A scientiometric review about educational gamification: methodology, support, character and types of game used in gamified proposals

Una revisión cienciométrica sobre la gamificación educativa: metodología, soporte, carácter y tipos de juego utilizados en las propuestas gamificadas

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RESUMEN

Esta revisión analiza las características de las propuestas didácticas de gamificación en diferentes áreas del conocimiento como las ciencias de la salud, las ciencias exactas, las ciencias sociales y las humanidades. Se identificaron ochenta y cinco estudios potenciales a través de una búsqueda en las bases de datos ISI, Web of Science y SCOPUS. Los resultados examinaron las siguientes características: población, método, soporte, carácter y tipo de juego utilizado en cada disciplina educativa. Se concluye que las aportaciones científicas se han centrado en la Educación Superior, siendo la gamificación y los videojuegos los métodos más utilizados bajo un soporte digital entre PC y móvil/Tablet. En cuanto a la metodología, fue de carácter cooperativo-competitivo o competitivo y con tres tipos de juego eminentemente: Plataformas de Enseñanza Virtual (PVE), juegos de aprendizaje activo y uso de mecánicas con puntos, insignias y tablas de clasificación (PBL). Este trabajo arroja luz sobre futuras propuestas de gamificación ya que puede servir para futuras innovaciones.

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PALABRAS CLAVES
didáctica, educación, juegos, videojuegos.

ABSTRACT

This review analyzes the characteristics of the didactic proposals of gamification in different areas of knowledge such as health sciences, exact sciences, social sciences and humanities. Eighty-five potential studies were identified through a search in the ISI, Web of Science and SCOPUS databases. Results examined the following characteristics: population, method, support, character and type of game used in each educational discipline. It is concluded that the scientific contributions have focused on Higher Education, with gamification and videogames being the most widely used methods under a digital support between PC and mobile / Tablet. Regarding the methodology, it was cooperative-competitive or competitive character and with three types of game eminently: Platforms Virtual Teaching (PVE), active learning games and use of mechanics with points, badges and leaderboards (PBL). This work shed light on future gamification proposals as it may serve to know how to innovate.

KEYWORDS
didactic; education; games; videogames.

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1. INTRODUCTION

Gamification has become one of the most innovative methodologies in the educational field in the last 10 years (Azman y Yunus, 2019; Prieto, 2020; Romero y Kalmpourtzis, 2020). In this line, the studies that have worked on the gamification of learning have also combined it with other methodological alternatives such as serious games (Holzmann *et al*., 2019; Maskeliūnas et al., 2019; Simons et al., 2021), video games (Wang y Hsieh, 2020; Zolfaghari et al., 2021), or Game Based Learning (GBL) (Azman y Yunus, 2019; Romero y Kalmpourtzis, 2020; Roy et al., 2019). In this review, gamification is understood as an educational strategy distinct from serious games, exergames, video games, and Game-Based Learning (GBL). Gamification involves integrating game elements (such as points, levels, rewards, or competition and collaboration mechanics) into non-game contexts, such as classrooms, to motivate and engage students in learning (Azman y Yunus, 2019; Prieto, 2020; Romero y Kalmpourtzis, 2020). In contrast, serious games are specifically designed for educational purposes beyond entertainment (Prieto, 2020). Exergames combine physical activities with educational or recreational objectives. GBL, on the other hand, uses complete games (either pre-existing or designed ad hoc) as the primary tool to achieve educational goals (Troussas et al., 2020). However, within the work through gamification as a methodology, there are various lights and shadows. In particular, Kalogiannakis et al. (2021) highlight that gamified proposals often lack a formal design process. Therefore, it is necessary to study the characteristics of gamified didactic proposals to help teachers structure any gamification process that they want to implement in the classroom. In this sense, the present scientometric review aims to shed light on the didactic proposals made in education according to their methodology, support, character and types of games used.

Starting with the support used, there are contradictory results that indicate that blended learning (BL) turns out to be effective as a learning strategy (Lam et al., 2018). However, in the study by Can and Dursun (2019) no differences were observed between the groups in motivation, performance or learning. On the other hand, there seems to be no scientific literature that addresses the effectiveness of a non-digital/digital support in a gamified environment.

On the other hand, the character of gamified proposals has been related to social comparison, students can share their badges on social networks and benefit from additional recognition from friends and family, but social pressure on students can also be cultivated. In addition, social comparison leads to competition, which research shows has negative effects in the classroom. As pointed out by Dindar et al. (2021) the effort towards the task in a competitive gamified experience could be due either to aim for higher rankings or to avoid lower rankings. Regarding the classification tables, Leitão et al. (2021) point out that they are very motivating in competitive gamified experiences, due to the immediate feedback they provide.

