





Benefits of Gamified Learning in Physical Education Students: A Systematic Review

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Abstract

The application of gamification in Education is becoming increasingly popular. However, empirical studies on gamification and physical education are very heterogeneous. What do we know about the impact of gamification in PE so far? The purpose was to provide a current overview on the benefits of gamification in PE belonging to the different educational levels. Additionally, this review aims to analyse the features that these interventions have in common. Studies were identified in seven databases: Dialnet, ERIC, Redalyc, EBSCOhost, ProQuest: ERIC, SCOPUS and Web of Science. Twenty-two studies were included: seven qualitative, seven quantitative and eight of mixed method, enrolling 2,095 students and 12 teachers. The analysis carried out showed significant increase in intrinsic motivation, and the satisfaction of all basic psychological needs and, consequently, commitment to the physical education subject, improving in learning and academic performance. Benefits were also highlighted regarding promotion of cooperative work and a positive atmosphere within physical education class.

Keywords: active methodologies, BPNs, compromise, educational innovation, engagement, gamification, motivation.

Introduction

The subject of Physical Education (PE) taught at school should be based on a curriculum adapted to the needs of the youngest and in accordance with social transformations. For example, PE aims to help pupils to optimally develop the motor, cognitive, social and emotional skills they need to lead a physically active life (McLennan & Thompson, 2015). To achieve this, unlike other subjects, PE already makes an extensive use of game as a didactic resource, being the cornerstone of this discipline (Normand & Burji, 2019).

Games have traditionally been considered as a form of entertainment (Yıldırım & Şen, 2019). In recent years, however, they have been at the heart of a growing trend in more formal environments such as industry and education (Dichev & Dicheva, 2017). The adoption of some mechanics, dynamics and components proper to games (Hanus & Fox, 2015; Werbach & Hunter, 2012) across a range of environments and/or contexts makes more formal, tedious and/or boring tasks more attractive. The inclusion of these new elements in the education system has brought about a relatively recent concept: gamification.

Gamification can be understood as the application of elements of game and video game principles and design to a learning environment so as to raise students' compromise, engagement and motivation levels (Buckley & Doyle, 2016; Dichev & Dicheva, 2017; Dicheva et al., 2015). In terms of its definition, gamification should not be confused with other similar terms, such as *serious games* or *game-based learning* (Sailer & Homner, 2020; Yıldırım & Şen, 2019). For example, *serious games* have serious aims about education before fun. Specifically, gamification transfers the mechanics and dynamics of games or video games to different contexts, such as the educational field, intended to augment or alter an existing learning process to create a version that users experience as game-like (Landers et al., 2018). While dynamics refer to restrictions, progression structure and narration technique, mechanics can be cooperation, challenge and competition. Generally, components (or aesthetics) within game design can be listed as point, badge, level, experience point, and leaderboards (Yıldırım & Şen, 2019).

Gamification or *gamified learning* (Armstrong & Landers, 2017) is becoming increasingly popular in educational contexts and its use has become more extensive across all subjects and levels. Nevertheless, a notable body of research has produced a variety of results and there is thus insufficient support to make substantiated claims about the effectiveness of gamification in education (Dichev & Dicheva, 2017). In line with this, empirical studies on gamification in PE are limited (Fernandez-Rio et al., 2020) varying greatly in their

methodology (sample size, educational stage, intervention duration, quantitative or qualitative results, etc.).

Some systematic reviews and meta-analyses on gamification in the educational context currently exist (Dichev & Dicheva, 2017; Kim & Castelli, 2021; Mora et al., 2017; Prieto-Andreu, 2020; Sailer & Homner, 2020; Yıldırım & Şen, 2019), but no review has specifically addressed the effects of gamified didactics on PE. In this regard, collecting the results of the experimental research carried out on the effects of gamified PE has relevance to the evolution of the subject and the future design of the gamified proposals in PE. In this context, the present review aims to answer the following research questions:

- (1) What benefits do PE students gain from a gamified learning?
- (2) What main features should gamified learning have to achieve these benefits in PE?

Method

This study was conducted in accordance with the PRISMA declaration, which includes a series of evidence-based criteria to report on systematic and meta-analysis reviews (Page et al., 2021).

Selection Criteria and/or Eligibility

Regarding the selection criteria, only articles written in English or Spanish were included, and no publication date restrictions were applied. To establish the rest of the inclusion criteria, we considered the PICOS acronym (Participants, Interventions, Comparisons, Outcomes, Study Design). Firstly, the study participants were students of any age, belonging to any educational stage. Secondly, studies directly related to a PE gamified teaching-learning technique were selected, since gamification should not be confused with *game-based learning* or *serious games* or *exergames*, despite some common characteristics. Studies on hybrid methodologies in gamification (e.g., Valero-Valenzuela et al., 2020), thesis and books' chapters were excluded. Thirdly, both the single-group studies and the ones with dual comparison groups were included. Fourthly, studies that demonstrated the advantages of gamification whether quantitatively or qualitatively, were considered. Finally, regarding the study design, pre-experimental, quasi-experimental, non-experimental (descriptive) and qualitative (narrative and research-action) studies were selected while studies understood to be reflections, proposals and didactical applications and/or educational experiences with no evaluation of processes or results were excluded.

