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Application of gamification in Early Childhood Education and Primary Education: thematic analysis
Aplicación de la gamificación en Educación Infantil y Educación Primaria: análisis temático

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Abstract. In recent years, interest in the application of gamification in education has increased. Gamification is intended to stimulate students' thinking through game techniques, involving them in problem solving. The main aim of this study is to implement a thematic analysis on the use of gamification in early childhood and primary students. To this end, a systematic review was conducted using the PRISMA model in the Web of Science database, following inclusion and exclusion criteria on quantitative and qualitative experimental and quasi-experimental studies that explore gamification in early childhood education and primary school. 24 studies were analyzed. The results show that the investigations are aimed at improving academic and collaborative skills and increasing motivation with positive results. Furthermore, most of the studies involve students between 10 and 12 years of age and are developed in science subjects supported by technological applications and gamified elements. In conclusion, it has been found that gamification has been applied in early childhood and primary education for many areas and objectives. Likewise, as a didactic strategy, it has brought significant improvements in academic performance, motivation and autonomy, which makes it advisable to continue deepening its application.
Keywords: gamification, early childhood education, primary education, thematic analysis

Resumen. En los últimos años, el interés por la aplicación de la gamificación en la educación ha aumentado. Con la gamificación se pretende estimular el pensamiento del alumnado a través de técnicas de juego, involucrándole y planteando la resolución de problemas. El estudio tiene como objetivo realizar un análisis temático sobre el uso de la gamificación en alumnos de educación infantil y primaria. Para ello, se efectuó una revisión sistemática utilizando el modelo PRISMA en la base de datos Web of Science, siguiendo criterios de inclusión y exclusión, sobre estudios cuantitativos y cualitativos experimentales y cuasi-experimentales que exploran la gamificación en educación infantil y primaria. Se analizaron 24 estudios. Los resultados muestran que las investigaciones están dirigidas a mejorar las habilidades académicas y colaborativas y a aumentar la motivación con resultados positivos. Además, la mayoría de los estudios involucran a alumnos de entre 10 y 12 años y se desarrollan en asignaturas de ciencias con apoyo de aplicaciones tecnológicas y elementos gamificados. En conclusión, se ha comprobado que la gamificación se ha aplicado en la educación infantil y primaria para muchas áreas y objetivos. Asimismo, como estrategia didáctica ha aportado mejoras significativas del rendimiento académico, la motivación o la autonomía, lo que hace recomendable seguir profundizando en su aplicación.
Palabras clave: gamificación, educación infantil, educación primaria, análisis temático

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Introduction

This is followed by the scientific background and concludes with the purpose of the study and the research questions.

Conceptualization of gamification

In recent years, there has been a rapid growth in scientific production in the area of educational gamification (Swacha, 2021). In this sense, different research has been developed in different educational stages such as Primary Education (García Ordóñez & Fernández Lorenzo, 2022; Rodríguez Martín et al., 2022), Compulsory Secondary Education (Cenizo-Benjumea et al., 2022; Moreno-Guerrero et al., 2022; Quintero González et al., 2018; Real-Pérez et al., 2021; Sánchez Silva et al., 2021) and University Education (Campillo-Ferrer et al., 2020). For this reason, it is being introduced in the training of future teachers at different stages (Flores Aguilar, 2019; García Álvarez et al., 2022; Souza Júnior et al., 2022). This growing interest in gamification by teaching teams began in the early 2010s, when Deterding et al. (2011) conceptualised the technique for the first time, defining it as the application of game design elements in non-game contexts in order to motivate players.

Sometimes, the concept of "game" has been used as a synonym for "gamification". However, this usage is not correct as gamification is not simply "playing in class" (Romero-Rodríguez & Torres-Toukoumidis, 2018). García-Ruiz et al. (2018) in order to clarify this novel concept stresses the idea that the main objective of gamification will never be to play, but rather to the elements of the game to learn in a curricular environment in the classroom. Moreover, gamified experiences are also different from other approaches, such as Game Based Learning (GBL). This is because gamification is characterized by its long temporalization and focus on working not only academic aspects, but also social and civic competencies (García-Ruiz et al., 2018). In short, authors such as Huang et al. (2019) noted that the gamification is a process related to the stimulation of player thinking through gaming techniques to engage users and solve problems.

It is worth noting that gamification transfers the power of games to instructional and problem-solving platforms (Lee & Hammer, 2011). In this line, Sailer & Hommer (2020) point out that the gamified learning approach aims to carry out an alteration of the learning process carried out so far in order to create an experience that users interpret as a game. Thus, this pedagogical approach integrates elements and principles of game design into educational contexts with the purpose of enhancing students' motivation, engagement, and learning (Sailer & Hommer, 2020). Among the elements typical of games that are included in a gamified experience can be found, competition and cooperation to achieve a goal;

combat and rewards, among others (Sailer et al., 2017). This strategy effectively combines playful dynamics and academic content, harnessing the inherent human predisposition towards play and competition (Kiryakova et al., 2014) to encourage active participation and knowledge acquisition (Fiş-Erümit & Karakuş-Yılmaz, 2022).

Reasons to apply of educational gamification

The application of gamification in educational contexts seems to bring numerous benefits to students (Donnermann et al., 2021; Sailer & Sailer, 2021). In this sense, authors such as Lledó et al. (2021) propose a didactic experience based on the gamification techniques destined to work with contents of physical education in the pre-school stage. The application of gamification increases student interest and motivation during the development of the subject (Sevilla-Sánchez et al., 2022), improving their participation in the classroom (Castañeda-Vázquez et al., 2019). Likewise, thanks to the use of gamification elements such as badges or points, students' effort is incentivized, which is reflected in improved academic performance in the areas of the official curriculum (Quintas & Bustamante, 2021). For example, Ioannou (2019) demonstrated that the use of gamification improves students' task engagement, empathy skills, collaboration, and social interactions. On the other hand, the dynamics of gamification themselves allow teachers to provide students with feedback on the tasks performed (Almeida, Kalinowski & Feijó 2021). In this way, students are aware of their failures and successes and can, from here, continue to build their learning (Cortizo et al., 2011).

Moreover, Pérez Pueyo & Hortigüela Alcalá (2020) indicate that the application of gamification strategies allows us to attend to the different levels and rhythms of learning that can be found in the same classroom. In particular, in early childhood education, the elements of play are a methodological strategy that favors motivation, the processes of socialization among peers, as well as the adaptation to learning rhythms, while in primary education it greatly promotes the motivation to learn (Orozco & Moriña, 2020). In the words of Vázquez-Ramos (2021), the effectiveness of a gamification proposal in the classroom is linked to the introduction of this educational experience from a curricular perspective.

Delving deeper into the benefits of gamification, it is worth noting, as Paniagua et al. (2019) expose, its application is linked to the reduction of stress and anxiety of students during the learning process. Thus, games can create an environment in which students feel comfortable to explore and make mistakes, fostering a trial-and-error mentality. Additionally, the design of a gamified experience can serve to reinforce specific skills, such as problem-solving, decision-making, collaboration and creativity (Saleem et al., 2022). In this sense, students practice these skills consistently while engaging in playful activities, thereby enhancing their competence in key areas.

Design frame for gamified experiences

Werbach & Hunter (2012) developed a framework for the design of gamified experiences called the DMC Pyramid (dynamics, mechanics and components). The authors mentioned argue that the foundations of gamification are threefold, dynamics, mechanics and components. These three elements are closely related, constituting a pyramid (Werbach & Hunter, 2012). Figure 1 shows the DMC Pyramid and the relationship of the fundamentals.

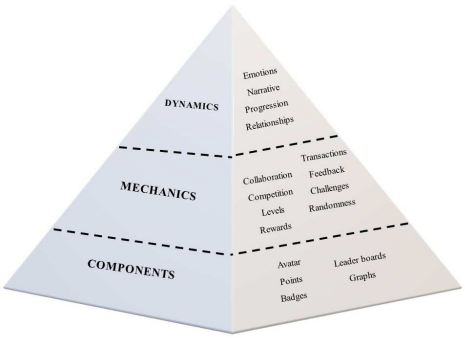

Figure 1. Pyramid of the gamification elements

Firstly, the dynamics at the top of the pyramid constitute the highest level of abstraction and refer to the gamification system in relation to expectations (Werbach & Hunter, 2012). Although these dynamics are not elements that have an explicit relation to the game, they are necessary (Wiklund & Wakerius, 2016). Emotions, narrative, progression or relationships are dynamics and for a better understanding of the concepts, their definition considering Werbach & Hunter (2012) is presented in Table 1.

Table 1.
Gamification dynamics

Dynamics	Description
Emotions	Competition, curiosity, frustration, happiness
Narrative	History as the common thread of the game.
Progression	Evolution and development of the player.
Relationships	Social interactions that occur during the experience.

