.</i> (2020).</li> </ul>
<p><b>Engineering and Architecture</b> (n=18)</p>	<ul style="list-style-type: none"> <li>• <b>Knowledge acquisition or comprehension of contents</b> (n=15; 83,3%): Chang, Chung <i>et al.</i> (2020); Corsi <i>et al.</i> (2019); De Barros &amp; Gama (2019); Din &amp; Gibson (2019); García &amp; Durán (2020); Gómez-Álvarez <i>et al.</i> (2017); Hernández-Linares <i>et al.</i> (2017); Khalip <i>et al.</i> (2018); Malliarakis <i>et al.</i> (2017); Perinía <i>et al.</i> (2018); Samaniego &amp; Sarango (2016); Smith &amp; Chan (2017); Tsai <i>et al.</i> (2020); Uiphanit <i>et al.</i> (2019); Wang &amp; Abbas (2018).</li> <li>• <b>Affective and motivational</b> (n=8; 44,4%): Bahadoorsingh <i>et al.</i> (2016); Din &amp; Gibson (2019); García &amp; Durán (2020); García <i>et al.</i> (2019); Khalip <i>et al.</i> (2018); Samaniego &amp; Sarango (2016); Tsai <i>et al.</i> (2020); Uiphanit <i>et al.</i> (2019).</li> <li>• <b>Cognitive and perceptual skills</b> (n=0; 0%).</li> <li>• <b>Behaviour change</b> (n=1; 5,5%): Hernández-Linares <i>et al.</i> (2017).</li> <li>• <b>Physiological skills</b> (n=0; 0%).</li> <li>• <b>Social and soft skills</b> (n=2; 11,1%): Corsi <i>et al.</i> (2019); Hernández-Linares <i>et al.</i> (2017).</li> </ul>

Source: Compiled by authors.

are 4 studies with outcomes related to social skills and soft skills (16% of the studies within the Social Sciences and Law domain), as well as 2 related to cognitive and perceptual skills and 2 on behaviour change in each case (8% of the studies in the Social Sciences). However, none of the reviewed studies investigate physiological skills. Finally, in Engineering and Architecture, in addition to what has been mentioned, there are also two studies with learning and behaviour outcomes associated with social skills and soft skills and one on behaviour change (11.1% and 5.5%, respectively). In general, this coincides with the findings of Boyle *et al.* (2016) regarding the achievement of positive learning outcomes through the pedagogical application of video games in education; however, our study focuses on university education.

## Discussion and conclusions

As observed in this study, video games can be utilised in the university setting as teaching material across a variety of academic domains with diverse learning objectives (Martín, 2019). Regarding the question related to the type of video games employed, there is a predominance of studies on serious games over entertainment games, as has been reported in previous studies (Martín, 2015). Furthermore, as Martí-Parreño *et al.* (2018) report, educational video games are considered a tool for motivating and engaging university-level students.

In terms of the academic domains of the degrees pursued by study participants, the majority of the studies in our study sample fall under the Social Sciences and Law, Engineering and Architecture. This aligns with the observation by Cuenca and Martín (2010) that, based on their analysis of different video games on the physically-sold video games market and on the Internet for integration into the educational processes in the Social Sciences, video games can be used for economic and commercial activities and for analysing the problems or social relations of citizens.

Concerning learning outcomes, the studies investigate the acquisition of knowledge and comprehension of content and the motivation of students regarding the learning process. In this sense, fostering motivation using video games aligns with the notion that the appropriate pedagogical use of technologies generates motivation in students (Amores-Valencia & De Casas-Moreno, 2019). Notably, motivation is a fundamental element of the teaching-learning process, being a driving force of learning



(Molina-Carmona & Llorens-Largo, 2020). However, the adoption of video games as teaching tools in university education should be complemented with the added objective of developing competencies and fundamental skills among university students that equip them to respond to social needs and their subsequent insertion into the labour market (Fernández *et al.*, 2017; Fernández-Sánchez *et al.*, 2020; Guenaga *et al.*, 2013).

In conclusion, this study represents an update and contribution to the body of knowledge on video games and education from an interdisciplinary perspective, with broad coverage of studies that investigate the impact of video games in university education. We understand that including only scientific papers in this SLR leaves out other types of research, such as theoretical studies – which would allow for a broader view of the subject – could be a limitation of our study. Emerging voices propose taking advantage of the opportunity offered by video games to transform university education, with advocacy for mixed, combined, integrated and flexible teaching and learning processes more characteristic of this new era (Adedoyin & Soykan, 2020; Rapanta *et al.*, 2020; Zhu & Liu, 2020). In this regard, the development of studies on learning outcomes achieved via commercial video games in the university setting and other educational stages is imperative. Similarly, given the low number of studies that have sought to contribute to the development of relevant capacities such as social and soft skills, it would be interesting to see more research that addresses the use of video games for the development of competencies related to conflict resolution and ethical issues among future education professionals. Finally, video games are tools that can support change processes in the university context; they facilitate highly student-centric learning methodologies and foster ubiquitous learning in an active and collaborative environment.

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