EFFECTS OF GAMIFICATION AND COOPERATIVE LEARNING IN PHYSICAL EDUCATION TEACHER TRAINING

EFECTOS DE LA GAMIFICACIÓN Y EL APRENDIZAJE COOPERATIVO EN LA FORMACIÓN DEL PROFESORADO DE EDUCACIÓN FÍSICA

Gonzalo Flores-Aguilar[1], *Miguel Ángel Oviedo-Caro*[1], *Pablo Saiz-Gonzaléz*[2], *José Enrique García del Moral*[3], *Javier Fernandez-Rio*[2]

[1] Department of Physical Education and Sports, Faculty of Education Sciences, University of Seville, España

[2] Department of Educational Sciences. Faculty of Teacher Training and Education, University of Oviedo, España

[3] Department of Didactics of Musical, Plastic and Corporal Expression, Faculty of Humanities and Educational Sciences, University of Jaén, España

Autor para la correspondencia:
Enrique García del Moral, jemoral@ujaen.es

Título Abreviado:
Effects of Gamification and Cooperative Learning in Physical Education Teacher Training

How to cite this article:
Flores-Aguilar, G., Oviedo-Caro, M.A., Saiz-González, P., García del Moral, J.E. & Fernández-Río, J. (2025). Effects of gamification and cooperative learning in physical education teacher training. *Cultura, Ciencia y Deporte, 20*(65), 2446. http://doi.org/10.12800/ccd.v20i65.2446

Received: 27 february 2025 / **Accepted:** 24 june 2025

Abstract

The aim of this study was to evaluate the impact of a gamified-cooperative project on achievement goals, basic psychological needs, and the perception of autonomy support in the initial training of Physical Education teachers. A total of 132 fourth year students from a university in southern Spain were divided into three groups (gamified-cooperative, cooperative, and traditional). The study followed a quasi-experimental, pre-test post-test design (10 and 12 weeks, 1.5 hours per week). Perceived autonomy support, basic psychological needs, and 3x2 achievement goals of the participants were assessed. The gamified-cooperative group experienced significant improvements in reducing comparison with other students and in procedural autonomy support. The cooperative group also showed improvements in organizational and procedural autonomy support, while the control group improved in the perception of competence. Although there is a need for further research to maximize the educational potential of these approaches in higher education, this study reveals that the implementation of gamification along with cooperative learning can reduce comparison among students and increase the perception of autonomy, which is associated with positive outcomes for students.

Keywords: Gamification, higher education, cooperative learning, physical education teacher training, pedagogical models.

Resumen

El objetivo de este estudio fue evaluar el impacto de un proyecto gamificado-cooperativo sobre las metas de logro, las necesidades psicológicas básicas y la percepción del apoyo a la autonomía en la formación inicial del profesorado de Educación Física. Un total de 132 estudiantes de cuarto curso de una universidad en el sur de España se dividieron en tres grupos (gamificado-cooperativo, cooperativo y tradicional). El estudio siguió un diseño cuasi-experimental, pre-test post-test (10 y 12 semanas, 1.5 horas semanales). Se evaluaron el apoyo percibido a la autonomía, las necesidades psicológicas básicas y las metas de logro 3x2 de los participantes. El grupo gamificado-cooperativo experimentó mejoras significativas en la disminución de la comparación con otros estudiantes y en el apoyo a la autonomía procedimental. El grupo cooperativo también mostró mejoras en el apoyo a la autonomía organizativa y procedimental, mientras que el grupo control mejoró en la percepción de competencia. Aunque existe la necesidad de realizar más investigaciones para maximizar el potencial educativo de estos enfoques en la educación superior, este estudio revela que la implementación de la gamificación junto con el aprendizaje cooperativo puede reducir la comparación entre estudiantes y aumentar la percepción de autonomía, lo que se asocia con consecuencias positivas para los estudiantes.

Palabras clave: Gamificación, educación superior, aprendizaje cooperativo, formación del profesorado de educación física, modelos pedagógicos.

Introduction

There is currently a certain consensus regarding the consideration of Physical Education (PE) as an essential subject for the holistic-integral development of students (at cognitive, physical-motor, affective-emotional, social, and cultural levels) (Pill et al., 2024), the promotion of physical activity, and the adoption of a healthy lifestyle that persists throughout adulthood

(Hills et al., 2015). However, despite its theoretical and curricular evolution, its educational value has historically been questioned (Quennerstedt, 2019). Since its inception, PE has maintained a low educational and social status (Schempp, 1993), as its teaching has focused almost exclusively on three recognisable aspects: a) free play (absence of learning); b) technical instruction of certain hegemonic sports; and c) physical fitness work (Kirk, 2017). The latter two follow a mechanistic and biological approach (Tinning, 2002), with directive and analytical methodologies (training) centred on the teacher (Pill, 2016), as well as subjective, summative, and penalising evaluation systems (López et al., 2016). Traditionally, this "physical" rather than "educational" approach has decontextualised learning through PE and has led to the marginalisation of those students (girls, immigrants, disabled individuals, etc.) (Flintoff & Scraton, 2001; Toohey et al., 1999) who did not fit into hegemonic masculinity (Nilges, 1998). Undoubtedly, this has caused some students to demonstrate demotivation towards the subject (Ntoumanis, 2001), which they remember negatively due to adverse experiences during their educational trajectory (Aniszewski et al., 2019; Fernández-Río & Saiz-González, 2023), an issue that worsens with secondary education students (girls), some of whom categorise it as "humiliating, frustrating, embarrassing, and barely tolerable" (Portman, 1995). Given the urgent need for reconstruction of this discipline (Velázquez-Buendía, 2007), the scientific community advocates for an urgent rethinking of its teaching (Pérez-Pueyo & Hortigüela-Alcalá, 2020) that should also permeate teacher training. As indicated by Flores-Aguilar et al. (2023), the real transfer of new methodologies in the school of the future depends, in part, on their practical and theoretical experience in initial teacher training (higher education).