In an intermate level, the mechanics can be distinguished whose main mission is to help the participant to achieve the dynamics proposed (Werbach & Hunter, 2012). These elements describe the objectives, rules, types of interaction and limits of the situation to be played (Díaz-Delgado, 2018). Among the mechanics, it could be found the collaboration, competition, levels, rewards, transactions, feedback or challenges (Werbach & Hunter, 2012). For clarification of these concepts, considering Werbach & Hunter (2012), Table 2 is given below.

Table 2.
Gamification mechanics

Mechanics	Description
Collaboration.	Teamwork to achieve a goal.
Competition.	There are losers and winners.
Levels.	To inform the participants about their progress.
Rewards	Benefits acquired after achieving an objective.
Transactions.	Trade between players.
Feedback	Reaction or response to the process or activity.
Challenges	Activities that require an extra effort from the players.

Lastly, at the lowest level are the components that are recognised as the specific implementations of both dynamics and mechanics (Ortiz-Colón et al., 2018). These

elements could be avatars, points, badges, leader boards, graphs, among others. These components are defined considering Werbach & Hunter (2012) in Table 3.

Table 3.
Gamification components

Components	Description
Leader boards	A leader board is used to show the current levels of the highest scorers and the overall scores.
Avatars	Graphic representation of the players.
Badges	A mark of appreciation or task accomplishment during the process of achieving objectives
Points	To inform the player or players about the score of success.

Previous reviews

Different reviews of the scientific literature (Alomari et al., 2019; Ishaq et al., 2021; Navarro Mateos et al., 2021; Sera & Wheeler, 2017; Silva et al., 2020; Souza Machado et al., 2018) have focused their efforts on analysing the application of gamification elements in educational practices at different educational stages. In this way, for instance, Sera & Wheeler (2017) conducted a non-systematic review on the use of digital games in pharmacy students and other health professionals, i.e., undergraduate students. Likewise, Souza et al. (2018) systematic mapping study to identify methods related to games, this time, in the context of software engineering education. Again, this review addresses a higher education population. Silva et al. (2020) on the other hand map the literature that addresses the application of gamification techniques in management education at different educational stages, not only at the university stage.

Alomari et al. (2019) performs a systematic review with PRISMA of literature focused on promoting student learning through gamification techniques. This research uses different databases during the procedure for obtaining the sample (Google scholar, Springer, ERIC, IEEE Xplore and Science Direct), however omitted the Web of Science (WoS) database. In addition, Alomari et al. (2019) despite being from 2019, it only incorporates studies from 2016 to 2018. Ishaq et al. (2021) also addresses this issue with a systematic review, but without using the PRISMA model. These authors (Ishaq et al., 2021) present a review of published research on mobile-assisted language learning and gamification for all educational stages. Finally, Navarro Mateos et al. (2021) presented a systematic review on the use of gamification in Spanish education, covering the application of this methodological strategy at university, secondary school, high school and primary school levels. The results of the study showed that only 6.7 % of the studies applied gamification in the latter stage. In this regard, none of the mentioned reviews systematically address gamification-based content for early childhood and primary education, covering all subject areas integrated into the curricula.

Aim and research questions

Based on this background, the main aim of this study is to implement a thematic analysis on the use of gamification in early childhood and primary students. For this purpose, the following research questions has been created:

- RQ1. Which are the main objectives of research that implements gamification at these stages?
- RQ2. What are the characteristics of the research sample implementing gamification at these stages?
- RQ3. Which areas of the curriculum is gamification used for?
- RQ4. What technological resources support the development of these gamified experiences?
- RQ5. What type of dynamics are used in studies?
- RQ6. What type of mechanics are used in studies?
- RQ7. What type of components are used in studies?
- RQ8. Which are the main findings of this research?

Method

In order to respond to the main objective of the research, a systematic literature review (SLR) (García-González & Ramírez-Montoya, 2019) was conducted to identify, select and collect the relevant research related to the application of experience gamification in early childhood and primary education classrooms.

To this end, the methodology used to conduct a SRL in the in the current investigation is called PRISMA model (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), which was proposed by Page & Moher (2017). This model is characterised by the fact that the review process is divided into seven stages (Lorenzo et al., 2021). In this sense, in the first stage, the research questions were established. To continue, the initial database search is conducted. Thirdly, the inclusion and exclusion criteria for the studies are established. Then, the studies are selected according to the previously established criteria until the final sample is obtained. At this point, the data are analysed and extracted. Once the data have been analysed, a summary and interpretation of the findings is made. And, to conclude, the review report is written.

Article search strategy

The Web of Science was selected as the main instrument to conduct the search of the current scientific literature with reference to the objective of the research. This database was selected because it is one of the most complete, since it has more than 22,000 indexed journals and there are many articles that can only be accessed through it (Lorenzo et al., 2021). To perform the initial database searching, it is convenient to select the appropriate terms to obtain the greatest number of articles focused on the topic, since, as Cronin et al. (2008) indicated, considering synonymous terms is vital to increase the information of systematic literature review. In this line, Table 4 includes the main terms and their synonyms that were used in the composition of the search command applied in the WoS.

Table 4.
Main search terms and synonyms

Main terms	Synonyms
Gamification	Gamification; ludification; learning gamification
Early childhood education	pre-primary education; early childhood education; pre-school education
Primary education	elementary education; primary education

Consequently, the following advance search command was applied, which is configured taking as a reference the terms close to the research objective. The search command is configurate using parentheses and Booleans. This command is presented in Table 5.

Table 5.
Search command

	Pre-primary/Pre-school or Early childhood education	Elementary education/Primary education
Search by title	pre-primary education AND gamification AND learning gamification pre-primary education AND gamification AND education pre-primary education AND gamification AND ludification pre-school education AND gamification AND learning gamification pre-school education AND gamification AND education pre-school education AND gamification AND ludification early childhood education AND gamification AND learning gamification early childhood education AND gamification AND education early childhood education AND gamification AND ludification	elementary education AND gamification AND learning gamification elementary education AND gamification AND education elementary education AND gamification AND ludification primary education AND gamification AND learning gamification primary education AND gamification AND education primary education AND gamification AND ludification
Search by content	pre-primary education AND gamification AND learning gamification pre-primary education AND gamification AND education pre-primary education AND gamification AND ludification pre-school education AND gamification AND learning gamification pre-school education AND gamification AND education pre-school education AND gamification AND ludification early childhood education AND gamification AND learning gamification early childhood education AND gamification AND education early childhood education AND gamification AND ludification	elementary education AND gamification AND learning gamification elementary education AND gamification AND education elementary education AND gamification AND ludification primary education AND gamification AND learning gamification primary education AND gamification AND education primary education AND gamification AND ludification

After applying the command, a total of 399 documents were obtained and the inclusion and exclusion criteria began to be applied until the final sample was obtained.

Inclusion and exclusion criteria

The different inclusion and exclusion criteria are formulated in accordance with the research objective were applied throughout the process aimed at obtaining the final sample of documents (Lorenzo et al., 2021). Table 6 below shows the inclusion and exclusion criteria used in this process.

Table 6.
Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
INC 1. Period: 2011-2021	EXC 1. Repeated documents
INC 2. Research areas: Education Educational Research and Computer Science.	EXC 2. Documents without access.
INC 3. Type of documents: articles.	EXC 3. Non-experimental studies.
INC 4. Language: English.	EXC 4. Research conducted in a clinical context.
INC 5. Type of studies: experimental or quasiexperimental	EXC 5. Participants not attending pre-school or primary school.
	EXC 6. Non-gamification experience.

The period chosen for the inclusion of papers begins in 2011, because it was the year that gamification was first conceptualized by Deterding et al. (2011). Papers published up to 2021 were included, because the search was initiated in 2022. Likewise, areas linked to the educational focus of the study and according to the technological component of gamification were chosen. Articles were included to ensure the presence of the highest scientific quality papers. The language chosen was English, which is the most widely used for scientific dissemination (Lorenzo et al., 2016). In addition, works that implied an intervention in the educational reality were included, so non-experimental research and clinical contexts were excluded. Finally, duplications were taken into account to exclude repeated papers.

Review process

As mentioned above, the initial WoS search resulted in a total of 399 papers (*identification stage*). From this point onwards, inclusion and exclusion criteria began to be applied throughout the different stages of the process following the PRISMA model (Page & Moher, 2017). Then, in a second stage called *screening*, inclusion criteria 1, 2, 3 and 4 were applied in addition to exclusion criteria 1 and 2, resulting in a total number of 100 papers. In this regard, figure 2 shows the number of papers removed depending on the exclusion and inclusion criteria employed. In the third phase, *eligibility*, the inclusion criteria number 5 and the exclusion criteria number 3, 4, 5 and 6 were applied. Finally, in the phase 4 which specifies the final sample, 24 papers were included. The search process was conducted between February and March 2022. The Figure 2 presents the process conducted to obtain the final sample.

