Game-Based Learning and Gamification in Physical Education: A Systematic Review

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Abstract: The use of educational games or some aspects of games in the educational context is known as game-based learning (GBL) or educational gamification. The objectives of this study are to assess the existing evidence about how GBL and gamification have affected the variables studied in each investigation over the past ten years; to analyse the educational levels, variables, dynamics, and types of games; and to determine the advantages of implementing these games in the classroom. A systematic review is proposed utilising the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology across five multidisciplinary databases by conducting an exhaustive search with inclusion and exclusion criteria, examining quantitative experimental studies exploring the use of gamification and GBL in physical education. The results identify GBL and gamification as significant learning methods due to their impact on student motivation, academic performance, and commitment to improving health and physical performance. Consequently, this study implies that more research is needed on the needs and challenges of students when they are learning through GBL or gamification.

Keywords: game-based learning; gamification; systematic literature review; physical education

1. Introduction

To take advantage of the rapidly changing educational environment, we must investigate new teaching and learning methods to know the needs of students. To benefit from this changing educational environment, it is necessary to address the following issue. Nowadays, the student population is defined as digital natives, a concept introduced by Prensky [1], characterised by their birth and adolescence in the era of technology and digital technology. As more and more people use electronic devices and the Internet, a new era of digital socialisation has begun, one that opens many possibilities in the field of education as well as digital socialisation in general. Traditional learning theory is based on the cognitive dimension. It does not take into account the socialisation that the new digital age makes possible, nor does it make sense of the emotions involved in learning [2]. This need for evolution entails that teachers must innovate in their pedagogical strategies [3]. For this reason, it is significant to investigate what active strategies are currently being researched [4–6] or the literature reviews [7–9].

Several authors have found games to engage students in an integrative way [10,11]. The use of games in formal education is essential for achieving meaningful learning. Specifically in physical education, games offer excellent opportunities for developing cooperation and socialisation [12,13]. Games are a common resource for teaching technical

and tactical gestures involved in sports in physical education classes. However, it is not only used for that. The proposal of a game as a pedagogical resource allows us to work the theoretical knowledge in a playful and motivating way [14]. Therefore, teachers can encourage students to actively participate not only in the field but also in the classroom. Several authors in their research have used games to achieve enjoyment [15], improve decision-making [16], even combined with technology [17]. With an emphasis on involving students in their learning processes, these include playful learning strategies, such as game-based learning (GBL) and gamification [16,18]. The wide popularity of using playful methodologies in education has caused these strategies to be considered as ideal solutions to rectify the deficiencies in the educational system and increase the motivation and learning of the student. GBL and gamification are becoming increasingly popular in education [19]. GBL consists of the continuous and strategic use of games or video games in teaching. The game is a resource for learning or working on a specific concept [20]. Recent research shows how the use of conventional games and video games, such as GoNoodle, Dance Dance Revolution, and Just Dance, can promote greater physical activity and reduce a sedentary lifestyle [21–23]. When games are designed specifically for learning, they are considered serious games [24] or exergame in the case that it is a video game that allows players to do some kind of physical activity, either individually or in a group [25]. In the educational field in general, the results of a meta-analysis show that the use of serious games has a positive effect on learning, cognition, affect, and the training of basic skills [26]. In the subject of physical education, in recent years, various serious games have been designed and investigated with promising results in relation to motivation, learning, and positive emotions, considering that part of this success may be due to the stimulation achieved thanks to the mechanics of game [27–29].

In contrast, gamification is characterised by applying some game elements in nongaming contexts [30]. In physical education, its use is spreading due to the benefits of this methodology; for example, a review of the literature in physical education from kindergarten to high school showed that gamification improves motivation and commitment to exercise [31]. There is an association between these methodologies and the constructivist vision of learning because they provide students with an opportunity for experimentation and to construct meaning as a result of their cognitive and emotional experiences during the learning process [32,33].