Sources of Information and Search Strategy

The search was performed during the months of May and June 2022 in the following databases: open access databases (Dialnet, ERIC and Redalyc) and databases with restricted access (EBSCOhost, ProQuest: ERIC, SCOPUS and Web of Science). The keywords used in both languages (English and Spanish) were: *gamification*, *gamified* and *physical education*. These descriptors were deemed the most pertinent. Finally, two search strategies were selected, composed of the above terms, compound concepts (""), truncators (*) and Boolean operators (AND/OR): *gamifi** AND "*physical education*"; *gamifica** AND "*Educacion Fisica*".

Data Extraction and Quality Assessment Process

After having sorted the studies included in the review by means of the *RefWorks* bibliographic manager, the following data were extracted: design type, participants and characteristics, variables, measuring instruments and results obtained (Table 1, 2 and 3).

Results

Study Selection Process

The search in all databases produced a total of 646 documents. After having verified and discarded 569 duplicates, 77 were left. The full text of the remaining 76 documents underwent a more detailed analysis (authors read the title and abstract, and discussed it to agree on the characteristics of the papers to be included in the review). A total of 54 studies did not meet the inclusion criteria described above. Finally, a total of 22 studies ultimately met the inclusion criteria and were included in the review: seven articles were based on a qualitative methodology, seven were quantitative studies and eight were mixed methods (Figure 1).

Characteristics of the Studies

We describe the characteristics of the qualitative (Table 1), quantitative (Table 2), and mixed methods studies (Table 3) included in this review, following the PICOS acronym.

Figure 1
Prisma study selection flow chart.

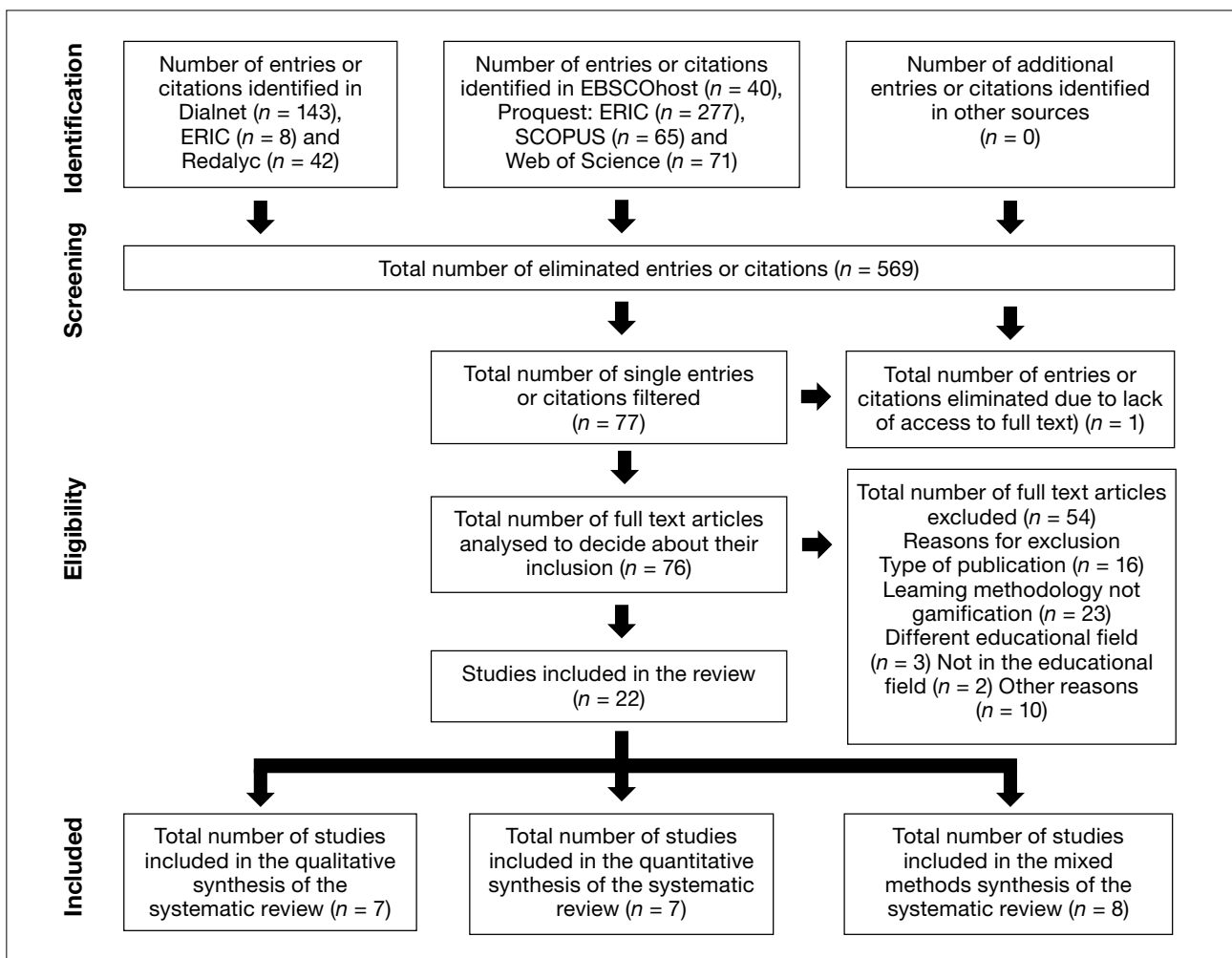


Table 1
Characteristics of qualitative studies included.