Regarding the types of games, the literature on educational gamification addresses the use of board games (Agustín et al., 2021; Rodríguez-Oroz et al., 2019), strategy (Dimova et al., 2018; Hernández-Nieto y Salinas, 2019), puzzles (Borrego et al., 2017; Kim et al., 2020), awareness (Pérez-López et al., 2019; Rutberg y Lindqvist, 2018), role (Fernández et al., 2018; Quintero et al., 2018), active learning (Arufe, 2019; Hernando et al., 2015), with mechanics of points, badges and classification tables (Points et al., PBL) (Martín-Moya et al., 2018; Zhang y Chen, 2021), or virtual learning platforms (Felszeghy et al., 2019; Prieto, 2018), with this structure being followed in the review to classify gamification processes in different educational disciplines.

As a novelty of this work, it is intended to analyze the gamified proposals made in education from a scientometric approach in which the characteristics of the proposals will be examined based on their methodology, support, character and type of game. Thus, this work aims to shed light on what has been done in terms of gamified educa-

tional proposals and propose new horizons in terms of what remains to be done within this section. As such, the following objective is proposed: to analyze the population, support, methodology, character, and type of didactic proposal for the game of gamification in different educational disciplines.

2. METHODOLOGY

2.1 Design

The scientometric method (Michán y Muñoz-Velasco, 2013) is a scientific discipline that provides a series of indicators after analyzing the scientific contribution, which serves to examine the progress and current scientific status. In this case, the search for information has been oriented towards studies related to didactic proposals or gamification experiences in four areas of knowledge: (1) Health Sciences, (2) Exact Sciences, (3) Natural and Social Sciences, and (4) Humanities, with the purpose of knowing its characteristics following the 5 indicators of this review: 1-population (Primary, Secondary or Higher Education), 2-methodology (serious games and exergames, videogames, Game Based Learning (GBL) or gamification), 3-support (digital-pc, digital-mobile/Tablet, blended learning (BL), or non-digital), 4-character (cooperative, collaborative, competitive, or cooperative-competitive), and 5-type of game (board, strategy, puzzle, awareness, role-playing, active learning, with mechanics of points, badges and leaderboards (Points, Badges and Leaderboards, PBL or virtual teaching platform). In this review, the criteria established in the PRISMA 2020 declaration (Huntton et al., 2016) were followed. On the other hand, the location of articles was carried out in August 2021 in ISI Web Of Science and Scopus.

Search Strategies

Different search strings were used according to four areas of knowledge: Health Sciences (Gamification AND Education OR learning AND evaluation AND physiology OR nutrition OR physical education); Exact Sciences (Gamification AND Education OR learning AND evaluation AND Maths OR physics OR chemistry OR computing); Natural Sciences (Gamification AND Education OR learning AND evaluation AND geology OR biology OR geography OR history); and Humanities (Gamification AND Education OR learning AND evaluation AND language OR literature), filtering the search by title, abstract and keywords. 13254 records were identified in both databases from 2015 to August 2021 (12904 in WOS and 350 in SCOPUS). Of this total, a random selection of 1128 records were made, distributed in a stratified manner, with 95% confidence and +/- 4.3 sampling error.

The reduction from the initial 13,254 records to a final sample of 1,128 is justified through a careful statistical selection process designed to ensure representativeness with an acceptable margin of error. The following explains this process: 1-Stratified sampling distribution: The sample was stratified based on the proportion of articles published per year relative to the total identified in the WoS and SCOPUS databases. This ensures a proportional representation of each year in the final sample, as shown in Table 1. /2-Applied statistical criteria: The sample was determined using a 95% confidence level and a ±4.3% margin of error, meaning the selected sample reliably represents the characteristics of the total 13,254 records. This statistical approach allows valid inferences about the entire dataset. / 3-Filtering for accessibility and relevance: Articles were initially filtered by title, abstract, and keywords, reducing the number of relevant records within each area of knowledge. The final sample was then selected to ensure quality and relevance while minimizing redundancy and maximizing analytical feasibility. Thus, the reduction reflects a rigorous methodological process balancing representativeness and feasibility, ensuring the validity of the study's findings.