GBL methodology uses games to learn or work on certain content [34]. Students are given challenges in educational games related to the main topic or task. Three key components must be considered to design a successful game: the player, the task, and the artefact [35]. An error in any of the three components can negatively affect the flow, a theory introduced by Mirvis and Csikszentmihalyi [36] that is described as a framework to facilitate the positive experience of players. Research has been found in the scientific community that fails to demonstrate educational gaming drawbacks [37,38]. The focus of educational games is not on the precise moments of the flow experience to maximise their impact but on the factors that contribute to the flow experience, such as a sense of control, concentration, and scope for action [39].

The elements most commonly used to gamify educational contexts can be divided into three categories [40]. On the highest level, there is what is referred to as dynamics, which include narrative, progression, and relationships. Secondly, the mechanics of the game include rules and challenges as well as cooperation and coordination that allow progress to be made. There are also the components, which are the elements that students will receive as a result of participating, such as badges, points, leaderboards, and levels. Through the appropriate combination of these three concepts, several empirical studies have concluded that motivation can positively impact performance [41,42], whereas other researchers disagree and provide contradictory results [43,44].

From the creator's perspective, what distinguishes gamification and GBL is the intention to create a dynamic that incorporates elements of games rather than creating a complete game [45]. There are different levels when designing effective gamification [30] (See Table 1).

Table 1. Levels of Game Design Elements.

Level	Description	Example
Game interface design patterns	A comprehensive list of standards, successful interaction design components, and solutions, including prototypical implementations, for a known problem in a particular context.	Badge, leaderboards, and level
Game design patterns and mechanics	A game's gameplay is one of the most recurrent design elements.	Time constraint, limited resources, and turns
Game design principles and heuristics	An evaluation of a given design solution or approach to a given design problem.	Enduring play, clear goals, and variety of game styles
Game models	The game's components or the experience of playing a game are conceptually modelled.	MDA; challenge, fantasy, and curiosity; game design atoms; CEGE
Game design methods	Practices and processes specific to game design.	Playtesting, play-centric design, and value-conscious game design

Note: Own elaboration from [30].

It has been found in many studies that physical education strategies have a strong correlation with students' motivation and performance in the classroom, especially when it comes to game-based learning (GBL) [46] and gamification [47]. Gamification offers the necessary ingredients to promote meaningful, motivating experiences in physical education in primary and secondary schools [48]. In contrast, another study found significant improvements in academic performance but could not confirm a positive outcome in university students' intrinsic motivation [49].

Several systematic reviews have been conducted on GBL and gamification in education, which indicate that gaming trends and external factors can influence engagement and learning [50]. GBL could be applied in primary education with good motivation and academic achievement results [51]. However, more longitudinal studies in physical education are needed to determine the true significance of the effect on students caused by the GBL.

We found it necessary to conduct this review of the literature to clarify the size of the effect of gamification or GBL applied to education, from kindergarten and from childhood through to a university degree, in the field of physical education, due to the variation and existence of multiple differences in implementation strategies, platforms, games, apps, etc. Therefore, we can conclude that the main objective of this literature review was to evaluate the motivational effect of gamified systems or GBL in all formal physical education.

As a result of the research objective mentioned above, the following research questions were formulated:

- RQ1: At which stage of education have the most empirical studies been conducted?
- RQ2: What are the most common game dynamics and mechanics used for educational purposes in the selected studies?
- RQ3: Which type of games, digital or physical, have been most frequently used in the studies selected?
- RQ4: In the educational context of physical education, what are the potential effects of the application of gamification and GBL?

2. Materials and Methods

The systematic review was conducted following the recommendations of the previously established Reporting Elements for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [52]. Between July and September 2022, some relevant articles on the above topic were reviewed. Systematic reviews have as their primary objective the grouping of scientific

evidence available in the literature through establishing inclusion criteria that will answer the research questions. The following search string was used in the Scopus, Pubmed, Scielo, JCR, and Dialnet databases in both English and Spanish: ("game-based learning" OR "GBL" OR "serious games" OR "educational games" OR "instructional games" OR "games for learning" OR "edutainment" OR "board games" OR gamif*) AND ("Physical education" OR exercise OR fitness OR health OR "sport learning" OR sport*).