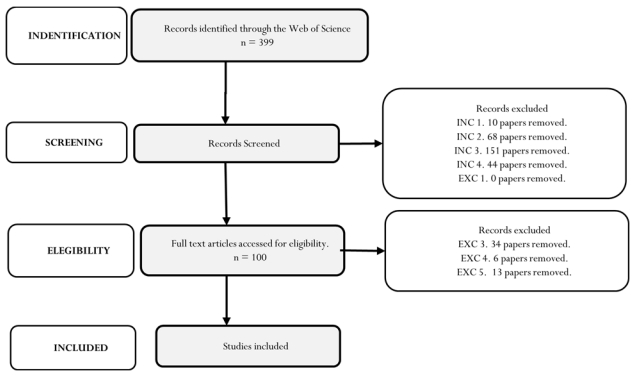

Figure 2. Flow diagram using PRISMA

Data analysis

To conduct the data analysis of the 24 articles a series of indicators are proposed, such as: objective, participants, area of work, resources, game elements (dynamics, mechanics and components) and findings. In this sense, in the Table 7, a description of the indicators, related to the research questions, which constitute the parameters on which the analysis of the documents included in the final sample is focused, is presented.

Table 7.
Indicators

Indicators	Description
I1. Aim	Refers to the main objective of the article that the authors intend to achieve.
I2. Sample	Refers to the number of study participants and their age.
I3. Area	Refers to the area of the curriculum on which the gamified experience is focused.
I4. Resources	ICT resources applied to help develop the gamified experience.
I5. Dynamics	Represent the gamification system in relation to the expectations: emotions, narrative, progression, relationships.
I6. Mechanics	Describe the objectives, rules, types of interaction and limits of the situation to be played: collaboration. competition, levels, rewards, transactions, feedback, challenges, randomness.
I7. Components	Refers to the concrete way to realize what the game mechanics require: avatar, points, badges, leader boards, graphs…
I8. Findings	Refer to the main findings of the research in terms of its specific objectives or research questions.

Results

Following the data analysis, the results obtained according to the research questions are shown below. Specifically, Table 8 shows the 24 articles in the sample according to the indicators.

Table 8.
Articles included in the systematic review

Research	I1	I2	I3	I4	I5	I6	I7	I8
Su & Cheng (2015)	To develop and implement game elements with well-designed m-learning activities to enhance motivation.	N = 4 Age = 10-11	Natural Science and Life Technology: botanical learning	MGLS application	Relationships	Rewards Collaboration	Leader board Badges Missions	The study suggests that the previous experience in gamified activities, genre (p = 0.044)., interest (p = 0.000), prior experience with smartphones (p = 0.010) affect the motivation for learning. According to the students' feedback, the method meets their expectations, they are satisfied and confident that they will be able to apply what they have learned. In addition, positive motivation predicts higher achievement. Incorporation of gamification technologies could achieve better learning performance and a higher degree of motivation.
Rawendy et al. (2017)	To help children learn Chinese language using gamification and mnemonic method in the game content.	N = 30 Years = 6-12	Chinese language	Computer application (Without name)	Progression.	-	Points	There are significant differences between pretest and posttest with a value of Sig. (2-tailed) of 0.000 (p< 0.05). Thus, the use of gamification improves students' knowledge of Chinese vocabulary.
Isayama et al. (2016)	To introduce students to the theory of automata through gamification at an early stage.	N = 90 Years = 9-12	Computer Science Education (CSE)	Computer application (Without name)	-	Challenges: obstacles	Avatar: robot	The study has provided evidence on the feasibility and significance of familiarizing children from an early age with automata. In this sense, the pupils showed an understanding of the basic concepts to be able to complete the game. In this sense, the pupils showed an understanding of the basic concepts to be able to complete the game. 98 % of the pupils found the game "enjoyable" or "quite enjoyable" in the questionnaires and many of them continued to play the game during break time.
Halloluwa et al. (2018)	To investigate how gamified mobile educational applications can support and enhance learning experiences in a developing country.	N = 70 Years = 8	Mathematics	Mobil App	Narrative	Collaboration Rewards Feedback	Badges Avatars Leader boards Social graphs Gifting	Some of the assumptions commonly applied in developed countries do not work in Sri Lanka and how the introduction of gamified tablet applications if students feel comfortable at the experience.
Garcia-Sanjuan et al. (2018)	To investigate how multi-screen environments based on tactile versus tangible interaction can support the development of collaborative skills.	N = 80 Years = 9-10	Language, natural science, history, and geography	Quizbot app	Progression Relationships	Collaboration	Realistic bombs	The results suggest that both versions of Quizbot are characterized by being fun and easy to use to use and allow to improve collaborative skills. However, with the tangible version, children reach greater consensus, but manage time less effectively.
Hsu & Wang et al. (2018)	To examine the effects of applying game mechanics and student-generated questions to promote algorithmic thinking skills in a puzzle-based online game learning system.	N = 242 Years = 9-10	Algorithmic thinking skills.	Turtle Graphics Tutorial System (TGTS)	Progression	Levels	Points Leader boards Badges	The results show that, on the one hand, Puzzle-based game learning + Game mechanics + Student-generated questions (PGS) groups scored significantly higher than the other groups in algorithmic thinking skills. On the other hand, that there are significant differences among the three groups in puzzle solving achievement (number of puzzles solved completely, attempts to solve the puzzle, times the puzzle is solved). And, finally, the engagement of PGS group is higher.
Ros Morente et al. (2018)	To explore the differences in emotional competence after undergoing gamified programmes during an academic year.	N = 574 Year = 10-12	Emotional and social competences	Happy 8-12 app	Progression	Levels	-	The scores related to emotional competencies of the experimental group increased significantly (p=0.02) after the administration of the program.
Hursen & Bas (2019)	To determine the impact of gamification applications on learning motivation and the	N = 16 Year = 9-	Science	ClassDojo app	Narrative Progression	Collaboration Competition. Feedback Rewards	Scores Avatar Leader board Badges	A significant difference was found between the pre- and post-test scores of the students in the dimensions "motivation to investigate" (p=0.025), "motivation to perform"

	opinions of students and families.	10						(p=0.040), "motivation to communicate" (p=0.038) and "motivation for cooperative study" (p=0.043). Non-significant differences in "motivation for participation" (p=0.206). A total of 93.75 % of the students were satisfied with the experience, as it allowed them to increase their communicative interaction with the rest of their classmates and with the teacher. Motivation was also positively affected.
Wardani et al. (2019)	To propose a means of education for learning cube nets and to examine their application.	N = 86 Year = 10-11	Maths: cubes	*Jariku* app	Progression	Challenges Levels	Scores Points	There are significant differences (p = 0.017) between pretest and postest. In other words, significantly better scores on the cubes. According to the students, gamification allows students to enjoy and better understand the cubes.
Ioannou et al. (2019)	To present a playful design model for learning through interactive boards,	N = 28 Year = 6-12	Socio-emotional education from de national curriculum	Interactive tabletops	Multimedia Progression	Challenges Collaboration Competition Rewards Feedback	Points	The study suggests that a model of gameful design for learning can be realized in the interaction of tabletop technology, pedagogy, and gamification. Moreover, the implementation of the model in the socio-emotional education classroom can enable students to playfully engage in understanding the "other" by fostering collaboration, empathy, and physical and social interactions.
Riaz et al. (2019)	To evaluate a gamified e-learning platform to train children in traffic safety.	N = 44 Year = 9-13	Traffic education	Moodle	Progression	Rewards	Performance graphs Badges	The results notes that there are significant among scores of the four school years (p = 0.01) respect to de models and in the familiar situations (p < 0.001). Students improved their score to 85.34 % on the second attempt on the same questions. The most difficult questions relate to the modules of situational awareness, risk detection and risk management. More than 50 % of the badges won are gold. The questions that students spent the most time on were the knowledge and risk management questions (17 s) and the questions they spent the least time on (7s) were the completion questions.
Garmen et al. (2019)	To describe the educational design of the TOI software and analyse how it works, analysing the distribution of the results game by game and checking if there are differences according to gender and grade.	N = 372 Year = 5-9	Multiple Intelligences	TOI, Tree of Intelligences	Progression	Challenges Levels	-	The results show significant differences between boys and girls in the successes variable in the mathematical-logical intelligence game (p=.000); body and visual intelligence (p=.033); and in the differences in the accuracy variable of the emotional (p=.039). No significant gender differences were found for the remaining variables and games. According to the school year, there were significant differences in accuracy, time and precision in each game.
Kim et al. (2019)	To apply a SMART design to develop an adaptive literacy intervention with two stages of activities.	N = 273 Year = 4-6	Language: reading comprehension, vocabulary	MORE@Home app	Progression	Levels	.	On the one hand, results note that the intervention through 10 conceptually coherent texts had a slightly positive, but statistically insignificant effect in reference to the use of 10 leveled texts. This slightly higher score is observed in Scientific Vocabulary Knowledge and Reading Comprehension. There is also no difference in the reading comprehension test. On the other hand, there are no differences in reading comprehension between the gamification plus text condition and the gamification only condition. In the MAP test subscore, significant differences (p=0.02) were obtained in the art and structure of the informative texts.
Quintas et al. (2020)	To analyse the effects of a gamified exergaming intervention compared to non-gamified and non-exergaming interventions on psychological variables relevant to physical education.	N = 417 Year = 10-12	Physical education	ClassDojo Just Dance Now exergame	Progression	Collaboration Competition Levels Challenges Rewards	Points Virtual avatars Badges Leader board	The results indicate that the control group was shown to show less intrinsic motivation over time. Moreover, external regulation decreased significantly in the experimental group over time and increased in the control group, but not significantly. However, there is no difference in the decrease of amotivation over time. Temporal transformation in the control group decreased significantly over time but did not increase significantly in the experimental group. Besides, there are no differences in BPN. On the other hand, there are significant differences in rhythmic motor skills in favour of the gamified activities. Finally, there are significant differences in engagement and behaviour towards learning in students.
Gómez-García et al. (2020)	To test the effect of Flipped Classroom and gamification on the development of motivation, autonomy and self-regulation	N = 202 Year = 11-12	Healthy Habits and Diet	EdPuzzle software LMS Moodle platform	-	Levels Challenges	Badges	The application of these methods promoted an increase in students' motivation, as well as in their autonomy and self-regulation when facing the contents of the subject. Moreover, no strong correlations were observed between the constructs of motivation,