Table 1

Proportion of works resulting from the search for open access articles in WOS and SCOPUS

Year	Articles WOS and SCOPUS	Total sample of the stratum	Stratum proportion
2021	1474	94	8.3%
2020	271	245	21.7%
2019	2698	264	23.4%
2018	2050	206	18.2%
2017	1862	169	15%
2016	1496	86	7.7%
2015	1103	64	5.7%%

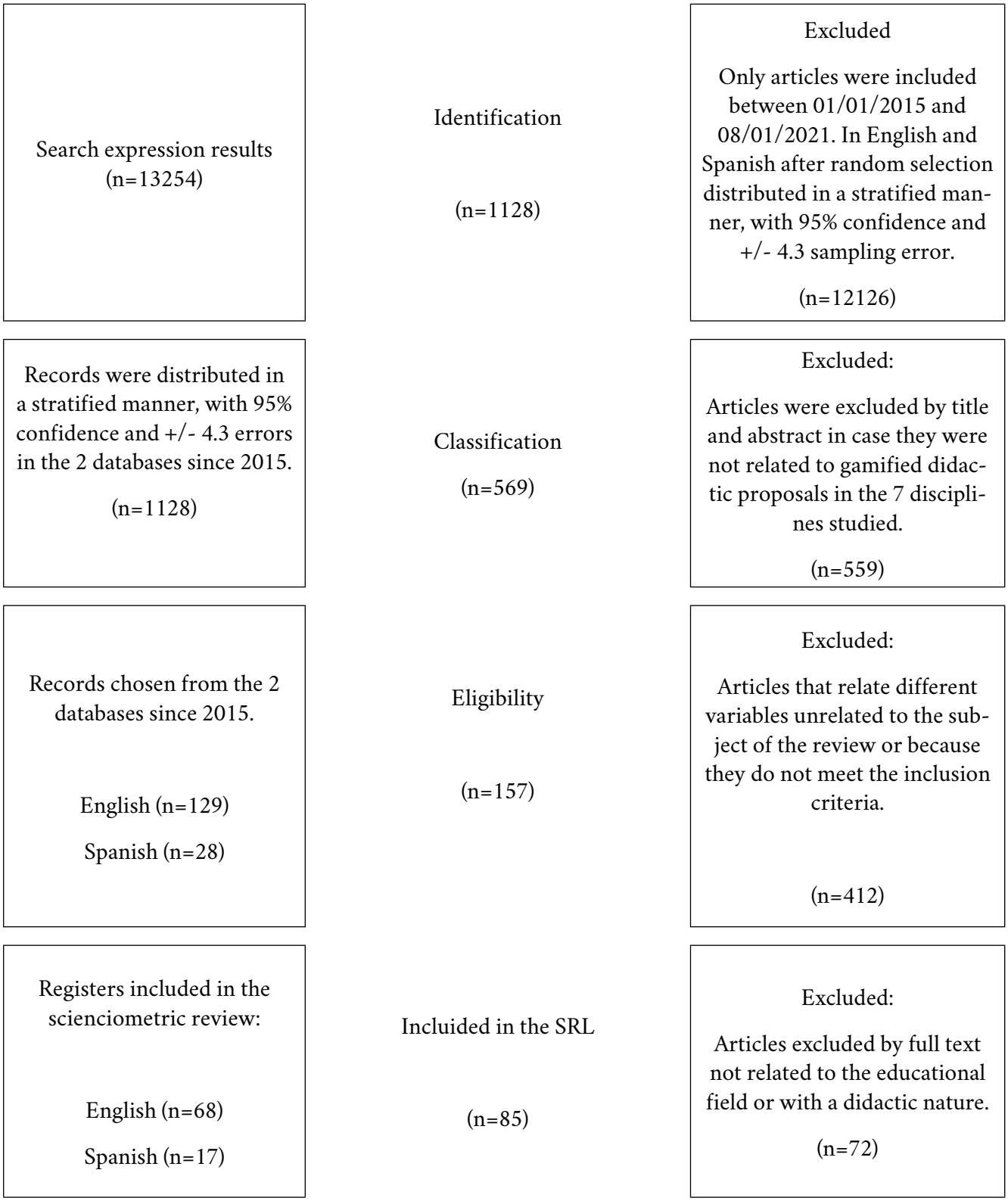
Note. Own elaboration, from the data extracted in WoS and SCOPUS

This selection was made from a table of random numbers created ad-hoc, assigning them a unique identification number that allowed the selection of each sample unit. Of the studies that were considered, 569 complete articles resulted for review in the classification phase, discarding by title, abstract and full-text, the studies that were not related to the area of knowledge. Subsequently, articles that examined different variables unrelated to the subject of the review or because they did not meet the inclusion criteria were excluded. Thus, 157 studies remained in the eligibility phase.

Subsequently, in the inclusion phase, 72 articles were eliminated, including the full-text articles. Of the subtotal of the records found in WOS and SCOPUS, 85 studies were finally analyzed (Table 3), and selected intentionally. Figure 1 shows the flowchart of the review process following the PRISMA protocol. The data of the studies were analyzed according to the population, the methodology, the support, the character and the type of game implemented.