Among all existing methodological approaches, recent research assigns a relevant role to Pedagogical Models (PM), such as gamification and Cooperative Learning (CL), since their application tends to increase student protagonism, facilitating a set of successful experiences that satisfy their needs and maintains and/or increases their motivation (Fernández-Río & Saiz-González, 2023), thus benefiting their holistic-integral development (Casey & Kirk, 2021). The emergence of gamification in the educational field has gained special interest in the last decade in Spain, particularly in the field of PE and teacher training. Originating in the business world, gamification consists of introducing the main elements of games into non-recreational environments (Werbach & Hunter, 2012), with the ultimate intention of generating a change in user (player) behavior (Zichermann & Cunningham, 2011). In the educational field, and due to the presence of significant terminological imprecisions, Fernández-Río and Flores-Aguilar (2019, p.11) define it as an emerging PM "that uses game elements to develop specific curricular content within a context, which includes tasks and activities adapted to game dynamics to achieve the proposed educational objectives, and not simply for fun". Although current research is still inconclusive, some reviews reveal positive effects at all educational levels of PE, such as decreased demotivation and increased intrinsic motivation of students, increased autonomy, responsibility, social relationships, as well as improved commitment and learning in the subject, among others (Arufe-Giráldez et al., 2022; Camacho-Sánchez et al., 2023; Ferriz-Valero et al., 2023; Mercan & Varol Selçuk, 2024). Regarding initial PE teacher training, the results are also encouraging: a) improvement of intrinsic motivation and decrease in demotivation (Sotos-Martínez et al., 2024); b) increase in academic performance and external regulation (Ferriz-Valero et al., 2020); c) improvement of intrinsic motivation and commitment to the subject (academic performance) (Flores-Aguilar et al., 2021; Liu & Lipowski, 2021); d) increase in intrinsic and self-determined motivation, basic psychological needs, and CL (Pérez-Muñoz et al., 2022); e) generation of feelings of satisfaction and enjoyment and increased motivation and commitment (Pérez-López et al., 2017); f) among other improvements, such as at the physical level (Mora-González et al., 2022; Pérez-López et al., 2017; Sañudo et al., 2024). Even so, Arufe-Giráldez et al. (2022) call for more research to maximize the educational potential of gamification in higher education.

With extensive experience in primary and secondary education, albeit somewhat less in the university setting (Barceló-Cerdá et al., 2024; León et al., 2011), CL is a consolidated PM where the involved students and teachers learn and co-learn based on a teaching and learning approach that enhances their group interaction and positive interdependence (Fernández-Río, 2021). To implement it appropriately, it is essential to create small, stable, and heterogeneous groups, but also to incorporate five basic elements (positive interdependence, face-to-face promotive interaction, individual accountability, group processing, and social skills) (Johnson et al., 2013), as well as two key elements (equal participation and simultaneous interaction) (Kagan, 1994). Some of the main existing reviews indicate that CL in PE causes improvements in students at physical, cognitive, social, and affective levels (Bores-García et al., 2021; Casey & Goodyear, 2015), and even at motivational levels (Goodyear et al., 2014), especially if hybridised with other models (Casey & MacPhail, 2018). In fact, in the experience of Flores-Aguilar et al. (2021), CL and gamification were hybridised in future PE teachers, causing an increase in commitment and motivation towards the subject among participating students, although they ended up negatively evaluating the creation of heterogeneous groups.

On the other hand, Achievement Goal Theory (Nicholls, 1984) is one of the main frameworks used to understand individual motivation in achievement contexts. According to Barkoukis et al. (2024), achievement goals directly influence participation and motivation levels in PE classes. This theory identifies two types of achievement goals (dichotomous model) (Elliott & Dweck, 1988): task orientation (mastery) and ego orientation (performance). Subsequently, Elliot and McGregor (2001) proposed a 2x2 achievement goal framework in which mastery goals, like performance goals, can be separated into approach and avoidance categories, proposing four types of goals: mastery-approach, mastery-avoidance, performance-approach, and performance-avoidance. Lastly, Elliot et al. (2011) proposed the 3x2 model, which includes six different goals: a) task-approach; b) task-avoidance; c) self-approach; d) self-avoidance; e) other-approach; and f) other-avoidance. Different PE teaching approaches can lead to increases or decreases in one or more of these goals.

Another widely used theory for understanding motivation is Self-Determination Theory (Deci & Ryan, 1985), which integrates several mini-theories, including the Basic Psychological Needs Theory (BPN). This theory identifies three fundamental innate needs for well-being: autonomy, competence, and relatedness (Ryan & Deci, 2002). In the present study, particular emphasis has been placed on autonomy, given that previous research has shown that educational contexts that promote it tend to generate higher levels of intrinsic motivation, well-being, and student engagement (Vansteenkiste et al., 2010; Martela & Ryan, 2021; Standage et al., 2003). Moreover, it has been observed that autonomy support acts as a key factor in self-regulated learning, which justifies its specific analysis within the framework of this research. This also occurs with the use of gamification and CL (Fernández-Río et al., 2017; Ferriz-Valero et al., 2020; Martín-Moya et al., 2018; Sotos-Martínez et al., 2024).

Within this motivational framework, it is worth mentioning the relevance of perceived autonomy support through the presence of a teaching structure (before, during, and after the activity) that provides guidance addressing students' problems and desires (Vansteenkiste et al., 2010). Traditionally, autonomy support is linked to three different dimensions: a) organizational: refers to choice opportunities in the environment (i.e., team, space, lesson structure, etc.); b) cognitive: refers to students' ownership of their learning (i.e., opportunities to discuss students' own solution routes, use of self-assessment and peer assessment...); and c) procedural: refers to choice opportunities in "form" (i.e., means used to present data, procedure used to demonstrate competence...) (Stefanou et al., 2004). It should be noted that teacher autonomy has been positively related to perceived self-efficacy, job satisfaction, empowerment, and a positive work environment (Parker, 2015). According to Wermke et al. (2019), teacher autonomy is an important, almost magical ingredient for successful schooling and professional development, so it should begin to be promoted in initial teacher training.

At this point, the aims of this study were to evaluate the impact of a gamified-cooperative project compared to a cooperative approach and a traditional approach in initial PE teacher training, on students' 3x2 achievement goals, satisfaction of basic psychological needs, and their perception of support for their autonomy.

Material and Methods

Design

A quasi-experimental study was carried out, comprising two experimental groups (Gamification#Cooperative and Cooperative) and one control group, with pre-test and post-test measurements (Dimitrov & Rumrill, 2003).

Participants

A total of 132 students enrolled in the subjects “Didactics of Physical Education” and “Teaching of Physical Education II” at a university in southern Spain participated. The sample comprised 58 men (43.9%) and 74 women (56.1%) aged between 20 and 57 years (M = 22.58, SD = 4.70). Of the total sample, 33 students (25%) aged between 20 and 27 years (M = 21.85, SD = 1.44) constituted the gamified#cooperative group (GE1), 63 students (47.7%) aged between 21 and 30 years (M = 22.13, SD = 2.01) the cooperative group (GE2), and 36 students (27.3%) aged between 21 and 57 years (M = 24.06, SD = 8.40) the control group (GC). All sessions were implemented by one of the authors of this article, who has extensive practical and research experience with all the implemented pedagogical models.