	towards learning.							autonomy and self-regulation. And the character of school can influence in the autonomy and in the self-regulation.
Lamrani & Abdelwahed (2020).	To improve children's skills in early childhood education through game-based learning and gamification in an interactive environment.	N = 30 Year = 4-6	Numeracy, life, language, geography skills	Computer apps	-	Feedback Levels Rewards	Points Cartoon character	The results indicated that the students understood the content well within a short period of time after the use of gamification.
Ríos Félix et al. (2020)	To investigate the impact and acceptance of a new technology for teaching Computational Thinking.	N = 102 Year = 9-12	Computer thinkig	EasyLogic3D	Progression	Levels	Points Trophies	Students accepted the technology (Cronbach's Alpha = >0.7). The students' perceived enjoyment of using the learning environment was positive.
Quintas-Hijós et al. (2020)	To find out the applicability and usefulness of the intervention designed with the ultimate aim of finding out which didactic elements of the intervention could be improved according to the opinion of the school community.	N = 417 Year = 10-12	Physical education: dance	Just Dance Now web platform	Progression	Collaboration Competition Levels Challenges Rewards	Points Virtual avatars Badges Leader board	The results indicate, in the first place, that the study is partially applicable. On the one hand, it has a realistic didactic design and its adaptability to different contexts, but the materials and facilities, as well as the low expectations of students about its use in the future. It is also useful because it produces more fun, motivation, greater enjoyment of dance, less embarrassment about dancing, more creative inspiration, more autonomous learning, and provides a digital leisure alternative. Finally, gamification provided a greater overall positive feeling and more motivation in the majority of students than the exergame.
Sudarmilah et al. (2020)	To develop a modified SDLC (Software Development Life Cycle) model with Augmented Reality (AR) educational games.	N = 64 Year = 6-12	Knowledge about Indonesian culture	Augmented reality	-	-	-	The results indicate improvements in learning. Specifically, a lower significance value of $p<0.05$ is obtained for the pretest and posttest items.
Cruz-García et al. (2021)	To develop a didactic proposal for teaching programming in Primary Education through a gamified approach using educational video games as a resource.	N = 100 Year = 10-12	Teaching programming	Videogames: Blocky	Progression	Levels Challenges Feedback.	Avatar	Results suggest that significant differences ($p=0.000$) in programming knowledge were observed between the October 2019, December 2019 and February 2020 tests. In the classes, the interest and motivation of the students in the subject matter was observed.
Zhao et al. (2021)	To connect the pre-class self-study math content and the gamified interactive e-book into classroom activities to help students bring knowledge to the math flipped classroom.	N = 130 Year = 6-12	Maths: e-book-based flipped learning approach	Interactive books	Narrative	Challenges Feedback	Avatar Badges Points	The results indicated that students in the gamified interactive e-book in the mathematics classroom (GIEBFL) had higher academic achievement, motivation and metacognition than students in conventional flipped learning (CFL) and traditional instruction (TI). The results indicated that the interactive gamified e-book in the flipped mathematics classroom significantly ($p<0.05$) outperformed conventional fipped learning and traditional instruction.
Puig et al. (2021)	To present a gamified itinerary through digital activities designed to teach geometry.	N = 60 Year = 10-13	STEM education: geometry	Digital games	Missions Progression Customization Emotion: surprise	Challenges Levels	Points Leader board Badges	The results show an improvement in their learning and in their interest in maths in the experimental group with an average of progress of 0.79 (1.14) respect to the control group (−0.28 (1.37)).
Almeida et al. (2021)	To co-design a serious educational video game based on a Lean UX methodology, to increase their level of engagement with the product and facilitate the perception of their own learning.	N = 50 Year = 10-12	Co-design videogames	Video game	Progression	Feedback Levels	Avatar: MOBI	Regarding satisfaction with the user experience of the video game, 92 % of the children remembered it, 85 % were satisfied with the finished game, 79 % still liked playing with it, and 85 % would recommend it to their friends. Regarding participation in the design of the video game, 94 % of the children were satisfied that they had participated, 85 % noted that the MOBI design had been affected by their opinion, and 63 % would have liked to continue contributing to its design. As for their perception of what they had learned, according to the responses obtained in the final questionnaire, 60 % of the children perceived that they had "learned to program".
Quintas & Bustamante (2021)	To analyse the effects of a gamified exergaming intervention on psychological variables associated with the promotion of physical education.	N = 417 Year = 10-12	Physical exercise	Just Dance Now web platform	Progress Emotions: fun, pleasure, interest	Cooperation Competition Reinforcement	Leader board Points Badges Avatars	No positive effects were shown on achievement motivation, exergaming intention or PEx intention of exergames. However, there are positive effects on enjoyment and attitude towards exergames.

Note: I1 = aim; I2 = sample; I3 = area of curriculum; I4 = ICT resources; I5 = dynamics; I6 = mechanics; I7 = components; I8 = findings

According to the aim of research

Figure 3 below presents the results related to the objectives established in each of the sample investigations.

In the first place, it is possible to distinguish a 45.83 % of research (Halloluwa et al., 2018; Hsu & Wang, 2018; Isayama et al., 2016; Kim et al., 2019; Lamrani & Abdelwahed, 2020; Puig et al., 2021; Quintas et al., 2020; Quintas & Bustamante, 2021; Rawendy et al., 2017; Wardani et

al., 2019; Zhao et al., 2021) that develops and implements gamified activities with the help of various electronic applications to improve the academic achievement of students in the contents of an area of knowledge. In this sense, some research such as those developed by Quintas et al. (2020) and Quintas & Bustamante (2021) focus their objective on analysing the effects of gamified exergaming intervention on psychological variables relevant to physical education which are related with the academic achievement. Similarly, other research applies gamification and measures its effect on academic performance in aspects related to Chinese language (Rawendy et al., 2017), cube nets (Wardani et al., 2019), algorithmic thinking skills (Hsu & Wang, 2018) or geometry (Puig et al., 2021).

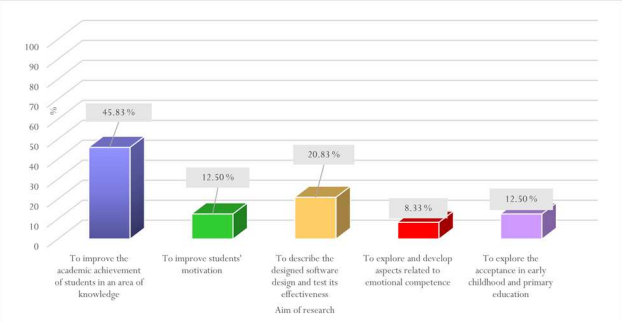

Figure. 3. Results according to the aim of research.

Secondly, the general objective of 12.50 % of the research (Gómez-García et al., 2020; Hursen & Bas, 2019; Su & Cheng, 2015) is related to the improvement of students' motivation through the implementation of gamified experiences. In this sense, Su & Cheng (2015) aims to develop and implement gamification elements with well-designed m-learning activities to improve motivation, while Hursen, & Cizem (2019) seeks to determine the impact of gamification applications on learning motivation and the opinions of students and families. Gomez-Garcia et al. (2020), on the other hand, attempts to test the effect not only of gamification, but also of flipped classroom on motivation development.

Furthermore, a 20.83 % (Almeida et al., 2021; Garcia-Sanjuan et al., 2018; Garmen et al., 2019; Ioannou et al., 2019; Sudarmilah et al., 2020) aim to describe the designed software design and test its effectiveness. For example, in the case of Sudarmilah et al. (2020) the software model is called (Software Development Life Cycle). Another 8.33 % (Cruz-García et al., 2021; Ros Morente et al., 2018) focus on exploring and developing aspects related to emotional competence. And an additional 12.50 % (Quintas-Hijós et al., 2020; Riaz et al., 2019; Ríos Feliz et al., 2020) focuses on investigating the applicability of gamification in early childhood and primary education classes and the acceptance of these gamified experiences by pupils.