Reference	Research design	Sample	Sample characteristics	Variables	Instruments	Game-fiction (Length)
Arufe-Giráldez (2019)	Action-research	$N_s = 47$	Physical Education Teacher Education	Satisfaction, values formation, motivation, cooperative working, gamified experience	Open-ended and closed-ended questionnaire	<i>Fornite PE</i> (~1 hour)
Monguillot-Hernando et al. (2015)	Action-research	$N_s = 99$ $N_t = 2$	Secondary (2 nd)	Healthy heart rate, motivation, gamified experience	Open-ended and closed-ended questionnaire, Systematic monitoring, Focus group (teachers)	<i>Play the game</i> (~12 hours)
Pérez-López & Rivera (2017)	Narrative-Evaluative	$N_s = 69$	College students from sports sciences	Learning, classroom environment, methodology and assessment, gamified experience	Form	<i>The prophecy of the chosen ones</i> (~60 h)
Pérez-López et al. (2017)	Narrative-Evaluative	$N_s = 69$	College students from sports sciences	Learning, classroom environment, methodology and assessment, gamified experience	Form	<i>The Threat of the Sedentaris</i> (~60 h)
Pérez-López et al. (2019)	Narrative-Evaluative	$N_s = 59$	College students from sports sciences ($N_f = 16$; $N_m = 43$)	Feelings, gamified experience	Open-ended questionnaire	<i>Game of Thrones: the wrath of dragons</i> (~60 h)
Rutberg & Lindqvist (2018)	Action-research	$N_s = 32$ $N_t = 2$	Primary ($N_f = 15$; $N_m = 17$)	School transport active, motivation, learning, gamified experience	Focus group, Interview	Active School Transportation (four weeks)
Rouissi et al. (2020)	Action-research	$N_s = 102$	Secondary (3 rd - 4 th) and Bachelor (1 st) ($N_f = 53$; $N_m = 49$)	Satisfaction, (dis)advantages of gamified experience and gender	Interview	<i>Orienteering</i> (~2 hours)

N_s = Students sample; N_t = Teacher sample; N_f = Female sample; N_m = Male sample

Table 2
Characteristics and results of quantitative studies non-randomised included.

Reference	Research design (N)	Sample	Sample characteristics	Variables	Instruments	Game-fiction (Length)
Castañeda-Vázquez et al. (2019)	Pre-experimental single-group	$N_s = 64$	Physical Education Teacher Education ($N_f = 40$; $N_m = 24$)	Intrinsic motivation, extrinsic motivation and gamified experience	Questionnaire CEAM II	<i>Actijuegos Pentathlon</i> (~60 h)
Ferriz-Valero et al. (2020)	Quasi-experimental non-equivalent group	$N_{EG} = 62$ $N_{CG} = 65$	Physical Education Teacher Education ($N_f = 54$; $N_m = 73$)	Intrinsic motivation, extrinsic motivation, academic performance and gamified experience	Motivational Questionnaire CMEF	<i>ClassCraft</i> (~30 h)
Fernández-Río et al. (2022)	Quasi-experimental non-equivalent group	$N_{EG} = 27$ $N_{CG} = 27$	Secondary (3 rd) ($N_f = 26$; $N_m = 28$)	Intrinsic motivation, autonomy satisfaction, competence satisfaction, relatedness satisfaction, and intention to be physically active	Three motivational questionnaires: PLOC, Basic Psychological Needs and Intentions.	<i>Dragon Ball Z</i> (~14 h)
Martín-Moya et al. (2018)	Pre-experimental longitudinal single-group	$N_s = 30$	Bachelor (2 nd) ($N_f = 15$; $N_m = 15$)	Motivation, self-perceived and comparative motor competence, commitment to learning, anxiety and fear to failure, gamified experience	MLPE Questionnaire Sociodemographic questionnaire	<i>DiverHealth</i> (~10 h)
Serrano-Durá et al. (2021)	Quasi-experimental non-equivalent group	$N_{GE} = 17$ $N_{GC} = 19$	Secondary (1 st) ($N_f = 19$; $N_m = 17$)	Health and back care knowledge, mood state, perception of effort, gender, resistance of flexor and extensor muscles of the trunk.	Two theoretical questionnaires (COSACUES and COSACUES-AEF-), Feeling scale, OMNI scale, Three physical tests (Side bridge, Biering-Sørensen and Forearm plank)	Back health (~6 h)
Sotos-Martínez et al. (2022)	Quasi-experimental non-equivalent group	$N_{EG} = 133$ $N_{CG} = 142$	Secondary ($N_f = 127$; $N_m = 148$)	Basic Psychological Needs and motivation	Satisfaction for basic psychological needs (BPNES) and motivation (SMS-II spanish version)	<i>ClassCraft</i> (~10 h)
Real-Pérez et al. (2021)	Quasi-experimental non-equivalent group	$N_{EG} = 49$ $N_{CG} = 49$	Secondary (3 rd and 4 th) ($N_f = 58$; $N_m = 40$)	Support and satisfaction for basic psychological needs, motivation and motivational climate	Support (CANPB) and satisfaction for basic psychological needs (BPNES), motivation (CMEF) and motivational climate (PEPS; SSI-EF)	African dance (~10 h)

N_s = Students sample; N_f = Teacher sample; N_f = Female sample; N_m = Male sample; N_{EG} = Experimental group sample; N_{CG} = Control group sample; EG = Experimental group; CG = Control group

Table 3
Characteristics and results of the mixed method studies included.