Figure 1

Flow chart of the search procedure according to PRISMA



2.2 Study Selection

For the selection of the study sample, the following inclusion criteria have been taken into account: works published from 2015 onwards, written in Spanish and English; peer-reviewed articles and conference papers published in a book of proceedings; articles belonging to the category: Education and Educational Research in WOS and any category in SCOPUS; works with free access to full-text in WOS; and studies of a single and double comparative group, with a survey design that assessed the implementation of the gamification experience. Subsequently, all the productions were extracted and organized in a data matrix using the SPSS program 25 version. The indicators on which the scientometric review has focused are: educational disciplines, population, method, support, character and type of game.

3. RESULTS

The total of the selected sample was analyzed, with 85 (80% in English and 20% in Spanish) studies analyzed in the review, seven being the underlying educational disciplines of the four areas of knowledge on which the scientometric review has focused: Physical Education (14.12%), Physiotherapy and Nutrition (10.59%), Mathematics, Physics and Chemistry (9.41%), Computer Science (22.35%), Social Sciences (10.59%), Natural Sciences (12.94%) and Linguistics (20%). Table 2 analyses the scientific production according to the categories studied for the seven educational disciplines.

Table 2

Scientific production distributed in each of the categories studied

		Phisical Education	Phisiotera-py./ Nutrition.	Maths./ Phisics./ Chemis-try.	Com-puter Sciences.	Social Sciences	Natural Sciences.	Linguistic.
Population (PB)	Primary Education (EP)	25.0%	22.2%	37.5%	10.5%	22.2%	27.3%	23.5%
	Secondary Education (ESE)	25.0%	22.2%	0.0%	0.0%	11.1%	18.2%	5.9%
	Higher Education (ES)	50.0%	55.6%	62.5%	89.5%	66.7%	54.5%	70.6%
Methodo-logy (ME)	Serious games and Exergames (JSE)	8.3%	33.3%	0.0%	10.5%	11.1%	18.2%	11.8%
	Videogames (V)	8.3%	22.2%	37.5%	36.8%	22.2%	36.4%	29.4%
	Game Based Learning (GBL)	16.7%	33.3%	37.5%	15.8%	22.2%	18.2%	17.6%
Support (SO)	Gamification (G)	66.7%	11.1%	25.0%	36.8%	44.4%	27.3%	41.2%
	Digital-PC (PC)	16.7%	22.2%	12.5%	47.4%	33.3%	54.5%	35.3%
	Digital-Mobile/Tablet (MT)	16.7%	55.6%	62.5%	36.8%	22.2%	9.1%	29.4%
	Non-Digital (ND)	41.7%	11.1%	12.5%	0.0%	44.4%	27.3%	5.9%
	Blended Learning (BL)	25.0%	11.1%	12.5%	15.8%	0.0%	9.1%	29.4%

Character (CA)	Cooperative (CO)	25.0%	11.1%	0.0%	0.0%	22.2%	0.0%	17.6%
	Colaborative (CL)	25.0%	44.4%	25.0%	10.5%	11.1%	27.3%	17.6%
	Competitive (CP)	8.3%	11.1%	12.5%	36.8%	22.2%	36.4%	23.5%
	Cooperative-Competitive (C-C)	41.7%	33.3%	62.5%	52.6%	44.4%	36.4%	41.2%
Game Type (TJ)	Tabletop Games (M)	0.0%	0.0%	0.0%	5.3%	0.0%	18.2%	5.9%
	Strategy Games (E)	0.0%	0.0%	25.0%	0.0%	22.2%	9.1%	0.0%
	Puzzle Games (R)	0.0%	22.2%	25.0%	10.5%	0.0%	0.0%	0.0%
	Awareness Games (C)	16.7%	11.1%	0.0%	0.0%	11.1%	0.0%	0.0%
	Juegos de rol (ROL)	16.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Active Learning Games (AA)	33.3%	11.1%	12.5%	5.3%	44.4%	9.1%	17.6%
	Games with Mechanics (PBL)	25.0%	11.1%	12.5%	15.8%	0.0%	9.1%	11.8%
	Virtual Teaching Platform (PVE)	8.3%	44.4%	25.0%	63.2%	22.2%	54.5%	64.7%

The base body of the study is distributed in the following percentages: population (Primary Education: 22.4%; Secondary Education: 10.6%; Higher Education: 67.1%), method (Serious Games Exergames: 12.9%; Video games: 28.2%; Game-Based Learning: 21.2%; Gamification: 37.6%), support (Computer: 34.1%; Mobile/Tablet: 31.8%; Non-Digital: 17.6%; Blended Learning: 16.5%), character (Cooperative: 10.6%; Collaborative: 21.2%; Competitive: 23.5%; Cooperative-Competitive: 44.7%) and type of game used in each educational discipline (Board games: 4.7%; Strategy games: 5.9%; Puzzle games: 7.1%; Awareness games: 4.7%; Role-playing games: 2.4%; Learning games active: 17.6%; Games with mechanics: 12.9%; Virtual teaching platform: 44.7%).