According to the participants

Firstly, regarding the number of participants in the studies included in the sample, this ranges from 3 participants in the case of the research conducted by Su & Cheng (2015) to 574 participants in the research by Ros-Morente et al. (2018). Figure 4 shows the results of the sample size.

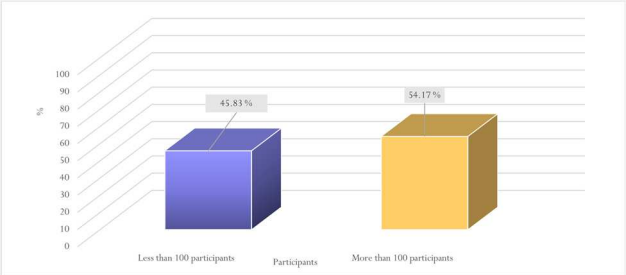

Figure. 4. Results according to the number of participants.

On the one hand, among the studies with less than a hundred participants are those developed by Rawendy et al. (2017) (n=30); Isayama et al. (2016) (n=90); Halloluwa et al. (2018) (n = 70); Garcia-Sanjuan et al. (2018) (n=80); Hursen, & Cizem (2019) (n=16); Wardani et al. (2019) (n=86); Ioannou (2019) (n=28); Riaz et al. (2019) (n=44); Lamrani & Abdelwahed (2020) (n=30); Sudarmilah et al. (2020) (n=64); Puig et al. (2021) (n=60); and Almeida et al. (2021) (n=50). This group of papers constitutes 45,83 % of the sample. On the other hand, studies with 100 or more than a hundred participants (54,17 %) correspond to Hsu & Wang (2018) (n=242); Ros-Morente et al. (2018) (n=574); Garmen et al. (2019) (n=372); Kim et al. (2019) (n= 273); Quintas et al. (2020) (n=417); Gómez-García et al. (2020) (n=202); Ríos et al. (2020) (n=102); Quintas-Hijos et al. (2020) (n=417); Cruz-García et al. (2021) (n=100); Zhao et al. (2021) (n=130); and Quintas & Bustamante (2021) (n=417).

Secondly, considering the age range of the participants in the studies, the results indicate that they range from 4 to 12 years old. In this regard, 8.33 % of the studies (Garmen et al., 2019; Lamrani & Abdelwahed, 2020) involve 4-year-olds. In 12.50 % of studies (Garmen et al., 2019; Kim et al., 2019; Lamrani & Abdelwahed, 2020), 5-year-olds participate. As for 6-year-olds, they participate in 29.17 % of the studies (Garmen et al., 2019; Ioannou, 2019; Kim et al., 2019; Lamrani & Abdelwahed, 2020; Rawendy et al., 2017; Sudarmilah et al., 2020; Zhao et al., 2021). In 20.83 % (Garmen et al., 2019; Ioannou, 2019; Rawendy et al., 2017; Sudarmilah et al., 2020; Zhao et al., 2021) and 25.00 % (Garmen et al., 2019; Halloluwa et a., 2018; Ioannou, 2019; Rawendy et al., 2017; Sudarmilah et al., 2020; Zhao et al., 2021) of the studies involved pupils aged 7 and 8 years, respectively. Those participants aged 9 years participated in 45.83 % of the sample (Garcia-Sanjuan et at., 2018; Garmen et al., 2019; Hsu & Wang, 2018; Hursen & Bas, 2019; Ioannou, 2019; Isayama et al., 2016; Rawendy et al., 2017; Riaz et al., 2019; Ríos Félix et al., 2020; Sudarmilah et al., 2020; Zhao et al., 2021).

In the case of pupils aged ten years, 79.17 % of the sample has their participation (Almeida et al., 2021; Cruz-García, 2021; Garcia-Sanjuan et al., 2018; Hsu & Wang, 2018; Hursen & Bas, 2019; Isayama et al., 2016; Ioannou, 2019; Quintas et al., 2019; Quintas & Bustamante, 2021;

Quintas-Hijós et al., 2020; Puig et al., 2021; Rawendy et al., 2017; Riaz et al., 2019; Ríos Félix et al., 2020; Ros Morente et al., 2018; Su & Cheng, 2015; Sudarmilah et al., 2020; Wardani et al., 2019; Zhao et al., 2021). Furthermore, eleven-year-old students are included in 70.83 % of the studies (Almeida et al., 2021; Cruz García et al., 2021; Gómez-García et al., 2020; Isayama et al., 2016; Ioannou, 2019; Quintas et al., 2020; Quintas & Bustamante, 2021; Quintas-Hijós et al., 2020; Lamrani & Abdelwahed, 2020; Rawendy et al., 2017; Riaz et al., 2019; Ríos Félix et al., 2020; Ros Morente et al., 2018; Su & Cheng, 2015; Wardani et al., 2019; Zhao et al., 2021).

Finally, students aged twelve years participate in 62.50 % of the sample (Almeida et al., 2021; Cruz-García et al., 2021; Garcia-Sanjuan et al., 2018; Garmen et al., 2019; Gómez-García et al., 2020; Halloluwa et al., 2018; Hsu & Wang, 2018; Hursen, & Cizem, 2019; Isayama et al., 2016; Ioannou, 2019; Kim et al., 2019; Lamrani & Abdelwahed, 2020; Puig et al., 2021; Riaz et al., 2019; Quintas & Bustamante, 2021; Rawendy et al., 2017; Ríos Félix et al., 2020; Ros Morente et al., 2018; Sudarmilah et al., 2020; Wardani et al., 2019; Zhao et al., 2021).

According to the area of curriculum worked on

Figure 5 shows the results related to the areas worked with gamification.

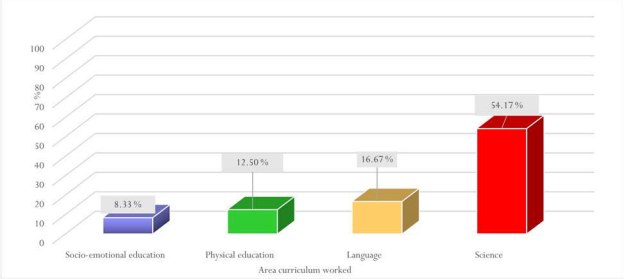

Figure. 5. Results according to area of curriculum worked.

The results of the analysis show, firstly, 8.33 % of the studies (Hursen & Bas, 2019; Ríos Félix, 2020; Ros Morente et al., 2018) focus on the area of socio-emotional education. In this sense, on the one hand, Ros-Morente et al. (2018) focus on emotional competence in everyday life situations and in conflict situations that may arise at school. And, on the other hand, Ioannou (2019) focuses on working on emotional competence. In particular, on the skills of perspective-taking and understanding the other. A 12.50 % of the studies (Quintas et al., 2020; Quintas-Hijós et al., 2020; Quintas & Bustamante, 2021) focus their gamified activities on the area of physical education, specifically dance. In addition, 16.67 % of the sample is constitute by studies working in the area of language (Garcia-Sanjuan et al., 2018; Kim et al., 2019; Lamrani & Abdelwahed, 2020; Rawendy et al., 2017). The analysis shows that Garcia-Sanjuan et al. (2018) and Lamrani & Abdelwahed (2020) also work with content of the area of science. Nevertheless, the other studies mainly target language skills related to Chinese language learning, namely vocabulary (2017) or in the case of Kim et al. (2019) to learning not only English language vocabulary but also reading comprehension skills.

The sample is also composed of 54.17 % of articles focusing on the area of science. Specifically, Su & Cheng (2015) explore the curriculum area called "Science of Nature and Technological Life" by conducting gamified activities on botany. Authors such as Isayama et al. (2016), Ríos et al. (2020), Hsu & Wang (2018); Cruz-García et al. (2021) and Almeida et al. (2021) focus their efforts on working on aspects related to the area of computer science, either by creating video games or learning programming language commands. Other authors (Halloluwa et al., 2018; Puig et al., 2021; Wardani et al., 2019; Zhao et al., 2021) use gamification to work on mathematics content such as the geometric figure of the cube (Wardani et al., 2019), geometry in general (Puig et al., 2021) or varied content (Garcia-Sanjuan et al., 2018; Halleluwa et al., 2018; Riaz et al., 2019; Cruz-García et al., 2021).

Other studies cover curriculum areas such as traffic education (Riaz et al., 2019), multiple intelligences (Garmen et al., 2019); healthy habits and diet (Gómez-García et al., 2020) or knowledge about Indonesian culture (Sudarmilah et al., 2020).