Instruments

Met Achievement Goals. The Spanish#validated version (Méndez#Giménez et al., 2014) of the 3x2 Achievement Goal Questionnaire (Elliot et al., 2011) was used. It comprises 18 items grouped into six factors: Task#approach (e.g., "Answering many questions correctly in this class's examinations"), Task#avoidance (e.g., "Avoiding incorrect answers in this class's examinations"), Self#approach (e.g., "Performing better in this class's examinations than I usually do in similar situations"), Self#avoidance (e.g., "Avoiding performing worse in this class's examinations than I have in previous ones"), Other#approach (e.g., "Surpassing other students in this class's examinations"), and Other#avoidance (e.g., "Avoiding performing worse than other students in this class's examinations"). Participants responded to the stem: "In the examinations of this subject, my goal is..." on a 7#point Likert scale, with 1 indicating "strongly disagree" and 7 "strongly agree." Cronbach's alphas were: Task#approach: .79 and .85, Task#avoidance: .78 and .78, Self#approach: .85 and .86, Self#avoidance: .82 and .80, Other# approach: .92 and .93, and Other#avoidance: .93 and .92. All values are very satisfactory.

Basic Psychological Needs. The Satisfaction subconstruct from the Spanish#validated version (Longo et al., 2018) of the Basic Psychological Needs Satisfaction and Frustration Scale (Longo et al., 2016) was used. This Likert#type instrument includes nine items with seven response options (ranging from "strongly disagree" to "strongly agree"), in which participants self#reported the satisfaction of their autonomy (e.g., "I feel that I have the freedom to decide how to do things"), competence (e.g., "I feel that I am quite good at what I do"), and relatedness (e.g., "I feel that the people around me care about me"). In the present study, Cronbach's alphas were autonomy: .87 and .89, competence: .84 and .88, and relatedness: .76 and .83. Again, all values are very satisfactory.

Perceived Autonomy Support. The scale by Burgueño et al. (2020) was used, which includes 15 items and three subconstructs introduced by the phrase "My teacher...": cognitive autonomy support (e.g., "Shows interest in our ideas"), procedural autonomy support (e.g., "Explains why we learn certain exercises"), and organizational autonomy support (e.g., "Allows me to perform exercises using different methods"). In the present study, Cronbach's alphas were cognitive autonomy support: .93 and .88, procedural autonomy support: .92 and .89, and organizational autonomy support: .93 and .84. All values are very satisfactory.

Programme

Following Hastie and Casey's (2014) guidelines, the basic characteristics regarding the implementation of the models are as follows:

A. Curricular Elements

The learning objectives and didactic content included in the teaching projects of the two subjects involved in this research are described in Table 1. As can be seen, these are almost identical in both subjects.

Table 1

Learning Objectives and Contents of the Teaching Projects of the Subjects Involved

Subject: Teaching of Physical Education II / Grade: Physical Activity and Sports Sciences / Group: GE1	
Learning objectives	**Contents**
1. To become aware of the importance of programming in Physical Education and to reflect on the role of the teacher in this phase of the Teaching in order to improve this teaching function in the E.S.O and Bachillerato. 2. To know the necessary aspects for the programming around Physical Education in E.S.O. and Bachillerato. 3. To acquire the fundamental concepts of evaluation in Physical Education in E.S.O. and Bachillerato. 4. To perfect the different elements of the didactic intervention in Physical Education. 5. To improve the knowledge, skills and attitudes to carry out the teaching-learning process of the activities related to Physical Education. 6. To expand the knowledge about the different methodologies of Physical Education teaching applied in this educational stage and be able to adapt them to the characteristics and needs	Lesson 1. Physical Education in the 21st century: historical review and future directions Lesson 2. Planning and programming Lesson 3. Pedagogical models: consolidated and emerging Lesson 4. Evaluation in Physical Education: What, how and when to evaluate?

Subject: Didactics of Physical Education / Grade: Primary Education / Groups: GE2 y GC	
Learning objectives	**Contents**
1. To reflect on the role of physical education in the 21st century and the role of its teachers. 2. Elaborate a didactic unit and program a PE session according to the educational legislation. 3. Conduct a practical PE session based on the appropriate teaching competences for classroom management. 4. To know the necessary tools to evaluate PE from a formative point of view. 5. To know some of the main innovative pedagogical models used in physical education sessions.	Lesson 1. Physical Education in the XXI century: where to go? Lesson 2. The evaluation in Physical Education: what, who, when and how to evaluate? Lesson 3. The programming in the classroom: the Programming Units. · Didactic bases for the preparation, management and evaluation for the practice. · Methodologies and innovative pedagogical models

B. Implementation Details of the Models

Gamified-Cooperative program. In GE1, the gamified project "Jurassic World: The Journey Home" was implemented. Drawing inspiration from this film saga and based on recommendations from other gamified projects (Fernández-Río & Flores-Aguilar, 2019; Fernández-Río, 2021; Flores-Aguilar et al., 2021), the basic elements utilised are presented in Table 2. For the hybridisation of the experience with Cooperative Learning, the seven basic elements of Cooperative Learning (Johnson et al., 2013; Kagan, 1994) were followed, in addition to the phases and basic strategies of the "Cooperative Learning cycle" (phase 1: group creation and cohesion; phase 2: Cooperative Learning as content for teaching and learning; and phase 3: Cooperative Learning as a resource for teaching and learning) (Fernández-Río, 2017). Moreover, stable and heterogeneous groups of four were formed, with rotating roles assigned throughout the process. Finally, in this experience, the cooperative strategy "think-share-act" (Velázquez-Callado et al., 2014) was employed.

Table 2

Basic Elements of Gamification

NARRATIVE

After the theatrical release of the last of the sequels entitled "Jurassic World: Dominion" (2022), the chosen narrative was as follows:

For some years now, dinosaurs have been living in harmony with humans on planet Earth. Due to climate change, many natural areas of the world, as well as many dinosaur species, are beginning to disappear at a dizzying rate. Dr. Ellie Sattler, as representative of the Prehistoric Fauna department, is looking for teams to participate in the great mission: to rescue all those dinosaur species that are still alive around the world and bring them back home (Isla Nublar - the only place out of danger for these prehistoric animals). Which team will be able to find a dinosaur and bring it back home alive?

Project logo

PLAYERS and TEAMS

Heterogeneous groups/teams of four members were created. To increase affinity and sense of belonging, the teams chose their own names, designed their shields, and managed the rotation and application of the functions of each of the team roles: secretary, facilitator, auditor, interlocutor. Finally, each member of the group signed a written contract of commitment to work cooperatively as a group.

Example of a shield

MISSIONS AND CHALLENGES

Based on the timing of the subject and the curricular contents, this experience consisted of four missions and eleven challenges:

(1) Mission Europe: teams must travel through Europe in search of dinosaurs, (2) Mission Biosyn Valley: teams must go to the Valley to save dinosaurs in danger, (3) Mission Isla Sorna: teams go to the island upon the warning of sightings of other species, (4) Mission Isla Nublar: teams transport all the captured dinosaurs to set them free.