Finally, Table 3 presents the basic body of the scientometric review in relation to the indicators studied and ordered by educational discipline. In particular, in the Physical Education subject, 6 studies in English and 1 study in Spanish were examined. On the other hand, in Physiotherapy and Nutrition, 7 studies in English and 1 study in Spanish were examined. On the other hand, in the subject of Mathematics, Physics and Chemistry, 7 studies in English and 1 in Spanish were examined. In addition, in the Computer Science subject, 17 works in English and 2 in Spanish were studied. In Social Sciences, 8 were examined in English and 1 in Spanish. In Natural Sciences, 8 were examined in English and 3 in Spanish. In linguistics, 15 papers were in English and 2 in Spanish.

Table 3

Gamified educational proposals and their characteristics in seven educational discipliness

ID	Year	Title	PB	ME	SO	CA	TJ
Physical Education (6 in english and 7 in spanish)							
1	2015	Play the Game: gamification and healthy habits in physical education	ESE	GBL	PC	CL	AA
2	2017	La profecía de los elegidos": un ejemplo de gamificación aplicado a la docencia universitaria	ES	G	BL	C-C	PBL
3	2018	Más allá del libro de texto. La gamificación mediada con TIC como alternativa de innovación en E.F.	ESE	G	BL	CO	ROL
4	2018	Aprendizajes Significativos mediante la Gamificación a partir del Juego de Rol: "Las Aldeas de la Historia"	EP	G	ND	CO	ROL
5	2018	Active School Transportation is an Investment in School Health	EP	G	ND	CL	C
6	2018	Motivación de logro para aprender en estudiantes de Educación Física: diverhealth	ESE	G	MT	C-C	PBL
7	2019	Rationale and design of an online educational programme using a game-based learning platform to improve nutrition and physical activity outcomes among university students in the UK	ES	GBL	PC	CL	PVE
8	2019	12 +1. Sentimientos del alumnado universitario de educación física frente a una propuesta de gamificación: "Game of Thrones: la ira de los dragones"	ES	G	ND	C-C	C
9	2019	Fortnite EF un nuevo juego deportivo para el aula de Educación Física. Propuesta de innovación y gamificación basada en el videojuego Fortnite	ES	G	ND	C-C	AA
10	2019	¿Jugamos al Súper Mario Bros? Descripción de una experiencia gamificada en la formación del profesorado de Educación Física	ES	G	ND	CO	PBL
11	2020	Effects of game-based teaching on primary students' dance learning: The application of the personal active choreographer	EP	JSE	BL	CP	AA
12	2020	"$in TIME"" Gamification Project: Using a Mobile App to Improve Cardiorespiratory Fitness Levels of College Students	ES	V	MT	C-C	AA
13	2021	Sports Gamification: Evaluation of Its Impact on Learning Motivation and Performance in Higher Education	ES	G	BL	C-C	AA
Physioterapy and Nutrition (7 in english and 1 in spanish)							
14	2017	Room Escape: Propuesta de Gamificación en el Grado de Fisioterapia	ES	GBL	ND	C-C	R
15	2019	Short-Term Efects of the Serious Game "Fit. Food.Fun" on Nutritional Knowledge: A Pilot Study among Children and Adolescents	ESE	JSE	PC	CL	C
16	2019	Using online game-based platforms to improve student performance and engagement in histology teaching	ES	GBL	PC	C-C	PVE
17	2020	Fammeal: A Gamified Mobile Application for Parents and Children to Help Healthcare Centers Treat Childhood Obesity	EP	JSE	MT	CL	PVE
18	2020	PuzzleWalk: A theory-driven iterative design inquiry of a mobile game for promoting physical activity in adults with autism spectrum disorder	ES	V	MT	CL	R
19	2020	Troubadour: A gamified e-learning platform for ear training	ES	GBL	MT	CP	PVE
20	2020	A serious game on the first-aid procedure in choking scenarios: Design and evaluation study	ESE	JSE	MT	CL	PBL
21	2021	Development and evaluation of a gamified smart phone mobile health application for oral health promotion in early childhood: a randomized controlled trial	EP	V	MT	CO	PVE