Documents included in the systematic review were selected based on the following criteria:

- The only language studies accepted were those conducted in either English or Spanish. Even if the abstract was in English or Spanish, studies in other languages were excluded.
- In terms of the format, only articles from scientific journals were accepted. We excluded articles published on nonspecialised web pages, blogs, and digital newspapers, as well as books, book chapters, and doctoral theses.
- Only studies focused on formal educational institutions were accepted as intervention recipients.
- Considering the type of research, only quasi-experimental and experimental studies with pre-post-test were accepted. Theoretical, reflective, and review articles were excluded.
- The subject of the study was limited to studies that used game-based learning or gamification as the central methodology. Other active strategies, such as flipped learning or problem-based learning, were excluded from the study.
- To address the research questions adequately, experimental studies that did not specify their sample, resources, or game-based learning elements were excluded.

The abstracts and full texts were reviewed after establishing the inclusion criteria. The literature that appeared using the search string was downloaded in RIS format to manage the database with the Rayyan software. Following the upload of all the documents to the application, duplicate texts were detected and discarded under review. Once this first filtering was completed, we pitched the articles whose titles, keywords, abstracts, and content were not directly related to the research question or did not meet all the inclusion criteria mentioned above. As a result, 17 scientific articles were included in the final systematic review (See Figure 1).
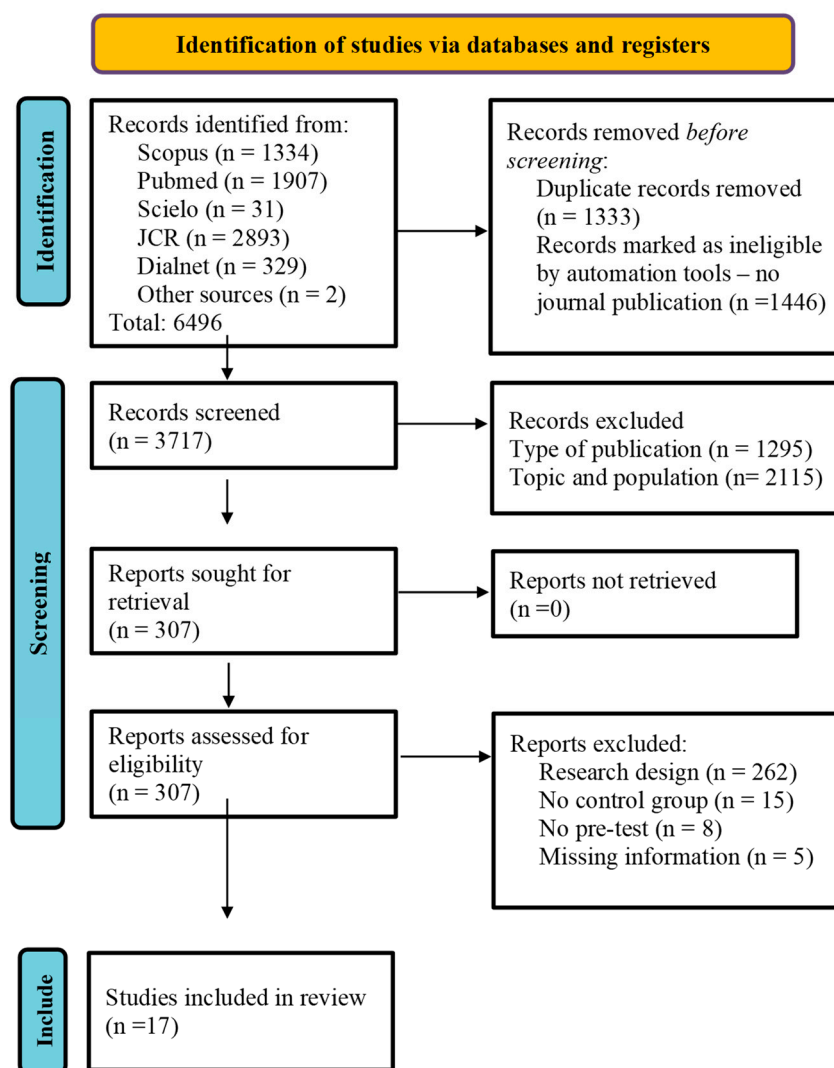
Figure 1. Scheme for searching and selecting the sources to be analysed.