(1) Challenge 1: Introduction of the didactic unit, justification of the innovation, and use of scientific articles, (2) Challenge 2: Curricular information, (3) Challenge 3. Learning objectives, (4) Challenge 4: Methodology and pedagogical models, (5) Challenge 5: Timing, (6) Challenge 6: PE session, (7) Challenge 7: Timing, (8) Challenge 8: Evaluation indicators, (9) Challenge 9: Checklist, (10) Challenge 10: Rubric, (11) Final Challenge: Breakout- EDU.

Example of mission and challenges

REWARDS, GOODS AND EXPERIENCE POINTS

Points -Tranquilizer darts: correspond to quantitative score for the successful completion of each challenge. They are small feedback that only makes sense within the game (the more darts you get the bigger the dinosaurs captured), therefore, they do not correspond to the task qualification. In order to pass each mission it is essential to get a minimum number. Otherwise, the deadline for corrections (Insert coin) is extended.

Experience points - Amber eggs: these rewards were obtained after successful completion of optional tasks. Three amber eggs are allowed to obtain a scratch card with individual advantages-privileges, such as eliminating a question in the written test, obtaining a bonus, etc.

Badges - Journey Notebook: after overcoming each of the missions (successful completion of the challenges) and depending on the score obtained (darts obtained), the teams can capture up to three types of dinosaurs. When this is the case, the teams get a sticker with the image of the captured dinosaur, which they must place in the Journey Notebook.

Amber Eggs

Journey Notebook complete with all badges

SPECIAL EVENTS

This experience included a combat between teams of kahoots (The Rebellion) and a Breakout EDU (Final Challenge), through which students had to overcome against the clock some conceptual challenges of the subject.

DIPLOMAS

Diploma: upon completion of the gamification program, all students received a diploma.

Cooperative program. In GE2, the same dimensions, phases, and basic Cooperative Learning strategies detailed in the previous section were used, along with the "icebreaker", "collective outcome" and "puzzle" strategies (Aronson et al., 1978). In this group, stable and heterogeneous groups of four were also created, with rotating roles applied throughout the process.

Traditional program. The GC followed a more traditional methodology in which the teacher adopted an approach dominated by directive styles and task assignment (Bowler, 2011; Metzler, 2017). In contrast to the previous programmes, the teacher monopolised the entire teaching and learning process, being solely responsible for the selection, organisation, and presentation of tasks, in addition to the evaluation (solely hetero-evaluation). Working groups were randomly formed and changed weekly.

C. Context Description

The gamified-cooperative project (GE1) was designed and implemented within the theoretical credits of the subject "Teaching of Physical Education II" in the fourth year of the Bachelor's Degree in Physical Activity and Sport Sciences, which was delivered in the first semester (from September to December) of the 2022/2023 academic year: 12 weeks (3.5 theoretical hours per week).

The cooperative and traditional projects (GE2 and GC) were designed and implemented within the theoretical credits of the subject "Didactics of Physical Education II" in the fourth year of the Bachelor's Degree in Primary Education, which was delivered in the second semester (from January to April) of the 2022/2023 academic year: 10 weeks (3.5 theoretical hours per week).

Procedure

Firstly, permission was obtained from the university's ethics committee by one of the researchers. Secondly, the project was explained in detail to the students during the first class. They were informed that they could choose the traditional approach (and leave the project) at any point during the semester. The students willing to participate signed a written informed consent form. Data protection and confidentiality were guaranteed.

All participants were treated in accordance with the ethical considerations of the American Psychological Association (2010): voluntary participation, anonymity of responses, complete confidentiality, freedom to withdraw from the study at any time, and no influence of responses on students' grades. A data collection protocol was designed to be consistent across all groups and to be conducted in the same week. A member of the research team administered the data collection, during which no class teacher was present (to avoid influencing the participants).

Statistical Analysis

All data were analysed using the statistical package SPSS 22.0. As normality tests indicated that the data did not meet the assumptions of normality, non-parametric statistics were employed. Specifically, a Friedman test was conducted to determine whether significant differences existed between groups and across time points. Subsequently, post hoc analyses were carried out using the Wilcoxon signed-rank test for intra-group comparisons and the Mann-Whitney U test for inter-group differences. Effect sizes (Cohen, 1998) were calculated using the partial eta-squared (η^2_p), statistic, with values being interpreted as small (> .01), medium (> .06) and large (> .14). Statistical significance was established at $p \leq .05$ (95% *CI*).

Results

Firstly, the Friedman test results showed significant differences between groups, with a chi-square value of 873.474 and a *p-value* < .00, indicating that significant differences existed between groups and time points. Subsequently, post hoc analyses were conducted to identify intra-group differences using the Wilcoxon signed-rank test and inter-group differences using the Mann–Whitney U test. The results of these analyses are presented below (Table 3).

Table 3

Analysis of Intra-Group and Intergroup Comparisons

	Pre - Intervention (GE1)	Post - Intervention (GE1)		Pre - Intervention (GE2)	Post - Intervention (GE2)		Pre - Intervention (GC)	Post - Intervention (GC)	
	M (DE)	*M (DE)*	*p*	*M (DE)*	*M (DE)*	*p*	*M (DE)*	*M (DE)*	*p*
Approach - Task	6.25 (0.87)	6.03 (1.16)	.25	6.43 (0.77)	6.29 (0.98)	.12	6.34 (0.87)	6.36 (0.84)	.82
Avoidance - Task	6.13 (1.21)	5.91 (1.20)	.16	6.09 (1.05)	6.07 (1.18)	.46	6.13 (1.12)	6.22 (1.05)	.74
Approach - Ego	6.30 (0.95)	6.10 (1.08)	.16	6.26 (0.91)	6.31 (0.89)	.61	6.08 (1.00)	6.20 (0.84)	.41
Avoidance - Ego	6.06 (1.37)	5.86 (1.46)	.49	5.85 (1.39)	6.02 (1.12)	.36	5.78 (1.25)	5.81 (1.03)	.90
Approach - Other	3.94 (1.67)	2.70 (1.67)[2]	.00**	3.98 (1.89)[3]	3.56 (1.89)[1]	.04**	3.12 (1.85)[2]	3.45 (2.16)	.34
Avoidance - Other	4.31 (1.99)	3.02 (1.75)[2]	.00**	4.72 (1.75)[3]	4.12 (1.91)[1]	.00**	3.81 (2.09)[2]	3.72 (2.16)	.84
Autonomy	5.81 (0.72)	5.97 (0.77)	.21	6.03 (1.05)	5.69 (1.29)	.05	5.82 (1.06)	5.65 (1.44)	.63
Competence	5.28 (0.78)[2]	5.32 (0.76)[2]	.62	5.66(0.90)[3],[1]	5.71 (1.03)[1]	.43	5.28 (0.91)[2]	5.66 (0.97)	.01**
Relationship	5.57 (0.97)	5.78 (0.74)	.18	6.01 (0.99)	5.85 (1.15)	.45	5.82 (0.94)	5.99 (1.03)	.16
Cognitive Autonomy Support	6.27 (0.56)	6.31 (0.80)	.40	5.84 (1.22)	6.03 (0.98)	.56	6.06 (0.83)	6.13 (0.85)	.98
Procedural Autonomy Support	6.13 (0.59)	6.43 (0.66)	.03**	5.77 (1.18)	6.17 (0.89)	.00**	6.04 (0.88)	6.10 (0.85)	.64
Organizational Autonomy Support	5.85 (0.71)	6.06 (0.85)	.12	5.35 (1.32)	5.86 (0.97)	.00**	5.59 (1.09)	5.87 (0.86)	.22