Mathematics, Physics and Chemistry (7 in English and 1 in Spanish)							
22	2017	Gamified Digital Math Lessons for Lower Primary School Students	EP	GBL	MT	C-C	PVE
23	2017	Los videojuegos como medio de aprendizaje: un estudio de caso en matemáticas en educación primaria	EP	V	MT	CP	E
24	2017	Learning Physics the Gamified Way	ES	G	ND	C-C	PBL
25	2019	Games for Teaching Mathematics in Nigeria: What Happens to Pupils' Engagement and Traditional Classroom Dynamics?	EP	GBL	MT	CO	AA
26	2019	Integration of gamification elements in the generation of visual representation of a mathematical function using digital technology: A case study	ES	G	MT	CL	E
27	2019	Analysis of elementary school students' mastery in math instruction based on arithmetic gamification	ES	GBL	BL	C-C	R
28	2019	Gamification of in-classroom diagram design for science students	ES	V	MT	CL	R
29	2021	"LimStorm" – A Didactic Card Game for Collaborative Math Learning for Gen Z Students	ES	V	PC	C-C	PVE
Computer Sciences (17 in english and 2 in spanish)							
30	2015	Engaging Asian students through game mechanics: Findings from two experiment studies	ES	G	BL	C-C	PBL
31	2016	Climbing Up the Leaderboard: An Empirical Study of Applying Gamification Techniques to a Computer Programming Class	ES	V	MT	CP	PVE
32	2017	Room escape at class: escape games activities to facilitate the motivation and learning in computer science	ES	GBL	PC	CP	R
33	2018	GaMoodlification: Moodle al servicio de la gamificación del aprendizaje	ES	V	PC	C-C	PVE
34	2018	OneUp: Supporting Practical and Experimental Gamification of Learning	ES	G	PC	CL	PBL
35	2018	Questionify: Gamification in Education	ES	G	MT	CP	PBL
36	2018	BrainQuest: The use of motivational design theories to create a cognitive training game supporting hot executive function	EP	JSE	MT	C-C	AA
37	2019	Swords and sorcery a structural gamification framework for higher education using role-playing game elements	ES	G	BL	C-C	PVE
38	2019	Diseños de entornos de aprendizaje activo basados en la gamificación: el juego Fiscal Re-Game	ES	G	BL	C-C	PVE
39	2019	Using Gamification to Stimulate the Cognitive Ability of Preschoolers	EP	V	PC	CP	PVE
40	2019	Assessment of the Socrative Platform as an Interactive and Didactic Tool in the Performance Improvement of STEM University Students	ES	G	MT	C-C	PVE
41	2019	Design of an Open-Source Decoder for Educational Escape Rooms	ES	V	PC	C-C	R
42	2019	PROud—A Gamification Framework Based on Programming Exercises Usage Data	ES	G	PC	CP	PVE
43	2019	Collecting Pokémon or receiving rewards? How people functionalise badges in gamified online learning environments in the wild	ES	GBL	MT	C-C	PVE
44	2020	An interactive serious mobile game for supporting the learning of programming in JavaScript in the context of eco-friendly city management	ES	JSE	MT	C-C	PVE
45	2020	Web gamification with problem simulators for teaching engineering	ES	V	PC	CP	M
46	2020	Collaboration and fuzzy-modeled personalization for mobile game-based learning in higher education	ES	GBL	MT	CL	PVE
47	2020	Video games and Kahoot! As cognitive gamifiers in compulsory social isolation	ES	V	PC	CP	PVE