3. Results

The characteristics of the 17 investigations that met the selection criteria are presented in the following table (Table 2). Based on the research questions, we decided that it was appropriate to include information about the number of participants, the number of sessions in which the games were implemented, the type of research, the educational context, the dynamics and mechanics of the games, the type of games, the electronic support device, and its effects on students based on the research questions.

According to the first research question (Where have the most empirical studies been conducted?), the studies indicate a predominance in the most advanced stages of compulsory education, with over half of the studies 47% conducting research in secondary education. It is estimated that 29% of the authors consider that implementing a strategy at the earliest stage would be beneficial. In contrast, 24% think that implementing a strategy at the university level would be helpful. Thus, it is evident that studies conducted at compulsory training stages predominate over those conducted at universities.

In response to the second question (What are some of the most common game dynamics and mechanics that have been employed as educational tools in the selected studies?), the methodological proposals based on gamification proposed by the authors were analysed in detail, including the dynamics, mechanics, and elements. It is equally distributed between narrative (47%) and challenges (47%). There was one study (6%) in which storytelling was used as the primary dynamic. A total of 80% of the researchers created a

team competition system by adding two essential elements: collaboration and competition. Collaboration was not used in only two studies. In place of this, they used individual competitions. In addition, two other studies chose not to compete. There is a great deal of evidence that almost all investigations, 76% of them, utilised a system of points, rewards, and leaderboards to reflect the progress of teams or participants. There were four studies that found it appropriate to use only points, while one study used both points and rewards at the same time.

Table 2. Research selected in the systematic review.

Reference(s)	Sample	Educational Stage	Type of Gamification	Type of Games and Devices	Variables Studied
[53]	CG:87 EG: 70 T:157	Primary education	Challenges with Collaboration and Competition using PBL	Challenge-based game with multiple devices.	=Physical performance. =Physical health.
[54]	CG:168 EG:329 T:497	Primary education	Narrative without Competition or Collaboration using Points and Badges.	Challenge-based game without devices.	+Physical performance.
[18]	CG:191 EG:226 T:417	Primary education	Challenges with Collaboration and Competition using PBL.	Level-based game with multiple devices.	+Motivation regulations. +Basic psychological needs.
[55]	CG:9 EG: 11 T:20	Primary education	Challenges with Collaboration and Competition using PBL.	Video game with computer.	+Physical performance. +Physical health.
[56]	CG:19 EG: 26 T:45	Primary education	Challenges with Collaboration	Challenge-based game without devices.	=Motivation regulations. =Pro social.
[57]	CG:27 EG: 27 T:54	Secondary education	Narrative with Collaboration and Competition using PBL.	Level-based game with multiple devices.	+Motivation regulations. +Basic psychological needs.
[58]	CG:49 EG: 49 T:98	Secondary education	Narrative with Collaboration and Competition using PBL.	Challenge-based game with a computer.	+Motivation regulations. +Basic psychological needs.
[47]	CG: 142 EG:133 T:275	Secondary education	Narrative with Collaboration and Competition using PBL.	Level-based game with a computer.	+Motivation regulations. +Basic psychological needs.
[59]	CG:19 EG: 17 Total: 36	Secondary education	Storytelling with Collaboration and Competition using PBL.	Challenge-based game with multiple devices.	=Physical performance. +Motivation regulations.
[60]	CG:32 EG: 26 T:58	Secondary education	Narrative with Competition using PBL.	Challenge-based game with multiple devices.	=Motivation regulations. +Physical performance.
[61]	CG:81 EG:132 T:213	Secondary education	Challenges with Collaboration and Competition using PBL.	Challenge-based game with multiple devices.	+Strength and difficulties. +Pro social.
[62]	CG:25 EG: 27 T:52	Secondary education	Challenges with Competition and using Points.	Board game and augmented reality with multiple devices.	+Motivation regulations.
[63]	CG:32 EG: 32 T: 64	Secondary education	Challenges with Collaboration and Competition using Points.	Escape room game with multiple devices.	+Motivation regulations. +Basic psychological needs. =Academic performance.
[49]	CG:65 EG:62 T:127	University education	Narrative with Collaboration and Competition using PBL.	Level-based game with a computer.	=Motivation regulations. +Academic performance.
[64]	CG:75 EG:75 T:150	University education	Challenges with Collaboration and Competition using Points.	Challenge-based game without devices.	+Motivation regulations. +Academic performance.
[65]	CG:59 EG: 58 T:117	University education	Narrative with Collaboration and Competition using PBL.	Challenge-based game with mobile phone.	+Physical performance.
[66]	CG:75 EG: 73 T:148	University education	Narrative without Competition or Collaboration using Points and Badges.	Challenge-based game with mobile phone.	+Physical health.