Reference	Research design	Sample	Sample characteristics	Variables	Instruments	Game-fiction (Length)
Carrasco-Ramírez et al. (2019)	Pre-experimental static single-group action-research	$N_{EG} = 50$ $N_{CG} = 40$ $N_T = 2$	Bachelor	Academic performance, perception, motivation, teacher perception and gamified experience	Questionnaire, Exam, Evaluation report, Interview, Anecdotal register, Focus group	Basic physical qualities (~10 h)
Dólera-Montoya et al. (2021)	Quasi-experimental non-equivalent group action-research	$N_{EG} = 26$ $N_{CG} = 19$ $N_T = 2$	Primary (5 th) ($N_f = 18$; $N_m = 27$)	Perception, motivation, responsibility, violence, psychological needs, and emotional and social functioning	Questionnaires (BREQ-2; PSRQ; CUVECO; PNSE and EQ-i:YV), Interview, Student's diary	<i>Problem on the Island</i> (~4 h)
Fernández-Río et al. (2020)	Pre-experimental longitudinal single-group action-research	$N_S = 290$ $N_T = 4$	Primary and Secondary (only 1 st and 2 nd) ($N_f = 138$; $N_m = 152$)	Intrinsic motivation, gamified experience	Questionnaire Motivation Drawing, Focus group, Teacher diary	<i>MarvEF</i> (~25 h)
Flores-Aguilar et al. (2021)	Pre-experimental longitudinal single-group action-research	$N_S = 76$	College students from sports sciences	Motivation, engagement, academic performance, learning, gamified elements, ICT, cooperative learning and formative assessment.	Self-Questionnaire (11 items) and three open-ended questions.	Super Mario Bros (~60 h)
Ortega & Chacón (2022)	Pre-experimental longitudinal single-group action-research	$N_A = 111$	Secondary (1 st) ($N_f = 60$; $N_m = 51$)	Final grades, students' attitudes, motivation and work done	Class notebook, Rubric and Teacher's notebook	Harry Potter (~10 h)
Pérez-López et al. (2017)	Pre-experimental static single-group action-research	$N_{EG} = 73$ $N_{CG} = 75$	College students from sports sciences	Healthy lifestyles and gamified experience	Questionnaire Green Survey, Overall assessment (only EG)	<i>The prophecy of the chosen ones</i> (~60 h)
Quintero-González et al. (2018)	Pre-experimental single-group action-research	$N_S = 29$	Secondary (2 nd) ($N_f = 11$; $N_m = 18$)	Motivation, learning, prosocial attitudes, collaboration-cooperation, transfer of learning, gender and gamified experience	Questionnaire: Diana, Two open-ended questions	<i>ExpandEF</i> (~20 h)
Rodríguez-Martín et al. (2022)	Pre-experimental longitudinal single-group action-research	$N_S = 143$ (Only girls)	Primary (5 th and 6 th)	Anxiety about failure	Spanish AMPET questionnaire Four open-ending question	<i>The trip to Healthy Land</i> (~20 h)

N_S = Students sample; N_T = Teacher sample; N_f = Female sample; N_m = Male sample; N_{EG} = Experimental group sample; N_{CG} = Control group sample

Participants

The total sample consisted of 2,123 participants (2,095 students and 12 teachers) divided into: 481 participants (477 students and four teachers) from selected qualitative studies; 686 students from selected quantitative studies and 940 participants (938 students and eight teachers) from selected mixed methods studies. They included university students enrolled in the Teacher Education degree with a specialisation in PE ($n = 240$) and in the Physical Activity and Sport Sciences Degree ($n = 421$), high school students ($n = 1,031$), and Primary Education students ($n = 403$).

Interventions

Just one investigation was conducted in Sweden (Rutberg & Lindqvist, 2018). The remaining studies were conducted in different parts of Spain (A Coruña, Alicante, Barcelona, Ceuta, Granada, Madrid, Murcia, Seville and Tenerife).

The educational objectives of the included interventions were varied:

- to teach sport and recreation (Arufe-Giráldez, 2019; Castañeda-Vázquez et al., 2019; Ferriz-Valero et al., 2020; Quintero-González et al., 2018; Rouissi et al., 2020) or coexistence (Dólera-Montoya et al., 2021).
- to develop healthy behaviors (Monguillot-Hernando et al., 2015; Pérez-López et al., 2017b; Rutberg & Lindqvist, 2018).
- to develop competencies that help students become better teachers (Carrasco-Ramírez et al., 2019; Flores-Aguilar et al., 2021; Pérez-López et al. 2017a; Pérez-López & Rivera-García, 2017).
- to assess the feelings or motivation of students (Fernandez-Rio et al., 2020, 2022; Ferriz-Valero et al., 2020; Martín-Moya et al., 2018; Ortega-Jiménez & Chacón-Borrego, 2021; Pérez-López et al., 2019; Real-Pérez et al., 2021; Rodríguez-Martín et al., 2022; Sotos-Martínez et al., 2022).