Note. Intragroup analyses before and after the intervention are indicated by two asterisks (**) when $p < .05$. Intragroup differences were analyzed using the Wilcoxon statistic and intergroup differences using the Mann-Whitney U statistic. Numerical superscripts represent intergroup differences two by two, with GE1 group represented by [1], GE2 by [2] and GC by [3].

Intra-Group Analysis

Secondly, intra-group analyses were carried out. It was found that the Gamified-Cooperative group (GE1) showed significant improvements in Other-approach (Z = - 3.38, p = .00) and Other-avoidance (Z = - 3.22, p = .00), with lower scores in the post-test. Additionally, a significant increase was observed following the implementation of the hybridisation in procedural autonomy support (Z = - 2.13, p = .03) for this same group. On the other hand, the Cooperative group (GE2) significantly improved its perception of procedural autonomy support (Z = - 2.89, p = .00) and organisational autonomy support (Z = - 2.87, p = .00), reporting higher post-test scores. Moreover, those who experienced a Cooperative Learning based approach (GE2), showed significant differences in Other-approach (Z = - 2.05, p = .04) and Other-avoidance (Z = - 3.10, p = .01), with lower post-test scores, indicating a significant improvement in the students' readiness to tackle tasks. Finally, the Control group exhibited significant improvements for the competence variable (Z = - 2.51, p = .01).

Inter-Group Analysis

Next, inter-group comparisons were conducted. Firstly, we reviewed the variables which showed significant differences between groups before implementing the different interventions of this study (pre-test). It was found that between the Gamified-Cooperative group (GE1) and the Cooperative group (GE2) there were significant differences in the competence variable (U = 744.50, p = .02), with higher values for the Cooperative group (GE2). Following the development of both interventions, these differences remained in favour of the Cooperative group (U = 726.00, p = .02), indicating that the groups were not homogeneous at baseline and that their differences persisted after the interventions. When comparing the Gamified-Cooperative group (GE1) and the Control group (GC), no significant differences were found for any of the variables analysed before educational interventions. Finally, a comparison between the Cooperative group (GE2) and the Control

group (GC) revealed significant differences in the variables Other-approach, Other-avoidance, and competence (indicating that the groups were not homogeneous before the study). Specifically, for both Other-approach and Other-avoidance, the Cooperative group (GE2) reported a significantly higher pre-test score (U = 832.50, p = .03 and U = 851.00, p = .04, respectively) than the Control group (GC). However, when analysing the post-test scores, no significant differences were observed (U = 1080.50, p = .70 and U = 1007.00, p = .35); this can be explained by the significantly lower values obtained by the Cooperative group (GE2) in the intra-group analyses (while the Control group (GC) maintained stable scores). Concerning competence, although significant differences were observed in the pre-test scores (U = 855.00, p = .04) in favour of the Cooperative group (GE2), the post-test results indicated that no differences existed between these two groups (U = 1076.50, p = .67). This is explained by the intra-group improvements observed in the Control group (GC) compared to the stable values found for the Cooperative group (GE2).

Subsequently, differences between groups were analysed for the post-test scores of all variables that were homogeneous before the educational interventions. Thus, between the Gamified-Cooperative group (GE1) and the Cooperative group (GE2), significant differences were found for the Other-approach variable, with the Gamified-Cooperative group (GE1) obtaining a significantly lower post-test score than the cooperative group (U = 764.00, p = .03), indicating that the Gamified-Cooperative group (GE1) improved significantly more after the intervention (i.e. achieved a lower mean score). It is noteworthy that, although both groups significantly improved their scores in the intra-group analyses, these inter-group comparisons indicated a substantially greater improvement in the Gamified-Cooperative group. Similarly, for Other-avoidance at the post-test, the Gamified-Cooperative group (GE1) demonstrated a significantly greater improvement than the Cooperative group (GE2) (U = 687.50, p = .01), despite both groups having significantly improved their scores relative to their pre-test values. Finally, comparisons of post-test values between the Gamified-Cooperative group (GE1) and the Control group (GC), as well as between the Cooperative group (GE2) and the Control group (GC), yielded no significant differences for any of the variables

Discussion

The aim of this study was to evaluate the impact of a gamified-cooperative project in comparison with a cooperative and a traditional approach in the initial training of future Physical Education teachers, focusing on the 3x2 achievement goals of the students, the satisfaction of basic psychological needs, and their perception of autonomy support. The results revealed improvements and differences in only some of the evaluated variables: a decrease in Other-approach and Other-avoidance, and in procedural autonomy support in the Gamified-Cooperative (GE1) and Cooperative (GE2) groups (with the first group showing a significantly greater reduction in the first two variables), an increase in organisational autonomy support in the Cooperative group (GE2), and an improvement in competence in the Control group (GC).

The main findings of the study demonstrate that the implementation of an intervention applying gamification alongside CL, as well as an intervention solely based on CL, alters students' perceptions regarding the achievement goals promoted in the training of future teachers. The results indicate that both approaches succeed in reducing comparisons with other students (performing better than or avoiding performing worse than them). Indeed, the essential elements of CL (positive interdependence, face-to-face promotive interaction, individual accountability, group processing, social skills, equal participation, and simultaneous interaction) (Johnson et al., 2013; Kagan, 1994), promote mutual assistance among students, the development of interpersonal skills, collaborative task execution, and positive connections among classmates to achieve the proposed learning objectives. All these factors cause the "student focus" to shift from viewing peers as competitors to regarding them as collaborators in their learning. Recently, an other-referenced achievement orientation (Other-approach and Other-avoidance) has been directly linked to social derogation (Thomas, 2022), which negatively affects peer relationships and classroom climate. Therefore, the present study's results indicate that incorporating CL in the training of future teachers significantly reduces student comparisons. Recent reviews have suggested that the use of CL may be beneficial in this context, as it promotes the development of content knowledge, pedagogical content knowledge, personal, interpersonal, and transversal skills, as well as professional competencies (Fernández-Río et al., 2022).