According to ICT resources employed in the gamification experience

Different digital resources have been used in the gamified experiences. In this sense, there is research such as those developed by Rawendy et al. (2017), Halloluwa et al. (2018), Lamrani & Abdelwahed (2020) or Puig et al. (2021) that use computer, tablet or unnamed mobile applications to develop the activities. These applications are designed by the authors themselves, as in the case of Rawendy et al. (2017) for learning Chinese vocabulary or Halloluwa et al. (2018) for learning mathematical content. However, other studies (Cruz-García et al., 2021; Garcia-Sanjuan et al., 2018; Kim et al., 2019; Quintas et al., 2020; Quintas-Hijós et al., 2020; Quintas & Bustamante, 2021; Ros Morente et al., 2018; Su & Cheng, 2015; Wardani et al., 2019) use apps with names such as MGLS application, Quizbot app, Happy 8-12 app, Jariku app, MORE@Home app, Blocky or Just Dance Now. In other gamified experiences (Hursen & Bas, 2019; Quintas et al., 2020; Quintas-Hijós et al., 2020; Quintas & Bustamante, 2021; Riaz et al., 2019) they use platforms for behaviour management and student progress such as Class Dojo or Moodle. Other authors also use resources such as interactive books (Zhao et al., 2021), augmented reality (Sudarmilah et al., 2020) or what are known as serious games (Almeida et al., 2021).

According to the dynamics employed in the gamification experience

In terms of the dynamics used in the gamification experience, 87.50 % of the sample used some type of these strategies. Figure 6 shows the results.

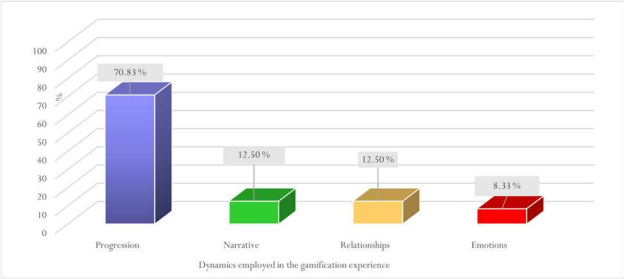

Figure. 6. Results according to dynamics employed in the gamification experience.

Firstly, the highest percentage of studies (Almeida et al., 2021; Cruz-García et al., 2021; Garcia-Sanjuan et al., 2018; Garmen et al., 2019; Hsu & Wang, 2018; Hursen & Bas, 2019; Ioannou, 2019; Kim et al., 2019; Puig et al., 2021; Quintas et al., 2020; Quintas-Hijós et al., 2020; Quintas & Bustamante, 2021; Rawendy et al., 2017; Riaz et al., 2019; Ríos Félix et al., 2020; Ros Morente et al., 2018; Wardani et al., 2019) which constitute the 70.83 %, use the dynamics of progression, since they look for the evolution and development of the player throughout a process that has a beginning and an end. Secondly, 12.50 % of the studies (Halloluwa et al., 2018; Hursen & Bas, 2019; Zhao et al., 2021) employ another type of dynamic called narrative. For instance, Zhao et al. (2021) implements gamification with a story based on elves, where the students are the warriors in charge of uncovering the mystery that the elves hide.

Thirdly, another dynamic employed in 12.50 % of the studies (Garcia-Sanjuan et al., 2018; Su & Cheng, 2015) was relationships. The development of these dynamics is observed in, for example, the research developed by Garcia-Sanjuan et al. (2018) focused on establishing collaborative relationships between students during the gamified experience. And, Fourthly, the last dynamic used is made up of emotions. In this sense, authors such as Puig et al. (2021) and Quintas & Bustamante (2021) explicitly state in their research that they aim to develop different emotions in students, such as joy, pleasure and interest through activities based on gamification (2021). Nonetheless, in the research conducted by Gómez-García et al. (2020), Lamrani & Abdelwahed (2020) and Sudarmilah et al. (2020) no dynamics of any kind were specified.

According to the mechanics employed in the gamification experience

Different types of mechanics are used in the different investigations that compose the sample. Figure 7 shows the results.

The most mechanic employed among the sample are levels (Almeida et al., 2021; Cruz-García et al., 2021; Gómez-García et al., 2020; Hsu & Wang, 2018; Kim et al., 2019; Lamrani & Abdelwahed, 2020; Puig et al., 2021; Quintas et al., 2020; Ríos Félix et al., 2020; Ros Morente et al., 2018). In this sense, more than half (54.17 %) of the investigations use this mechanics. In the research of Hsu & Wang (2018), the courses are classified into two levels, but they are not sequential, students can solve the puzzles as they see fit. In addition, the participants (wizards) are classified into fourteen levels, from level 0 which corresponds to the novice wizard they can level up as they gain magic points. Another example of levels is shown in the gamified experience carried out by Quintas et al. (2020) who establish ten levels of difficulty. To advance to the next level, they must pass the previous level. In this research, each level corresponds to a song, with level 1 being "Rasputin" and level 10 "Jambo Mambo".

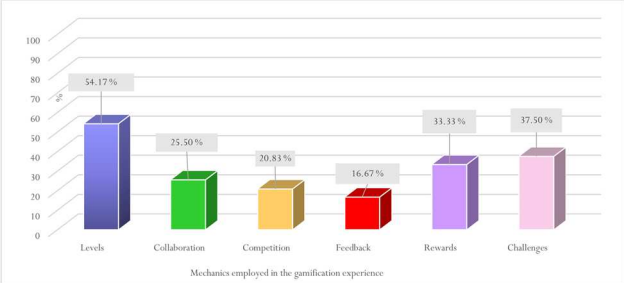

Figure. 7. Results according to mechanics employed in the gamification experience.

In 25.50 % of the studies (Garcia-Sanjuan et al., 2018; Halloluwa et al., 2018; Hursen, & Cizem, 2019; Ioannou, 2019; Quintas et al., 2020; Quintas-Hijos et al., 2020; Su & Cheng, 2015), collaboration is observed as the mechanics used. In this sense, Su & Cheng (2015) provide collaborative activities for learning. In this way, teamwork is essential to solve the tasks. Moreover, Halloluwa et al. (2018) develops an intervention where collaboration among team members is necessary to meet the objectives of the activity. Along the same lines, for example, Garcia-Sanjuan et al. (2018) indicate that the Quizbot application establishes a common goal for which it is only possible to achieve it by working as a team, making use of coordination, communication and positive interdependence between the members of the group.

According to Hursen, & Cizem (2019), the development of the activities of the gamified experience are based on cooperative learning. In this way, points are assigned not only individually, but also in teams. In the case of Ioannou (2019) all three phases of the intervention use the mechanics of colloboration, namely guessing the story told in the puzzle among all team members (phase 1), explaining together how the hero of the story might feel (phase 2) or selecting the best ending for the story (phase 3). Research by Quintas et al. (2020) and Quintas-Hijos et al. (2020) propose the same gamification scenario where students are asked to collaborate to create a group choreography as the main activity.

In addition, in 20.83 % of the studies (Hursen, & Cizem, 2019; Ioannou, 2019; Quintas et al. 2020; Quintas-Hijos et al., 2020; Quintas & Bustamante, 2021) the mechanics of the competition are distinguished. To do this, the authors Hursen, & Cizem (2019) propose a mechanics in which the groups of students who engage in the activities

compete, as a final comparison is established on the basis of the points obtained throughout the experience. Along the same lines, Ioannou (2019) in phase 3 of his intervention each group presents an alternative final and competes with the rest of the teams, as there will only be one winner. In the research by Quintas et al. (2020), Quintas-Hijos et al. (2020) and Quintas & Bustamante (2021) the teams compete to see who receives the highest score.

There are also 16.67 % of studies (Halloluwa et al., 2018; Hursen & Cizem, 2019; Ioannou, 2019; Riaz et al., 2019) where participants receive feedback after responding to a task or performing an activity. For example, in the case of Halloluwa et al. (2018) this feedback is received at the end of each level of the activity. In this way, when the attempt is successful, a congratulation window appears and if the attempt is unsuccessful, the student receives an encouraging response to try again. Hursen & Cizem (2019) use the ClassDojo platform to provide feedback on the progress of individual learners in the sessions which is always available to learners. In Ioannou' research (2019), the correct answer is coloured green, and the incorrect answer is coloured red, providing correction and feedback to students. And Riaz et al. (2019), when the answer was given, the students received a video and audio feedback about the correct answer.

Furthermore, there is a percentage (33.33 %) of research (Halloluwa et al., 2018; Hursen & Bas, 2019; Ioannou, 2019; Lamrani & Abdelwahed, 2020; Quintas et al., 2020; Quintas-Hijós et al., 2020; Riaz et al., 2019; Su & Cheng, 2015) that provide participants with benefits after reaching a goal, in other words, rewards. Authors such as Halloluwa et al. (2018) developed a reward system with the use of stars, ensuring that all learners received at least some reward for attempting the activities. In the case of Ioannou (2019) the rewards implemented are social. Moreover, other reward use is a cartoon character as in the research of Lamrani & Abdelwahed (2020) On the other hand, in a 66.67 % of research (Almeida et al., 2021; Garcia-Sanjuan et al., 2018; Garmen et al., 2019; Gómez-García et al., 2020; Cruz-García et al., 2021; Hsu & Wang, 2018; Isayama et al., 2016; Kim et al., 2019; Puig et al., 2021; Quintas & Bustamante, 2021; Rawendy et al., 2017; Ríos Félix et al., 2020; Ros Morente et al., 2018; Sudarmilah et al., 2020; Wardani et al., 2019; Zhao et al., 2021) it is unclear which type of rewards are used.