CG (control group); EG (experimental group); T (total sample); PBL (points, badges, and leaderboard); + (positive effects); = (no effects).

Concerning question 3, (Which type of games, digital or physical, have been most used in the selected studies?), there are various kinds of activities, with games based on

challenges being the most prevalent in the selected articles (58%). Level-based games are the second most prevalent type of activity. There was one article for each modality in the next section for board games, escape rooms, and video games. On the other hand, the most used devices for performing these dynamics are a combination of several devices, such as computers, mobile phones, and some specific applications (86%); however, 14% do not consider it appropriate for the activity to be hosted or managed by a device.

Finally, in response to the fourth and last research question (What are the potential effects of gamification and GBL in the educational context of physical education?), it was observed that there are a variety of variables that were considered. The results from all the interventions can be seen in Figure 2, which depicts the results obtained throughout the intervention (See Figure 2).
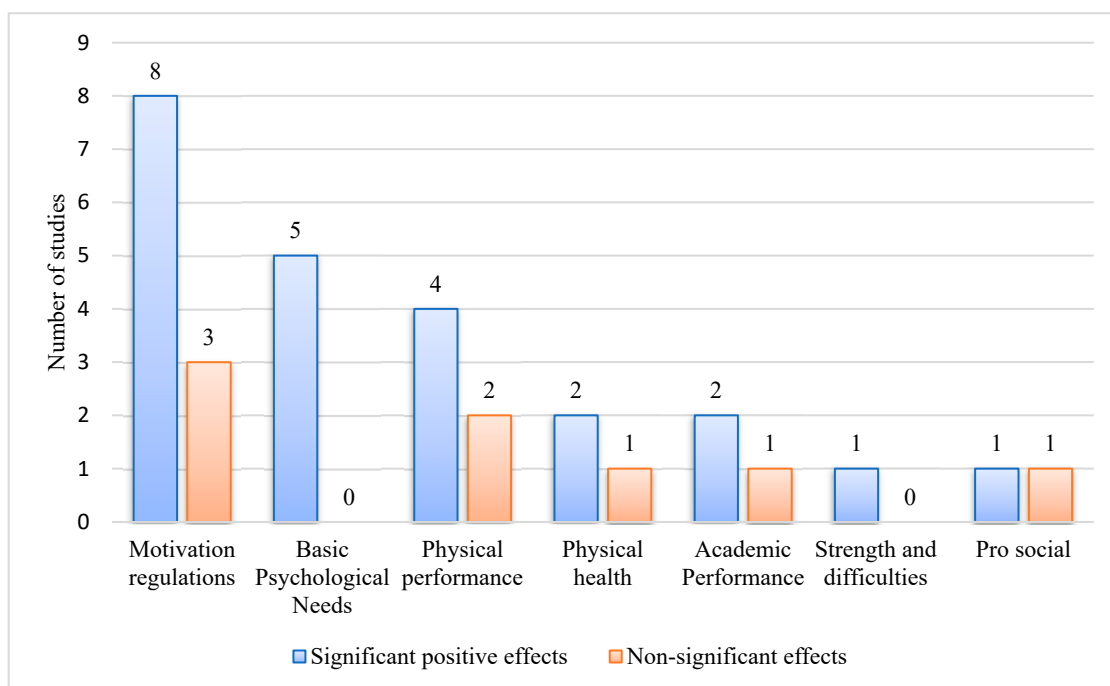

Figure 2. Results of the variables studied.