Regarding the length of intervention, the average of all interventions is ~26.7 hours. Within the range of the selected studies, there are studies with interventions of only one or two hours (Arufe-Giráldez, 2019) and another of ~60 h (Castañeda-Vázquez et al., 2019; Pérez-López & Rivera-García, 2017). In total, five studies applied < 10 hours, 11 studies between 10-30 hours and six studies ~60 hours.

The design of a gamified experience can be applied from a superficial approach of Points, Badges and Leaderboards (PBL) or, instead, develop it through a deeper and complex model of mechanics, dynamics and components of the game (MDA). Of all the studies included in this review, only four studies use the PBL model (Carrasco-Ramírez et

al., 2019; Martín-Moya et al., 2018; Rouissi et al., 2020; Rutberg & Lindqvist, 2018). The rest of the studies, except Serrano-Durá et al. (2021) which is not determined, offer indications in their methodology to conclude that they follow an MDA model.

The learning content of PE worked with the student in the selected articles relate to physical condition and health ($n = 12$), sports and recreation ($n = 8$), outdoor and sustainability ($n = 8$), body expression ($n = 3$), and coexistence ($n = 1$). Some of these studies work several of these blocks in the same intervention (Pérez-López et al., 2019; Sotos-Martínez et al., 2022).

Finally, most studies implement gamification without technological resources, except Monguillot-Hernando et al. (2015), that use Google Sites as a virtual classroom, and Ferriz-Valero et al. (2020) and Sotos-Martínez et al. (2022), that carried out gamification with Classcraft®. Although other studies are considered not to use technological resources to implement gamification, some of them use them as a complement to teach (social networks, blogs, videos, QR codes, Kahoot, etc.).

Comparison

Firstly, the qualitative studies included did not compare gamification with any other intervention and/or methodology. Secondly, Castañeda-Vázquez et al. (2019) and Martín-Moya et al. (2018) were the only quantitative studies included that did not compare gamification to a traditional methodology. Finally, other investigations (Carrasco-Ramírez et al., 2019; Dólera-Montoya et al., 2021; Pérez-López et al., 2017a) were the only mixed methods studies that have compared gamified and traditional methodologies.

Outcomes

The most relevant results are summarized below. The variables evaluated were diverse.

(1) *Motivation (15 studies)*. All studies, after gamified intervention, claim to find an increase in student motivation except one (Carrasco-Ramírez et al., 2019), which claimed that teachers felt that motivation depends on the teacher and not the type of methodology used. Specifically, the studies that address motivation from the SDT framework observe positive aspects such as an increase in intrinsic motivation (Castañeda-Vázquez et al., 2019; Fernandez-Rio et al., 2020, 2022; Sotos-Martínez et al., 2022) or a decrease in amotivation (Dólera-Montoya et al., 2021; Sotos-Martínez et al., 2022). Other investigations (Castañeda-Vázquez et al., 2019; Ferriz-Valero et al., 2020) also observed an increase in extrinsic motivation. Although the study of

Ortega-Jiménez & Chacón-Borrego (2021) describes that a motivational questionnaire is used, no results or references of the instrument used are provided.

(2) *Learning and academic performance (10 studies)*.

Most studies reveal greater learning after gamified intervention. Some authors (Monguillot-Hernando et al., 2015; Pérez-López et al., 2017a) revealed that students positively appreciated the use of gamification as a strategy to learn ICT skills and healthy behaviors, especially in boys (Serrano-Durá et al., 2021). Others (Pérez-López et al., 2019; Pérez-López et al., 2017b; Pérez-López & Rivera-García, 2017) concluded that students were satisfied with learning and they highlighted students' acquisition of competences in terms of knowledge, know-how, life skills and attitudes. Castañeda-Vázquez et al. (2019) noted that 87.9% of students passed the subject in the first examination. Fernandez-Rio et al. (2020) noted that some students claimed to have learned during the experience. Finally, only two investigations (Carrasco-Ramírez et al., 2019; Ferriz-Valero et al., 2020) demonstrated a higher academic performance in gamified group.

(3) *Engagement (Nine studies)*. This variable is almost always accompanied by the term motivation. In fact, just a quantitative study (Martín-Moya et al., 2018) measures it specifically through a validated instrument such as the MLPE questionnaire, observing this improvement only in boys. All of them conclude that students' engagement improves with the gamified proposal. Specifically their commitment to physical activity (Arufe-Giráldez, 2019; Monguillot-Hernando et al., 2015) or to learning (Flores-Aguilar et al., 2021; Martín-Moya et al., 2018; Pérez-López et al., 2019; Quintero-González et al., 2018; Rodríguez-Martín et al., 2022; Rutberg & Lindqvist, 2018).