Additionally, 37.50 % of the sample (Cruz-García et al., 2021; Garmen et al., 2019; Gómez-García et al., 2020; Ioannou, 2019; Puig et al., 2021; Quintas et al., 2020; Quintas-Hijós et al., 2020; Wardani et al. 2019; Zhao et al., 2021) incorporates challenge activities during the development of the learning experience. There are some research studies such as Wardani et al. (2019), Quintas et al. (2020), Quintas-Hijos et al. (2020) or Puig et al. (2021) where the authors refer to the use of challenges, without specifying exactly what they consist of. Authors such as Cruz-García et al. (2021) also do not describe the challenges presented, however specify the fact that these challenges increase in difficulty as the students' progress. Authors as Ioannou (2019) indicate that different types of challenges are presented in the three phases of the project. For example, in the first phase, the challenge consists of guessing the story being told while assembling a puzzle. In the second phase, the challenge consists of explaining how the hero of the story might feel. And, in the third phase, the challenge involves recording the possible good or bad endings of the story, considering "what would happen to the hero if…".

In the case of Garmen et al. (2019), it is noted that the types of challenges proposed throughout the gamified experience are of different types: logical, visual, natural, linguistic, corporeal, emotional and musical. In this regard, researchers such as Gómez-García et al. (2020) establish a close relationship between the challenges and the exercises and activities of the didactic unit. These authors also give some examples of these challenges, such as bringing a piece of fruit twice a week to eat during the rest period, the preparation of a weekly record in which the amount of physical exercise performed per day was determined, or a research project on the unknown properties of some vegetables. Along the same lines, Zhao et al. (2021) the quizzes that students must complete during the process correspond to challenges.

According to the components employed in the gamification experience

The results regarding the components used in gamification are presented in Figure 8.

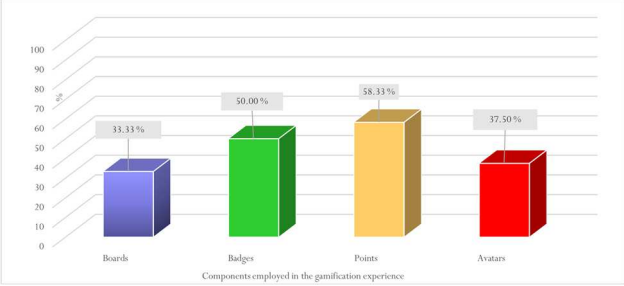

Figure. 8. Results according to components employed in the gamification experience.

Among the gamification components implemented in the experiences addressed in the articles in the sample, we can distinguish, first of all, the leader boards. Among the gamification components implemented in the experiences addressed in the articles in the sample, we can distinguish, first of all, the points boards in a 33.33 % (Halloluwa et al., 2018; Hsu & Wang et al., 2018; Hursen & Bas, 2019; Puig et al., 2021; Quintas et al., 2020; Quintas-Hijós et al., 2020; Quintas & Bustamante, 2021; Su & Cheng, 2015). Specifically, authors such as Su & Cheng (2015) or Hursen, & Cizem (2019) name the aforementioned boards, but do not give a detailed description of them. In the case of Halloluwa et al. (2018) a league table that uses stars to recognise the achievements of the participants. Puig et al. (2021) a league table highlighting the social status achieved by the player. Hsu & Wang's (2018) league table reflects much more information, as it shows a ranking of participants

based on magic points, experience points, skill points, wizard levels and stars. In the same direction, in the research developed by Quintas et al. [43], Quintas-Hijos et al. (2020) and Quintas & Bustamante (2021) the leaderboard was designed virtually using Microsoft Excel where the average scores of the students for each dance and the totals obtained from the beginning were indicated. Not only individually but also in groups.

Other components used in a 50.00 % of investigations (Gómez-García et al., 2020; Halloluwa et al., 2018; Hsu & Wang, 2018; Hursen & Bas, 2019; Puig et al., 2021; Quintas et al., 2020; Quintas-Hijós et al., 2020; Quintas & Bustamante, 2021; Riaz et al., 2019; Ríos Felix et al., 2020; Su & Cheng, 2015; Zhao et al., 2021) are badges. On the one hand, despite mentioning their application, Su & Cheng (2015), Zhao et al. (2021) and Hursen, & Cizem (2019) do not describe them. On the other hand, Halloluwa et al. (2018) and Puig et al. (2021) use stars as badges and Riaz et al. (2019) and Gómez-García et al. (2020) use bronze, silver or gold badges. Specifically, Quintas et al. [43], Quintas-Hijos et al. (2020) and Quintas & Bustamante (2021) designed a total of twelve badges for the three best dancers of each level, the three best dancers of each week, the three most improved students and the three groups with the most points overall. Finally, Rios et al. [46] used trophies as badges.

Points are also used in others research (58.33 %) when participants complete the activities as in the case of Zhao et al. (2021) or according to the behaviours performed as in the case of Hursen, & Cizem (2019). There is also research (Hsu & Wang, 2018; Riaz et al., 2019) that details the number of points that students can receive. In this sense, for example, in the experience reported by Hsu & Wang (2018) the participants (novice magicians) can get between 0 and 3 points depending on the result of solving the puzzle they have done. These points are transformed into "experience points" and "skill points" which, when added together, result in "magic points". Another example is the research conducted by Riaz et al. (2019) where students could obtain a score between 0 and 100 for each module. In the case of Ioannou (2019) participants only get a score if the correct answer is selected at the first attempt. These points can be used to personalise their own avatars and obtain a higher score in the subject (Puig et al., 2021; Quintas et al., 2020; Quintas-Hijós et al., 2020; Quintas-Bustamante, 2021).

In addition, avatars are also used in investigations (37.50 %) to identify the different players, although sometimes no description of such characters is provided, as in Halloluwa et al. (2018), Cruz-García et al. (2021) or Puig et al. (2021). In contrast, other research uses avatars in the form of monsters (Quintas et al., 2020; Quintas-Hijós et al., 2020; Quintas & Bustamante, 2021) or warriors (Zhao et al., 2021). Finally, performance graphs are also used in research such as Halloluwa et al. (2018) and Riaz et al., (2019).

According to the findings of the studies

The results of the studies included in the sample are presented below. First of all, the analysis of the results indicates that 62.50 % of the whole sample (Cruz-García et al., 2021; Garmen et al., 2019; Hsu & Wang, 2018; Kim et al., 2019; Lamrani & Abdelwahed, 2020; Puig et al., 2021; Quintas et al., 2020; Rawendy et al., 2017; Riaz et al., 2019; Ros Morente et al., 2018; Su & Cheng, 2015; Sudarmilah et al., 2020; Zhao et al., 2021) which conclude that the use of gamification has led to improved participant achievement. For example, Rawendy et al. (2017) indicate significant differences between the pre-test and post-test with a Sig. (2-tailed) value of 0.000 ($p<0.05$), indicating that the application of gamification improves learners' knowledge of Chinese language vocabulary. Hsu & Wang (2018) also show significant differences ($p = 0.000$) between the groups using gamification techniques for the development of puzzle-building activities and those using a traditional approach. In the research conducted by Ros Morente et al. (2018) these significant differences correspond to a $p = 0.02$. Other research such as that developed by Cruz-García et al. (2021) observe significant differences ($p=0.000$) in programming knowledge between the October 2019, December 2019 and February 2020 tests, concluding that there is an increase in this knowledge.

Secondly, there is another group of studies that constitutes 29.17 % of the sample (Cruz-García et al., 2021; Gómez-García et al., 2020; Hursen & Bas, 2019; Quintas et al., 2020; Quintas-Hijós et al., 2020; Su & Cheng, 2015; Zhao et al., 2021) determined that gamification improves student motivation. Among these studies, Su & Cheng (2015) observed significant differences in the motivational dimension between the control group and the control group with a p-value of less than 0.05 ($t = 2.538$, sig. $= 0.022$). In the same line, Hursen, & Cizem (2019) find significant differences between pre-test and post-test in all dimensions related to motivation, except in the one focused on "motivation to participate" ($p=0.206$). Thus, significant differences are observed in "motivation to investigate" ($p=0.025$), "motivation to perform" ($p=0.040$), "motivation to communicate" ($p=0.038$) and "motivation for cooperative study" ($p=0.043$). On the contrary, authors such as Quintas & Bustamante (2021), one-way ANOVA analyses (post-pre) showed, on the one hand, that the control group showed less achievement motivation as time went by and, on the other hand, that the experimental group did not show more or less achievement motivation over time. In this sense, all these studies conclude that gamification can be an effective educational tool for promoting student motivation.