Motivation regulation has a preponderance of significant effects on intrinsic motivation based on the included studies. This is followed by introjected regulation, identified regulation, and integrated regulation. Finally, although there is one case, no such significant effects were found for extrinsic motivation. As shown in Figure 2, among the basic psychological needs, autonomy, competence, and relatedness obtained significant results in the five studies. The physical performance and physical health variables did not follow a logical pattern regarding significant results. In some physical endurance tests and muscular strength tests, the authors reported positive results. Contrary to this, other authors failed to demonstrate that student physical or mental health improved.

4. Discussion

This study provided a deep systematic analysis of GBL and gamification pedagogical methodologies, as well as the dynamics and mechanics of games, specifically in physical education. In addition, the university stages have also been primarily understudied and under-reviewed in recent studies. This study analyses the motivational, physical, and educational effects that students experience. Understanding the design aspects and components of educational games is essential to achieve a maximum positive impact on students. Therefore, an exhaustive analysis of the literature that exists up to now can be beneficial to both the scientific community and the teachers who oversee deciding what

elements and components will constitute the game in their classrooms based on their student situation and context.

Overall, the results indicate that GBL and gamification can have significant positive effects on different variables related to regulated motivation [18,47,57,58], basic psychological needs [60,63], academic performance [49,64], and improvements in physical and mental health [55,60,66]. As a result of these findings, playful strategies may be a practical methodology for motivating students in physical education classes. To date, systematic reviews have been deepened by adding earlier educational stages to the review process. In addition to this, a particular focus has been placed on examining the types of dynamics and mechanics used in the game that are used [31,51]. There is still a need to study other active and gamified methodologies in the university environment and other active and gamified methodologies in the sector.

There is growing interest in gamified methodologies, such as GBL or gamification, among teachers and educational institutions [19]. In terms of the academic level, much research has been conducted on the early stages of education, such as primary education [18,53,54] or secondary education [47,59,61]. However, there are fewer contributions in the university context [49,64–66]. It may be because of the erroneous association between play use and restrictive thoughts at infantile ages. The studies included in the systematic review have shown that university students also benefit in terms of motivation, healthy habits, physical performance, and academic performance. This finding is evidence that playful methods, such as GBL or gamification, do not have limitations at different levels of education.

Various dynamics can be used in gamification, but narrative dynamics are most used in the literature [49,65] and the challenges proposed [55,63]. These two strategies introduce the student to a story in which they participate, which is why the motivational results are so favourable. According to the systematic review conducted, we can conclude that there is an equal amount of emphasis placed on narrative and challenge proposals. There have been some instances where physical education and sport are positively associated with self-improvement. Hence, if this explanation is the case, perhaps the use of challenges in the sessions can be explained by the fact that they are being used frequently.

Regarding the interactions in gamification, it can be observed that the vast majority have incorporated collaboration and competition. If the situation and the educational context allow it, competition can be a fascinating and decisive element to incorporate into pedagogical dynamics [6,67]. When it comes to ludic methodologies, there is no clear pattern as to how team competitions are used in ludic methodologies. Although this is the case, the studies gathered in this review show that many significant positive effects on motivation had been observed. There is a need to continue researching the real effects of competition and collaboration on gamification and GBL in the future, so it would be constructive if further research is conducted in this area.

To use games as a learning resource, it is possible to create digital resources or physical materials. A total of 14 studies of the 17 included in this review utilised some electronic device, such as a mobile phone or a computer. Considering the digital age and the exponential development of mobile devices in recent years, they may play an essential role in motivating students and facilitating their socialisation and digital interactions [68]. No additional motivation is provided by using electronic devices in a meaningless manner without any additional meaning. To increase student attention and learning, it is necessary to associate electronic devices with a means of providing more possibilities [57]. Achieving this usability will increase student attention and learning. In order to introduce these devices as enablers and not just novelty tools, we should view them as enabling mechanisms [62].