The data obtained showed that the reduction in both other-referenced orientations (Other-approach and Other-avoidance) was significantly greater in the group that experienced the combination of gamification and CL (GE1). Thus, the gamified environment appears to amplify the positive effects fostered by CL. There are few studies that have hybridised both approaches in the university context, but Flores-Aguilar et al. (2021) found that the combination of CL and gamification in future PE teachers led to an increase in commitment and motivation towards the subject among participating students.

These results, together with the present findings, seem to indicate that in a gamified and cooperative context, students forget to compare themselves with their peers and instead direct their focus onto the task at hand and on themselves. Hence, the implementation of gamification and CL in teaching and learning processes favours the development of educational settings that reduce the perception of achievement goals that promote interpersonal performance comparisons, thereby creating a learning environment focused on personal development. This is significant, as previous studies have shown that educational interventions fostering interpersonal performance comparisons are associated with adverse consequences in the teaching and learning process (Liu et al., 2017). Research on gamification in higher education has demonstrated its effectiveness in promoting intrinsic motivation (Sotos-Martínez et al., 2024), academic performance (Ferriz-Valero et al., 2020), subject commitment (Liu & Lipowski, 2021; Flores-Aguilar et al., 2021), and the generation of feelings of satisfaction and enjoyment (Pérez-López et al., 2017). The present study's results seem to indicate that the reduction in "other focus" in favour of focusing on the task and on the self may explain the benefits of the environment created by gamification and CL. Although this interpretation remains speculative, further research is needed.

Regarding the support for students' autonomy, the Gamified-Cooperative group (GE1) significantly increased procedural autonomy support, while the Cooperative group (GE2) also enhanced organisational autonomy support. These findings suggest that CL is a differentiating factor in the development of students' procedural autonomy, enabling them to make decisions about how to respond to the various challenges and stimuli proposed in the activity, as well as providing opportunities to debate and test different responses to achieve the set objective, thus affecting the procedural dimension of autonomy (Stefanou et al., 2004). Similarly, through the processes involved in CL, students' perceptions of organisational autonomy are also enhanced, as they gain the ability to make decisions regarding elements such as equipment, space, and materials utilised in learning activities. Elements of CL such as individual accountability in collective work, positive interdependence, and group processing (Johnson et al., 2013) foster both procedural and organisational autonomy among students. This is very important because previous studies have shown that educational environments promoting procedural autonomy are associated with the initiation and regulation of learning behaviours (Vansteenkiste et al., 2012), as well as with increased student motivation and engagement in the learning process (Stroet et al., 2013). Therefore, the implementation of gamification and CL in teaching and learning processes favours the development of educational contexts that support student autonomy, promoting participatory processes that allow students to be involved throughout the learning process, making decisions their own and adapting them as necessary. Such supportive educational environments have been linked to higher intrinsic motivation and enhanced competency quality among students (Chapman & Rich, 2018; Haerens et al., 2015).

Finally, regarding basic psychological needs, the traditional learning group (GC) was the only one that improved its perception of one of these needs: competence. This improvement may perhaps be attributed to the so-called "Hawthorne effect," whereby control groups experience improvements owing to the perception of being observed or evaluated (Adair, 2000). It is worth noting that previous studies have found that gamified environments in university training enhance students' basic psychological needs (Pérez-Muñoz et al., 2022), yet the present study did not indicate any such improvements. Likewise, although CL has been shown to be an effective pedagogical approach for increasing all basic psychological needs in secondary students (Palau-Pamies et al., 2022), this underscores the need for further research in the university context.

Conclusions

The results of this study indicate that CL can significantly reduce future PE teachers' perception of achievement goals, reducing the focus on interpersonal performance comparisons (such as performing better than or avoiding performing worse than their peers). Moreover, when this approach is combined with gamification, the reduction is even more pronounced. In addition, this combination increases students' perceptions of procedural autonomy support, while the use of CL alone only augments organisational autonomy support. Therefore, both gamification and CL can improve students' perceptions of autonomy, which is associated with positive outcomes for this group.

Despite the valuable evidence regarding the effects of gamification and CL in the training of future PE teachers, this work presents some limitations. One limitation is the absence of long-term follow-up to assess the persistence of the observed effects. Future studies should undoubtedly include longitudinal designs to examine the sustainability of these benefits over time. Additionally, the research was conducted within a single university context, which may limit the generalisability of the results to other institutions or educational levels. In fact, it would also be useful to explore the implementation of these approaches in different educational contexts and with diverse student populations to validate and expand upon the current findings. Furthermore, the university degree programmes were not the same across the three groups studied, with, for

example, a two-week difference between GE1 and groups GE2 and GC. In this sense, incorporating other universities where the same subjects are taught within the same degree programmes could be of particular interest. Finally, it is recommended to investigate the combination of gamification and CL with other pedagogical models to maximise their educational impact at all levels.

Ethics Committee Statement

The study was conducted in accordance with the Declaration of Helsinki and was approved by the Ethics Committee: University of Vic-Central University of Catalonia (010-2021).

Conflict of Interest Statement

There are no conflicts of interest.

Funding

There are no funding.

Authors' Contribution

Conceptualization G.F.A. & J.F.R; Methodology M.A.O.C, P.S.G .& J.F.R; Formal Analysis M.A.O.C, P.S.G. & J.F.R Investigation G.F.A., M.A.O.C, P.S.G., J.E.G.M. & J.F.R; Resources G.F.A. & J.F.R.; Data Curation M.A.O.C, P.S.G., & J.F.R.; Writing – Original Draft G.F.A. & J.F.R.; Writing – Review & Editing G.F.A. & J.F.R; Visualization J.E.G.M; Supervision J.E.G.M. All authors have read and agreed to the published version of the manuscript.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author jemoral@ujaen.es

References

Adair, J. G. (2000). Hawthorne effect. In A. E. Kazdin (Ed.), *Encyclopedia of psychology* (Vol. 4, p. 66). Oxford University Press. https://doi.org/10.1037/10519-030

Aniszewski, E., Henrique, J., Oliveira, A. J. de, Alvernaz, A., & Vianna, J. A. (2019). Motivation in physical education classes and satisfaction of competence, autonomy and relatedness. *Journal of Physical Education, 30*, e3052–e3052. https://doi.org/10.4025/jphyseduc.v30i1.3052

Aronson, E., Blaney, N., Sikes, J., Stephan, C., & Snapp, M. (1978). *The jigsaw classroom*. Sage Publications.