(4) *Teamwork component (seven studies)*. Arufe-Giráldez (2019) study concluded gamification was regarded as an effective tool for cooperation work. Rutberg and Lindqvist (2018) showed that links were created between the students after the gamified proposal. Rouissi et al. (2020) showed that student satisfaction appeared with the teamwork component (higher in girls). Dólera-Montoya et al. (2021) observed that students emphasized the interest in challenges and group work in the student's diary. Fernandez-Rio et al. (2020) highlighted that some students claimed to have worked as a team. Flores-Aguilar et al. (2021), Quintero-González et al. (2018) and Rodríguez-Martín et al. (2022) identified benefits regarding cooperative work following the implementation of the gamified treatment.

(5) *Class climate (five studies)*. All studies report improvements in class climate except one (Real-Pérez et al., 2021). Arufe-Giráldez (2019) study concluded that Fortnite PE was highly instrumental in preventing violent behaviors in the classroom despite the violent nature of the original game. In addition, the experience was regarded as an effective tool for cohesion among classmates. Dólera-Montoya et al. (2021) observed another very remarkable aspect which is that both treatment groups decreased the violence suffered. Pérez-López and Rivera-García (2017) concluded that the students progressed in their life skills competences as individuals and social beings. Pérez-López et al. (2017a) pointed to the achievement of a remarkably positive classroom atmosphere.

(6) *Basic Psychological Needs (Four studies)*.

Fernández-Río et al. (2022) and Sotos-Martínez et al. (2022) found improvement in all BPNs (autonomy, competence and relation). Instead, Dólera-Montoya et al. (2021) and Real-Pérez et al. (2021) did not observe any statistically significant differences in the BPNs' support and satisfaction although the authors argue a higher improvement in the gamified group.

(7) *Other variables*. In the study of Martín-Moya et al. (2018), the experimental group showed significant improvements in self-perceived motor competence (especially girls) and comparative motor competence (especially boys). Pérez-López et al. (2019) found that the implemented gamified learning methodology generated differences in feelings according to sex. Girls showed greater disappointment, enjoyment, emotion, stress, frustration, illusion, nervousness, satisfaction, and surprise. Instead, boys showed greater happiness, anxiety, confidence, and uncertainty. These differences remained constant throughout each stage of the experience and/or proposal (presentation, initial phase, mid-term phase, and final phase) except for an increase in enjoyment and satisfaction at the initial stage and a decline in satisfaction at the final stage. Rutberg and Lindqvist (2018) showed a change in family attitudes towards active school transport. Rouissi et al. (2020) and Fernandez-Rio et al. (2020) highlighted that most of students claimed to have a good time (enjoyment). Most students did not report any negative aspects of the gamification experience, only a few of them reported finding some difficulties in the tasks or lack of time to complete them. In this line, teachers claimed that gamification requires greater workload. In addition, they considered the narrative the most important factor and portfolio as a key element in the implementation of a gamified experience.

Design

Firstly, among the qualitative studies, four were designed based on an action-research tradition and/or methodology; three employed a narrative-evaluative methodology (Table 1). Secondly, all quantitative studies were based on a pre-experimental or quasi-experimental design. Five were cross-sectional in nature, and six were longitudinal (Table 2). Thirdly, according to mixed methods studies, as far as the quantitative component is concerned, all the studies were based on a pre-experimental and quasi-experimental design. Three were cross-sectional and five were longitudinal. As for the qualitative component, an action-research tradition and/or methodology was followed in all works (Table 3).

Discussion

Summary of the Evidence

We adopt Landers (2014) *theory of gamified learning* to lead the guiding thread of this discussion, unifying theory with practice. This theory explains that gamification can affect learning through one of two processes: a more direct mediating process or a less direct moderating process. For instance, many studies included in this review (Dólera-Montoya et al., 2021; Fernandez-Rio et al., 2020, 2022; Flores-Aguilar et al., 2021; Pérez-López et al., 2019; Pérez-López et al., 2017a; Pérez-López et al., 2017b; Pérez-López & Rivera-García, 2017; Quintero-González et al., 2018; Sotos-Martínez et al., 2022) using narrative as a game-fiction component. Although there is not enough information to determine exactly whether the narrative used serves to increase motivation (via moderation) or to increase learning of contents (via mediation) as well, all studies conclude that motivation is improved except one (Dólera-Montoya et al., 2021). Of the remaining research that does not use narrative as a gamified component, all works report an improvement in the student motivation (Arufe-Giráldez, 2019; Castañeda-Vázquez et al., 2019; Martín-Moya et al., 2018; Monguillot-Hernando et al., 2015; Rouissi et al., 2020; Rutberg & Lindqvist, 2018) except one (Carrasco-Ramírez et al., 2019) that relates to increased motivation to the novelty of the pedagogical approach (González-Cutre & Sicilia, 2019). Even though some authors believe the narrative is the highest conceptual level and the most significant feature of gamification (Dichev & Dicheva, 2017; Hanus & Fox, 2015; Werbach & Hunter, 2012), the results seem to indicate that the use of a narrative is not a moderating factor in applying gamified didactic in PE according to other meta-analysis studies performed with closely serious games (Wouters et al., 2013).