Playful strategies will likely be used more frequently in the coming years. The popularity of these strategies and their digitisation with the support of virtual environments is a testament to their success [35]. Still, teachers must be trained to adapt to these tools and dynamics and ensure that these strategies are used effectively in the classroom. The

adoption of innovative learning games has the potential to increase student understanding, create motivational opportunities at the school, and develop student competencies. So, we found a synergy between the benefits of using games on the field [10] and using games in the classroom [62]. However, these expectations will only be achieved if teachers are confident or interested in their use. Our challenge is to ensure that the teaching staff accepts these methodologies and exposes all the benefits that may be derived from their use in the classroom.

As a result of the scientific evidence we have generated, we can now expose functional tools to the educational community as a result of this research. It has been shown through the results of the conducted systematic review that the use of appropriately designed games can have a positive effect on variables, such as motivation [57], healthy habits [55], and learning [49]. The games produce in the students improvements in their socialisation [12,61]. Additionally to the benefits of the use of ludic strategies in practical physical education content [54,65], there is also evidence that the use of games can make the theoretical content more appealing to students [59,62].

GBL or gamification in an educational setting can achieve positive motivation, academic performance, and physical and health benefits. Upon completion of the review, the studied methodologies can serve as a teaching strategy that can be applied in various pedagogical contexts and pursue multiple objectives. Playful strategies are often associated with searching for healthy habits [22,23,61] or enhancing physical abilities in physical education [54]. Undoubtedly, physical education is one of the most practical subjects, especially in primary and secondary education. In college, though, there should not be any barrier between using the game and pursuing higher education [9]. The use of games in these contexts has also been shown to have significant effects, according to studies conducted in this field [64,66]. As mentioned in the introduction, this review concurs with several other reviews [31,50] that the context and design of the game can have an impact on expected student outcomes. For this reason, it is very important to analyse the educational context and to design a game or a gamification that is appropriate for the specific situation of the students.

Generally, systematic literature reviews are proven methods in educational science research. Transparency and openness to criticism are among the strengths of systematic reviews based on the PRISMA methodology. This review has some limitations, such as some methodological aspects, which prevented it from including more research, thus allowing a more comprehensive analysis. It would be interesting for the scientific community to obtain more studies that have measurements before and after the intervention. This methodological approach will allow the real impact of the proposed methodologies to be observed. The application of gamification and these educational games or experiences played in other subjects from other educational contexts would help to determine whether the type of game played or dynamics involved is a differential factor. This study focused solely on research conducted in academic journals without considering other types of research, such as book chapters, conference papers, and others. Due to language limitations, other articles could not be analysed. Additionally, it would be appropriate to apply different kinds of activities or more interactive video games, such as the metaverse, that were not used in the reviewed articles to determine if the results differed.

5. Conclusions

This study aimed to gain a deeper understanding of how gamification and game-based learning methodologies are applied to physical education. In addition, the study was familiar with GBL and gamification strategies. In particular, the decision to include a university context showed us that there is still much research in this field. According to a systematic review of the literature, both GBL and gamification can be beneficial in different contexts and at different educational levels depending on the context. Several benefits were identified in the systematic review, including improved motor control, academic performance, and health.

Moreover, we believe that it is essential that they are also related to learning variables as they pertain to higher education. The study identified the main types of games that were most frequently played. It also identified the electronic devices used, the dynamics and mechanics of the activities, and the interactions between participants. According to the findings of the review, GBL and gamification can be used effectively in the context of sports education and result in positive outcomes for students, based on the research findings. In addition, it was demonstrated that GBL and gamification can be effective in university education. The narratives used or the challenges posed may differ from those found in primary and secondary education; however, that does not mean that games cannot be used in higher education.

Throughout this review, our goal was to advance the search for scientific evidence that can be used to analyse and develop playful strategies in the educational field. These strategies can be improved and adapted to meet the needs of students in the future. The effect of different active learning strategies and the combination of various methodologies, such as problem-based learning and flipped learning, on the student population, as a result, should be explored and investigated further to determine the extent of their impact.

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