Arufe-Giráldez, V., Sanmiguel-Rodríguez, A., Ramos-Álvarez, O., & Navarro-Paton, R. (2022). Gamification in Physical Education: A Systematic Review. *Education Sciences, 12*(8). https://doi.org/10.3390/educsci12080540

Barceló-Cerdá, M. L., López-Gómez, E., Poveda-García-Noblejas, B., & Gómez, I. R. (2024). The views of trainee teachers on the application of cooperative learning at university. *Educar, 60*(2), 553–568. https://doi.org/10.5565/rev/educar.2074

Barkoukis, V., Grasten, A., Huhtiniemi, M., & Jaakkola, T. (2024). Developmental relations of achievement goals and affect in physical education. *Psychology of sport and exercise, 75*. https://doi.org/10.1016/j.psychsport.2024.102700

Bores-García, D., Hortigüela-Alcalá, D., Fernández-Río, J., González-Calvo, G., & Barba-Martín, R. (2021). Research on Cooperative Learning in Physical Education. Systematic Review of the Last Five Years. *Research quarterly for exercise and sport, 92*(1), 146–155. https://doi.org/10.1080/02701367.2020.1719276

Bowler, M. (2011). Instructional Models for Physical Education. *Journal of pedagogic development, 1*(1).

Burgueño, R., Macarro-Moreno, J., & Medina-Casaubon, J. (2020). Psychometry of the Multidimensional Perceived Autonomy Support Scale in Physical Education with Spanish Secondary School Students. *SAGE OPEN, 10*(1). https://doi.org/10.1177/2158244019901253

Casey, A., & Goodyear, V. A. (2015). Can Cooperative Learning Achieve the Four Learning Outcomes of Physical Education? A Review of Literature. *Quest, 67*(1), 56–72. https://doi.org/10.1080/00336297.2014.984733

Casey, A., & Kirk, D. (2020). *Models-based Practice in Physical Education* (1st ed.). Routledge. https://doi.org/10.4324/9780429319259

Casey, A., & MacPhail, A. (2018). Adopting a models-based approach to teaching physical education. *Physical education and sport pedagogy, 23*(3), 294–310. https://doi.org/10.1080/17408989.2018.1429588

Chapman, J. R., & Rich, P. J. (2018). Does educational gamification improve students' motivation? If so, which game elements work best? *Journal of education for business, 93*(7), 314–321. https://doi.org/10.1080/08832323.2018.1490687

Cohen, J. (1998). *Statistical Power Analysis for the Behavioral Sciences Second Edition*. Lawrence Erlbaum Associates.

Deci, E. L., & Ryan, R. M. (1985). The general causality orientations scale - self-determination in personality. *Journal of research in personality, 19*(2), 109–134. https://doi.org/10.1016/0092-6566(85)90023-6

Dimitrov, D. M., & Rumrill, P. D. J. (2003). Pretest-posttest designs and measurement of change. *Work (Reading, Mass.), 20*(2), 159–165.

Elliot, A. J., & McGregor, H. A. (2001). A 2 x 2 achievement goal framework. *Journal of personality and social psychology, 80*(3), 501–519. https://doi.org/10.1037//0022-3514.80.3.501

Elliot, A. J., Murayama, K., & Pekrun, R. (2011). A 3 x 2 Achievement Goal Model. *Journal of educational psychology, 103*(3), 632–648. https://doi.org/10.1037/a0023952

Elliott, E. S., & Dweck, C. S. (1988). Goals - an approach to motivation and achievement. *Journal of personality and social psychology, 54*(1), 5–12. https://doi.org/10.1037/0022-3514.54.1.5

Fernández-Río, J. (2017). The Cooperative Learning Cycle: a guide to effectively implement cooperative learning in physical education. *Retos-nuevas tendencias en educación física deporte y recreación, 32*, 264–269.

Fernández-Río, J. (2021). Aprendizaje cooperativo. In A. Pérez Pueyo, D. Hortigüela and J. Fernández-Río (coords.). *Modelos pedagógicos en Educación Física: qué, cómo, por qué y para qué* (pp. 26–49). Universidad de León.

Fernández-Río, J., Sanz, N., Fernández-Cando, J., & Santos, L. (2017). Impact of a sustained Cooperative Learning intervention on student motivation. *Physical Education and Sport Pedagogy, 22*(1), 89–105.

Fernández-Río, J., & Flores-Aguilar, G. (2019). Gamificando la Educación Física. De la teoría a la práctica en Educación Primaria y Secundaria. In J. Fernández-Río (coord.). *Fundamentación teórica de la Gamificación* (pp. 9–18). Universidad de Oviedo.

Fernández-Río, J., Rivera-Pérez, S., & Iglesias, D. (2022). Cooperative learning interventions and associated outcomes in future teachers: A systematic review. *Revista de psicodidáctica, 27*(2), 118–131. https://doi.org/10.1016/j.psicod.2022.04.002

Fernández-Río, J., & Saiz-González, P. (2023). Educación Física con Significado (EFcS). Un planteamiento de futuro para todo el alumnado. *Revista Española de Educación Física y Deportes, 437*(4), 1–9.

Ferriz-Valero, A., Osterlie, O., García Martínez, S., & García-Jaén, M. (2020). Gamification in Physical Education: Evaluation of Impact on Motivation and Academic Performance within Higher Education. *International journal of environmental research and public health, 17*(12). https://doi.org/10.3390/ijerph17124465

Ferriz-Valero, A., Agullo-Pomares, G., & Tortosa-Martínez, J. (2023). Benefits of Gamified Learning in Physical Education Students: A Systematic Review. *Apunts educación física y deportes, 153*, 39–51. https://doi.org/10.5672/apunts.2014-0983.es.(2023/3).153.04

Ferriz-Valero, J., García-Martínez, A., & Tortosa-Martínez, S. J. (2024). The effects of gamification on the motivation and basic psychological needs of secondary school physical education students. *Physical education and sport pedagogy, 29*(2), 160–176. https://doi.org/10.1080/17408989.2022.2039611

Flintoff, A., & Scraton, S. (2001). Stepping into active leisure? Young women's perceptions of active lifestyles and their experiences of school physical education. *Sport education and society, 6*(1), 5–21. https://doi.org/10.1080/713696043

Flores-Aguilar, G., Fernández-Río, J., & Prat-Grau, M. (2021). Gamificating physical education pedagogy. College students' feelings. *Revista Internacional de Medicina y Ciencias de La Actividad Física y Del Deporte, 21*(83), 515–533.