Gamification applications can be very varied, and there are many different game design elements that can

result in different affordances for learners, modes of social interactions, and learning arrangements (Sailer et al., 2017). Another example of this is the different models used (PBL vs MDA). In most cases, MDA includes the characteristics of PBL. Although the PBL model could respond to those teachers who are concerned that the application of gamified teaching requires excessive workload (Fernandez-Rio et al., 2020), being a simpler and easier model, most authors use the MDA model. According to this, some studies have claimed that the PBL model could generate excessive competitiveness, increased external regulation or even a decrease in interest (Blázquez-Sánchez & Flores-Aguilar, 2021; Ferriz-Valero et al., 2020; Werbach & Hunter, 2012). At this point of the gamification research in PE, it would be very speculative to reflect on which model is best in PE, since both show positive results of gamification. For instance, Rutberg and Lindqvist (2018) point out that the stickers (points and badges for achieving challenges) enhanced the motivation and engagement for the children, and many children wanted to bike to school even if the weather was bad. Although the age of the students could be a significant independent variable in this assertion, when students voluntarily proposed to participate in a gamified environment, one aspect that repeated in many studies, with examples from primary to college students, was the student engagement to challenges (Arufe-Giráldez, 2019; Carrasco-Ramírez et al., 2019; Castañeda-Vázquez et al., 2019; Dólera-Montoya et al., 2021; Fernandez-Rio et al., 2020; Monguillot-Hernando et al., 2015; Pérez-López et al., 2019; Pérez-López et al., 2017a; Pérez-López et al., 2017b; Pérez-López & Rivera-García, 2017; Quintero-González et al., 2018; Rouissi et al., 2020; Rutberg & Lindqvist, 2018) and, consequently, a greater self-perceived motor competence (Martín-Moya et al., 2018). In fact, in the Pérez-López et al. (2017b) study, a college student stated that: "The truth is that I recognize that my self-esteem has been reinforced, because I never thought I would be able to improve some lifestyles, and more importantly, to be able to help my girlfriend improve hers" (p. 947).

According to the previous paragraph, there is a key mechanic element (Werbach & Hunter, 2012) that we consider important to discuss: the feedback that students receive about their progress in gamified experience. Points, badges, levels, etc., help this goal through a portfolio (Fernandez-Rio et al., 2020), progress bar (Castañeda-Vázquez et al., 2019; Rutberg & Lindqvist, 2018; Serrano-Durá et al., 2021), tracking card or leaderboards (Arufe-Giráldez, 2019; Martín-Moya et al., 2018; Monguillot-Hernando et al., 2015; Pérez-López et al., 2019; Pérez-López et al., 2017a; Pérez-López et al., 2017b; Pérez-López & Rivera-García, 2017; Quintero-González et al., 2018; Rouissi et al., 2020) and, finally, using mobile apps (Ferriz-Valero et al., 2020).

These resources used to encourage student feedback are usually set up to direct players' actions towards concrete or desirable actions, and are closely linked to levels, and a specific number of points are required to move from level to level. As for the leaderboards, each participant can follow their progress in terms of performance level according to the goals presented in the activity. This means that the individuals involved are motivated to progress in their performance and increase competitiveness among them, as it also allows to observe how the others advance. At this last point, it is important to note that public exposure of leaderboards or scoreboards could cause discomfort in students, as there are aspects that have not been achieved and a non-constructive comparison between classmates could be favoured, avoiding another gamification benefit as a relaxed classroom atmosphere (Arufe-Giráldez, 2019; Dólera-Montoya et al., 2021; Pérez-López et al., 2017a; Pérez-López & Rivera-García, 2017) and/or teamwork.

A promising gamification design feature is collaboration work. All the studies mentioned in this review have included cooperative work in their PE gamified proposal, except two where this is not specifically indicated (Carrasco-Ramírez et al., 2019; Serrano-Durá et al., 2021). Collaboration can be manifested in many ways in gamified environments, but the important thing is that the interaction among students in a learning activity appears to have a durable effect on student learning outcomes (Sung et al., 2017) across educational settings (Huang et al., 2020). A common benefit in most of these research studies that include collaborative work is the increase in motivation of the student. A less investigated common benefit is improved commitment to physical activity (Arufe-Giráldez, 2019; Monguillot-Hernando et al., 2015), commitment to learning (Flores-Aguilar et al., 2021; Martín-Moya et al., 2018; Pérez-López et al., 2019; Quintero-González et al., 2018; Rodríguez-Martín et al., 2022; Rutberg & Lindqvist, 2018), the class climate (Arufe-Giráldez, 2019; Dólera-Montoya et al., 2021; Pérez-López et al., 2017a; Pérez-López & Rivera-García, 2017) and Basic Psychological Needs (Fernández-Río et al., 2022; Sotos-Martínez et al., 2022).

Besides that, positive results were also found in relation to the learning outcomes of content in PE (Carrasco-Ramírez et al., 2019; Fernandez-Rio et al., 2020; Ferriz-Valero et al., 2020; Monguillot-Hernando et al., 2015; PPérez-López et al., 2017b; Pérez-López & Rivera-García, 2017; Rutberg & Lindqvist, 2018; Serrano-Durá et al., 2021). Fitness and health is the block of instructional content which is common to all previous studies, except for Ferriz-Valero et al. (2020), where it was outdoor sports. However, according to the *theory of gamified learning*, instructional content could hide the success of gamification intervention. If the instructional

content does not already help students learn, gamification of that content cannot itself cause learning (Landers, 2014). Consequently, in order to implement effective gamification, the student must participate voluntarily and, therefore, feel a minimum pleasure towards the instructional content that they are going to learn.