Thirdly, 20.83 % of the studies (Almeida et al., 2021; Cruz-García et al., 2021; Quintas-Hijós et al., 2020; Quintas & Bustamante, 2021; Wardani et al., 2019) whose results show that the application of gamification creates experiences of enjoyment and generates satisfaction in students can be differentiated. This satisfaction on the part of the students is observed throughout the sessions carried out by Cruz-García et al. (2021) and is reflected by the teachers in the interviews conducted. Similarly, Almeida et al. (2021) also reports student satisfaction. Specifically, this research

shows that 92.00 % of students were satisfied with the experience. Likewise, Quintas & Bustamante (2021) showed that the use of gamified games produced significant differences in student satisfaction. In addition, Quintas & Bustamante (2021) showed that students enjoyed the use of gamified games more than those where this type of technique was not applied ($p = 0.02$).

To be continued, it is observed, on the one hand, 16.67 % of research (Hsu &Wang, 2018; Ioannou, 2019; Puig et al., 2021; Quintas et al., 2020) where the application of gamified activities improves student engagement with the tasks. Therefore, in the Hsu & Wang (2018) research the engagement of the students who carry out the activities with gamification mechanics is significantly higher than the PBL ($p = .001$) and PGM groups ($p = .004$). On the other hand, the same percentage (16.67 %) of research (Rawendy et al., 2017; Garcia-Sanjuan et al., 2018; Quintas-Hijós et al., 2020) positively evaluates the use of this technique and its ease of application. Fifthly, Gómez-García et al. (2020) and Quintas-Hijos et al. (2020) show in their results that this type of activity improves student autonomy. Also, two other studies (Halloluwa et al., 2018; Ríos Félix et al., 2020) determine that their use allows for the creation of a positive learning environment.

Finally, research such as that conducted by Gómez-García et al. (2020) finds positive relationships between the use of gamification and the self-regulation of participants' behaviour, and Garcia-Sanjuan et al. (2018) finds this relationship with the promotion of collaborative skills.

Discussion

In the following lines, the discussion of the results for each of the research questions posed at the beginning of the study is presented. In the first instance, according to the first research question focused on the objectives of the sample research, the results indicate that the highest percentage of research (37.50 %) aims to improve student performance through the application of gamified experiences in the classroom. These results are in line with those presented by Manzano-León et al. (2021) where the highest percentage of articles (50.00 %) included in the sample focus on improving academic achievement. This phenomenon could be explained, following Ortiz-Colón et al. (2018), by the current need of teachers and institutions to look for new innovative methodologies that allow them to adapt to the needs of students and at the same time promote significant learning, engagement and motivation towards learning. In this sense, as reported by Tsai et al. (2019) there are a number of reasons for this high level of interest in investigating the use of gamification to improve academic performance. Among them, the possibility offered by these experiences for students to be the active protagonist of their own learning, the possibility of designing gamified activities based on the curriculum and the continuous feedback received by students during the game process.

After this, responding to the second research question which is focused on the sample of participants in the studies, the results show that more than half of the studies (54.17 %) have 100 or more participants. Again, our results coincide, in part, with the research carried out by Manzano-León et al. (2021), who show that, despite locating a smaller number of articles focused on the school education level (Early Childhood Education and Primary Education), 60.00 % of these have a number of participants of around 100 or more. This result could be related to the positive view of gamification held by teachers at these stages, since, as Zou (2020) points out, they consider that its use promotes student motivation, confidence, communication skills and self-regulation of learning. This awareness leads to the promotion of this type of activities throughout these stages. On the other hand, the percentage of pupils between 10 and 12 years old, that is, students from 4th grade of primary education up to 6th grade, is among the highest. These results could be due to teachers thinking that pupils in this age group are more suitable for gamification than younger pupils (2016).

In the case of the third research question related to the curriculum areas worked on, our results show that more than half of the interventions, 54.17 %, focus on the area of science. The reason for this result could be, as Díez et al. (2017) noted, that students feel they are the active protagonists of their learning, as the game mechanics, often organised in levels, allow them to follow their progression and get clues and opportunities for reflection when it comes to scientific problem solving. Following Kalogiannakis et al. (2021), this result, which reflects a strong focus on gamification in this area, would be supported by the fact that science education is seen as one of the essential parts of education today. This is because it is responsible for shaping a scientifically literate citizenry and fostering 21st century skills such as adaptability or problem solving.

In reference to the type of ICT resource most used throughout the research, the results of our research which reflect that the majority of cases employ gamification platforms and applications, which is in line with Zainuddin et al. (2020). These same authors (Zainuddin et al., 2020) indicate that the generalised support for the incorporation of this type of resource is based on the direct influence that gamified technologies have on learning and the potential to modernise the educational landscape in this new digital era. Thus, this use of digital gamification applications and platforms, in the words of Alhalafawy & Zaki (2019), is based on the potential of digital resources to enhance autonomy, personal development, positive relationships and environmental enabling.

According to the next research questions, the results show that the progression is the most applied dynamic along the gamification experience (70.83 %). This phenomenon is also observed by authors such as Ortiz-Colón et al. (2018) who identify the presence of progression dynamics in more than half of the research (60.00 %) involved in their review. This emphasis on the existence of a dynamic of progression is based on the fact that, according to Lamprinou &

Paraskeva (2015), it is essential for students to be aware of their overall development during the process. Moreover, the most mechanics used are levels (54.17 %), followed by challenges (37.50 %). Kalogiannakis et al. (2021) and Manzano-León et al. (2021) highlight challenges as one of the most commonly used game elements in gamified experiences. In the case of levels, the reason why the authors use them is related to the search for a structuring of the gamification experience that allows extrinsically motivating the students (Zainuddin et al., 2020). And respect to the last category of DCM pyramid, that is components more than half of the sample (58.33 %) use points. These results are partly in line with the findings of Kalogiannakis et al. (2021) and Ekici (2021), who identify points among the most frequently used game elements in research. The use of these and other mechanics is based on the fact that students tend to perceive these elements in a positive way, as their use has a positive effect on students' motivation to learn (Manzano-León t al., 2021; Lamprinou & Paraskeva, 2015).

Finally, the results show that in reference to the last research question, the main finding of investigation is that the use of gamification techniques in 62.50 % articles denote a significant increasement of children achievement, this result could be explained, following Putz et al. (2020) by the change from a traditional methodology, unidirectional and passive on many occasions, to another active teaching characterized by proposing challenges appropriate to the level of the students, whose resolution leads to the acquisition of significant and functional learning for day-to-day life.

Conclusion

The systematic literature review has been found that gamification has been applied in early childhood and primary education for many areas and objectives. In this sense, from the proposed research questions, the following conclusions are indicated:

- This review identified that the main objectives of the research are aimed at improving academic performance in different areas of the curriculum, increasing motivation and improving collaboration skills.
- On the one hand, this review also identified that the number of participants in the studies ranges between 3 and 574, with the study by Ros-Morente et al. (2018) having the largest number of participants. On the other hand, students with 10, 11 and 12 years old are the ones for whom most gamified experiences have been designed and implemented.
- Gamification could be applied to teach emotional competence, physical education, language and science (mathematics, geometry, algorithmic skills, biology). The area of science corresponds to the one where most gamified experiences have been developed.
- Moreover, computer and mobile applications are the most commonly used tools to support the gamified experience.
- Despite the fact that a large number of dynamics are not usually identified, this research concludes that progression is the most commonly used dynamic in the research.
- Although a large number of dynamics are not used, again levels are the most used mechanics in research.
- In the case of components, articles reviewed apply a large number of them, highlighting the points are the most used in research.
- This review denotes that the application of gamification according to research results improves significantly academic achievement, motivation, task engagement, autonomy and enjoyment.

Despite the fact that the PRISMA methodology allows for systematised research, like any other study, the study has some limitations. Firstly, the study focuses on analysing research collected only in the WoS database, without considering others such as SCOPUS or some related to the educational field ERIC. This could have led to the omission of other articles that are not found in WoS but in other databases. On the other hand, the language selected, i.e., English, despite being the language of scientific publication par excellence, other publications of interest could have been discarded due to a lack of knowledge of the language in which they are written. Nonetheless, the strength of this research is that it provides a comprehensive review that shows that the application of gamified elements in early childhood and primary education classrooms is a reality. Moreover, it is considered necessary to increase the number of gamified elements based on the DMC Pyramid model, as this approach to the model would make it easier to adapt them to the official curriculum of the stages. In this sense, the dynamics could be associated with the didactic objectives and assessment criteria. For their part, the mechanics would correspond to the contents and methodology used, and the components to the assessment instruments.

Gamification can be a reality in the classroom and this article is a starting point for the future design of gamified experiences, as it provides an analysis for teachers to use in the future as a source of knowledge of what has been done so far and what can be improved. In this sense, future lines of study will focus on the creation of a protocol for the design of gamified experiences interrelating the DMC pyramid model with the curricular elements.

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