48	2021	Usability evaluation of a Gamification-based programming learning platform: Grasshopper	ES	V	PC	C-C	PVE
Social Sciences (8 in English and 1 in Spanish)							
49	2015	Gamifying the Museum A Case for Teaching for Games Based Learning	ESE	V	MT	CL	AA
50	2016	Luris: la lógica de los juegos en la enseñanza del derecho	ES	G	ND	C-C	AA
51	2016	Game-based learning and gamification in initial teacher training in the social sciences: an experiment with MinecraftEdu	EP	GBL	PC	CO	C
52	2017	Playhist: play and learn history. learning with a historical game vs an interactive film	ES	V	MT	C-C	AA
53	2017	Segeberg 1600 – reconstructing a historic town for virtual reality visualisation as an immersive experience	ES	G	PC	CO	E
54	2018	Towards Better Understanding of Ancient Civilizations by Storytelling and Gaming	ES	G	PC	CP	E
55	2020	Good gamers. good managers? A proof-of-concept study with Sid Meier's Civilization	ES	JSE	PC	C-C	PVE
56	2020	Game-based e-learning for urban tourism education through an online scenario game	ES	GBL	PC	CL	PVE
57	2021	The effects of a gamified project based on historical thinking on the academic performance of primary school children	EP	G	ND	C-C	AA
Ciencias Naturales (8 en inglés y 3 en español)							
58	2016	Online Interactive Activities to Learn Ramayana Epic by Primary Tamil Students	EP	JSE	PC	CL	AA
59	2018	Una web 2.0 para la enseñanza-aprendizaje de las ciencias en bachillerato mediante gamificación: Jedirojo Sciences	ES	V	PC	CP	PVE
60	2018	Earthquake in the city using real life gamification model for teaching professional commitment in high school students	ESE	V	BL	CL	PVE
61	2019	Using Gamification in a Teaching Innovation Project at the University of Alcalá: A New Approach to Experimental Science Practices	ES	G	ND	C-C	PBL
62	2019	Aprendizaje basado en un proyecto de gamificación: vinculando la educación universitaria con la divulgación de la geomorfología de Chile	ES	G	ND	C-C	M
63	2019	Gamification of Assessments in the Natural Sciences Subject in Primary Education	EP	JSE	MT	CL	PVE
64	2019	Use of the game-based learning platform KAHOOT! to facilitate learner engagement in Animal Science students	EP	G	PC	CP	PVE
65	2020	Ubiquitous Pokémon Go: Human–Environment Relationships and the Location-Based Augmented Reality Game	ES	V	PC	CP	PVE
66	2020	Constructive alignment in game design for learning activities in higher education	ES	GBL	PC	CP	E
67	2020	QuoVidi: An open-source web application for the organization of large-scale biological treasure hunts	ES	V	PC	C-C	PVE
68	2021	Una experiencia de aula para la clasificación de vertebrados usando la Ciencia Ficción: Proyecto Pokédex	ESE	GBL	ND	C-C	M
Linguistic (15 in english and 2 in spanish)							
69	2016	Digital Games and Second Language 2 Learning	ES	V	PC	CO	PVE
70	2016	VR-Based Gamification of Communication Training and Oral Examination in a Second Language	ES	V	PC	CO	AA
71	2016	Mobile learning. Gamificación y Realidad Aumentada para la enseñanza-aprendizaje de idiomas	ESE	V	PC	CL	PVE
72	2017	Gamifying Content and Language Integrated Learning with Serious Videogames	ES	JSE	PC	C-C	PVE

73	2017	"Learning from real life and not books": A gamified approach to Business English task design in transatlantic telecollaboration	ES	G	BL	C-C	PVE
74	2018	Meaningful Gamification and Students' Motivation: A Strategy for Scaffolding Reading Material	ES	JSE	PC	CP	PVE
75	2018	The Case of Literacy Motivation: Playful 3D Immersive Learning Environments and Problem-Focused Education for Blended Digital Storytelling	ES	V	MT	CL	PVE
76	2018	Students' reflections on vocabulary learning through synchronous and asynchronous games and activities	ES	GBL	BL	CP	PVE
77	2018	King's Speech: Pronounce a Foreign Language with Style	ES	G	BL	CO	AA
78	2019	Secuencias didácticas gamificadas por docentes de LE en formación continua: puntos. insignias y tablas de clasificación	ES	G	MT	C-C	PBL
79	2019	Using the Flipped Classroom Model in the Development of Basic Language Skills and Enriching Activities: Digital Stories and Games	EP	GBL	BL	CP	AA
80	2019	Kahoot! to Enhance Irregular Verbs Learning	EP	GBL	MT	CP	PVE
81	2019	Use of Digital Games in Writing Education: An Action Research on Gamification	ES	G	BL	C-C	M
82	2020	Design of english vocabulary mobile apps using gamification: An Indonesian case study for kindergarten	EP	V	MT	C-C	PVE
83	2020	Evaluation of Gamification in E-Learning Systems for Elementary School Students	EP	G	PC	C-C	PVE
84	2021	Examining the Effects of Gamification on Chinese College Students' Foreign Language Anxiety: A Preliminary Exploration	ES	G	ND	CL	PBL
85	2021	An experimental study on the effects of gamified cooperation and competition on English vocabulary learning	ES	G	MT	C-C	PVE

4. DISCUSSION

The objective of the scientometric review is to analyze the population, support, methodology, character, and didactic proposals for the type of game of gamification in different educational disciplines. The review sample is 85 scientific productions, seven of which are the underlying educational disciplines of the four areas of knowledge on which the review has focused. The analysis of the categories studied for the seven educational disciplines highlights that the scientific contribution has focused on Higher Education, with gamification and video games being the most used methods under digital support between PC and mobile/Tablet, with a cooperative-competitive or competitive and with three types of game eminently: Virtual Teaching Platforms (PVE), active learning games and use of mechanics with points, badges and leaderboards (PBL).

In computer science, the majority of gamified proposals are raised in Higher Education (89.5%). On the other hand, in the disciplines of Mathematics, Physics and Chemistry, the highest percentage of proposals implemented is in Primary Education (37.5%), although none in Secondary Education. The discipline that has implemented the most gamified proposals in Secondary Education has been Physical Education (25%).