Regarding the studies included in this review that compared gamified and traditional learning methodologies, differences were notably found with respect to the benefits for students. Firstly, the participants who performed their activity based on a gamified experience significantly improved their intrinsic motivation compared to those who did not (Fernandez-Rio et al., 2022; Sotos-Martínez et al., 2022). In contrast to these findings, studies such as that of Ferriz-Valero et al. (2020) on the effects of gamification in the context of PE teacher training showed a significant increase in extrinsic motivation. Apostol et al. (2013) argue that gamification allows both extrinsic and intrinsic motivation to be encouraged whenever it contains challenges to overcome, awakens the student's curiosity, allows the ability to control, and contains fantasy elements. In this way, according to the contributions of Hanus and Fox (2015), many studies recommend that caution be taken when seeking to increase students' intrinsic motivation, since the use of rewards, badges, etc., have been found to be counterproductive and diminish the intrinsic motivation of the most motivated and interested students (Deci et al., 2001; Deci & Ryan, 1985; Hanus & Fox, 2015). However, if properly implemented, it can contribute to the development of various positive effects in the educational context, such as a greater ability to concentrate on the task or higher levels of learning engagement (Aelterman et al., 2012; Ferriz-Valero et al., 2020; Hagger et al., 2003). On the other hand, the study of Carrasco-Ramírez et al. (2019) found no significant motivation differences between the control and experimental groups, although the latter presented greater engagement. Secondly, in relation to healthy lifestyle habits, the students participating in the gamification experience obtained a significant improvement compared to those who did not (Pérez-López & Rivera-García, 2017). In line with these results, the program on gamification and prevention of childhood obesity conducted by González et al. (2016) demonstrated its effectiveness relating to the adoption of healthy habits, significant differences in diet quality rates having been observed between the control and the experimental groups. Finally, differences, albeit not significant ones, were also encountered in terms of academic performance. Students who participated in the intervention achieved better results (Carrasco-Ramírez et al., 2019; Ferriz-Valero et al., 2020).

Limitations of the studies, the results and the review

Firstly, the methodological quality of the qualitative, quantitative, and mixed methods studies varied widely. Secondly, none of the quantitative and mixed methods studies included in the review guaranteed sample representativeness. The bias due to the non-response of some participants in the quantitative and mixed studies constituted an additional notable drawback. Regarding the mixed methods studies, the lack of integration of the qualitative and quantitative component in the vast majority of the studies generated a risk of result interpretation bias, which prevented attaining the robustness of the combination of both methods. Furthermore, the differences in quality between each study's qualitative and quantitative component led us to consider them of low quality. Finally, the quality of some criteria (complete results data and confounders) could not be adequately assessed due to lack of information in some studies.

The main limitation of the present work as a review article was the scarce number of publications on the use of gamification in PE in countries other than Spain, perhaps due to the novel nature and complex execution of such gamification. This does not mean that the topic is not relevant, since many articles are published in the most impact scientific journals in PE (Fernandez-Rio et al., 2020, 2022; Sotos-Martínez et al., 2022) and this is not happening in other gamification reviews in other subjects than PE (Yıldırım & Şen, 2019). Meta-analysis techniques were not used either. Finally, it is necessary to highlight that only four studies have shown differentiated results based on sex.

Conclusions/ Future Lines of Research

Regarding the benefits of gamification, the review showed that it was considered as a very useful tool to foster positive attitudes and behaviors in PE students (whenever the student participates voluntarily and is grateful for the instructional content) and, consequently, learning outcomes. In line with the findings of other authors, gamification is presented in the scientific literature as a pedagogical innovation capable of increasing students' engagement and motivation, autonomy (through continuous feedback), teamwork, as well as improving their learning.

On the one hand, the results analysed in this review point to the fact that the narrative is not a moderator element within the gamified design in PE. On the other hand, motivation, engagement, "pointification" (Huang et al., 2020) and feedback do seem to be mediators of gamified learning. However, gamification in education should not be

understood as a concept formed by juxtaposed features, but as a complex and global concept formed by elements interacting synergically within a continuous process. Consequently, gamification with all moderating/mediating elements may not be effective. Instead, a gamified design with all well-designed factors will find the best results. Therefore, more studies are suggested to analyse the interaction between these elements to establish stronger conclusions.

Most studies focusing on analysing the effects of gamification present very diverse methodological approaches; that is why the conclusions must be interpreted with caution. Despite having identified various studies with empirical evidence on the effectiveness of gamification in PE (significant increases in intrinsic motivation, benefits regarding academic performance, notable improvements in healthy lifestyle habits, etc.), many studies show low methodological rigor.

Further relevant empirical research is thus needed to examine other variables that may be affected by the methodology (i.e., sex differences, relationship between moderating/mediating factors, use of technology) in the benefits of PE gamification and to ultimately confirm the effectiveness of this active learning methodology in PE. We hope this review has reflected the potential of gamification to continue to advance in our knowledge of quality education for our PE area and all future students.

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