Regarding the methodology, the disciplines of mathematics, physics, and chemistry stand out as they do not use serious games in their proposals, although they do use video games in the majority (37.5%). Physiotherapy and Nutrition use serious games (33.3%) and GBL (33.3%), and the rest of the disciplines prioritize gamification in their proposals. Rodríguez-Hoyos and Joao-Gómes (2013) confirmed that games and video games do not provide a knowledge-enhancing resource, the most important being how they are utilized for the use of the game. In other

words, for the implementation of a video game or serious game to work in the classroom, it must be accompanied by a pedagogical methodology such as gamification or GBL.

Concerning the support, the use of the PC stands out in Natural Sciences (54.5%) and in Computer Science (47.4%), the Mobile/Tablet digital support in Mathematics, Physics and Chemistry (62.5%) and Physiotherapy and Nutrition (55.6%). Nevertheless, it was Social Sciences (44.4%) and Physical Education (41.7%) the ones that prioritize non-digital support in their proposals. This makes sense, as the subject of Physical Education presents certain limitations for the use of digital instruments, when it is carried out outdoors and due to the denial of the use of Mobile/Tablet devices in several countries (Cakirpaloglu et al., 2020). On the contrary, the Computer Science subject presents a higher ease due to the greater use of virtual environments.

Regarding the nature of the gamified proposals, Dindar *et al.* (2021) suggest that most of the existing gamification studies have focused on the characteristics of competitive gaming. Hence, in this review the proposals with a cooperative-competitive (44.7%) and competitive (23.5%) nature stand out to a greater extent. Therefore, it is pointed out that the full potential of cooperative gamification is yet to be explored. In terms of gamified cooperation, teachers can develop interdependence among students by giving them group learning goals, rather than individual goals. The individual responsibility of each individual for the success of the group can generate a sustained commitment to the learning tasks. However, there are disciplines such as Physical Education (25%) and Social Sciences (22.2%) that opt for cooperative and even collaborative proposals, as is the case of Physiotherapy and Nutrition (44.4%) and Natural Sciences (27.3%). Regarding the types of games, although PVE were the most used in most disciplines, active learning games were the priority in Physical Education (33.33%) and Social Sciences (44.4%).

As practical applications, the results of the scientometric review point out the characteristics that the gamified didactic proposals of each educational discipline usually have, demonstrating how little has been exploited in each of them under another methodology, support, character or type of game. If the intention is to innovate in the gamification processes in any of the seven educational disciplines studied in this review, the support, character or type of game that has shown a lower percentage of use should be used. Kalogiannakis et al. (2021) point out that gamification applications often lack a formal design process. They do not always follow a theoretical framework, and the role of game elements within the gamified application does not always have the desired effect that is intended. As Prieto (2020) indicates, *"you should always start from the need to know perfectly what you want to achieve and ensuring that the proposals respond to the needs raised"* (p.91). In this review, five indicators have been provided that can help teachers structure their gamified educational proposals.

As a future line of research, the need to study the relationships between motivational or learning results with the use of any of the indicators studied in the review or with the use of a certain game mechanic or dynamic is highlighted. It is crucial in order to establish protocols or strategies in the elaboration or design of formal gamification structures that guide teachers who want to start a gamification process. Finally, it would be of interest to conduct a future review that addresses the design of the gamified proposals to ensure that they follow a formal design and a clear background. This would be of interest to assess the design quality, identify areas of improvement in the proposals and enrich the comparative analyses.

A limitation of this proposal is that it does not focus on the search for proposals in a specific country. Not focusing the searches on a particular country means that not all the proposals examined are located in a country with the same educational and economic resources. This fact can increase the degree of heterogeneity and lead to understanding the results in a global way at the international level. On the other hand, the existence of other gamified proposals that have not been published makes it difficult to compare many quality works that do not meet the scientific criteria of this review, which in turn can cause a lot of information to be lost because it is not rigorous.

In conclusions, the discipline with the most proposals in higher education, it has been Computer Science. On the other hand, the discipline with the most proposals in secondary school has been Physical Education. Finally, in primary school, most of the proposals have been for Mathematics and Physics and Chemistry. On the other hand, in terms of methodology, Mathematics, Physics, and Chemistry use video games in their proposals, Physiotherapy and Nutrition use serious games and GBL, and the rest of the disciplines prioritize gamification. Regarding the support used, the use of non-digital proposals in Physical Education and Social Sciences and digital instruments in the rest of the subjects stands out. Finally, when it comes to character, most of the proposals focus on competitive game. Finally, after the works examined on the gamified proposals based on: methodology, support, character and types of game; It can be concluded that this work has shed light on what has been done and the characteristics that future works must meet to be considered innovative.

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