Flores-Aguilar, G., Prat-Grau, M., Fernández-Gavira, J., & Muñoz-Llerena, A. (2023). "I Learned More Because I Became More Involved": Teacher's and Students' Voice on Gamification in Physical Education Teacher Education. *International Journal of Environmental Research and Public Health, 20*(4). https://doi.org/10.3390/ijerph20043038

Goodyear, V. A., Casey, A., & Kirk, D. (2014). Hiding behind the camera: social learning within the Cooperative Learning Model to engage girls in physical education. *Sport education and society, 19*(6), 712–734. https://doi.org/10.1080/13573322.2012.707124

Haerens, L., Aelterman, N., Vansteenkiste, M., Soenens, B., & Van Petegem, S. (2015). Do perceived autonomy-supportive and controlling teaching relate to physical education students' motivational experiences through unique pathways? Distinguishing between the bright and dark side of motivation. *Psychology of sport and exercise, 16*(3), 26–36. https://doi.org/10.1016/j.psychsport.2014.08.013

Hastie, P. A., & Casey, A. (2014). Fidelity in Models-Based Practice Research in Sport Pedagogy: A Guide for Future Investigations. *Journal of teaching in physical education, 33*(3), 422–431. https://doi.org/10.1123/jtpe.2013-0141

Hills, A. P., Dengel, D. R., & Lubans, D. R. (2015). Supporting Public Health Priorities: Recommendations for Physical Education and Physical Activity Promotion in Schools. *Progress in cardiovascular diseases, 57*(4), 368–374. https://doi.org/10.1016/j.pcad.2014.09.010

Johnson, D., Johnson, R., & Holubec, E. (2013). *Cooperation in the Classroom* (9th ed.). Interaction Book Company.

Kagan, S. (1994). *Cooperative learning*. Kagan Cooperative Learning.

Kirk, D. (2017). Teaching games in physical education: Towards a pedagogical model. *Revista Portuguesa de Ciências Do Desporto, 17*, 17–26.

León, B., Felipe, E., Iglesias, D., & Latas, C. (2011). El aprendizaje cooperativo en la formación inicial del profesorado de Educación Secundaria. *Revista de Educación (Madrid), 354*(1), 715-729.

Liu, T., & Lipowski, M. (2021). Sports Gamification: Evaluation of Its Impact on Learning Motivation and Performance in Higher Education. *International journal of environmental research and public health, 18*(3). https://doi.org/10.3390/ijerph18031267

Liu, J., Xiang, P., Lee, J., & Li, W. (2017). Developing physically literacy in K-12 physical education through achievement goal theory. *Journal of Teaching in Physical Education, 36*(3), 292–302. https://doi.org/10.1123/jtpe.2017-0030

Longo, Y., Alcaraz-Ibánez, M., & Sicilia, A. (2018). Evidence supporting need satisfaction and frustration as two distinguishable constructs. *Psicothema, 30*(1), 74–81. https://doi.org/10.7334/psicothema2016.367

Longo, Y., Gunz, A., Curtis, G. J., & Farsides, T. (2016). Measuring Need Satisfaction and Frustration in Educational and Work Contexts: The Need Satisfaction and Frustration Scale (NSFS). *Journal of happiness studies, 17*(1), 295–317. https://doi.org/10.1007/s10902-014-9595-3

López-Pastor, V., Pérez, D., Manrique, J., & Monjas, R. (2016). Los retos de la Educación Física en el Siglo XXI. *Retos. Nuevas Tendencias En Educación Física, Deporte y Recreación, 29*, 182–187.

Martela, F., & Ryan, R. M. (2021). In selecting measures for a comprehensive assessment of well-being, it is essential to include indicators of psychological need satisfaction. *Preventive medicine reports, 23*. https://doi.org/10.1016/j.pmedr.2021.101474

Martín-Moya, R., Ruiz-Montero, P. J., Capella-Peris, C., & Chiva-Bartoll, Ò. (2018). Achievement motivation for learning in physical education students: Diverhealth. *Interamerican Journal of Psychology, 52*(2), 273–283.

Méndez-Giménez, A., Cecchini-Estrada, J.-A., & Fernández-Río, J. (2014). Examinando el modelo de metas de logro 3x2 en el contexto de la Educación Física. *Cuadernos de Psicología Del Deporte, 14*(3), 157–168.

Mercan, G., & Varol Selçuk, Z. (2024). Investigating the Impact of Game-Based Learning and Gamification Strategies in Physical Education: A Comprehensive Systematic Review. *Journal of Interdisciplinary Education: Theory and Practice, 6*(1), 1–14. https://doi.org/10.47157/jietp.1389843

Metzler, M. (2017). *Instructional models for physical education (3rd ed.).* Routledge.

Mora-González, J., Navarro-Mateos, C., & Pérez-López, I. J. (2022). "STAR WARSTM: The First Jedi" Gamification Program: Improvement of Fitness Among College Students. *Journal of teaching in physical education*. https://doi.org/10.1123/jtpe.2021-0309

Nilges, L. M. (1998). I thought only fairy tales had supernatural power: A radical feminist analysis of Title IX in physical education. *Journal of teaching in physical education, 17*(2), 172–194. https://doi.org/10.1123/jtpe.17.2.172

Ntoumanis, N. (2001). A self-determination approach to the understanding of motivation in physical education. *British journal of educational psychology, 71*, 225–242. https://doi.org/10.1348/000709901158497

Palau-Pamies, M., Garcia-Martínez, S., Ferriz-Valero, A., Tortosa-Martínez, J., & Valero, A. F. (2022). Impact of cooperative learning on physical education in basic psychological needs. *Revista internacional de medicina y ciencias de la actividad física y deporte, 22*(88), 787–806.

Parker, G. (2015). Teachers' autonomy. *Research in education, 93*(1), 19–33. https://doi.org/10.7227/RIE.0008

Pérez-López, I. J., Rivera García, E., & Delgado-Fernández, M. (2017). Improvement of healthy lifestyle habits in university students through a gamification approach. *Nutrición Hospitalaria, 34*(4), 942–951. https://doi.org/10.20960/nh.669

Pérez-Muñoz, S., Muñoz, A. S., De Mena Ramos, J. M., & Rodríguez-Cayetano, A. (2022). Mario and Sonic at the Olympic Games: Effect of Gamification on Future Physical Education Teachers. *Applied sciences-basel, 12*(19). https://doi.org/10.3390/app12199459

Pérez-Pueyo, A., & Hortigüela-Alcalá, D. (2020). Is innovation always positive in Physical Education? Reflections and practical considerations. *Retos. Nuevas Tendencias En Educación Física, Deporte y Recreación, 37*, 579–587.

Pill, S. (2016). Exploring challenges in australian physical education curricula past and present. In *Journal of Physical Education & Health, 5*(7), 5-17.

Pill, S., SueSee, B., & Davies, M. (2024). The Spectrum of Teaching Styles and models-based practice for physical education. *European Physical Education Review, 30*(1), 142–155. https://doi.org/10.1177/1356336X231189146

Portman, P. A. (1995). Who is having fun in physical education classes? Experiences of sixth-grade students in elementary and middle schools. *Journal of Teaching in Physical Education, 14*, 445–453.

Quennerstedt, M. (2019). Physical education and the art of teaching: transformative learning and teaching in physical education and sports pedagogy. *Sport, Education and Society, 24*(6), 611–623. https://doi.org/10.1080/13573322.2019.1574731

Ryan, R., & Deci, E. (2002). Overview of self-determination theory: An organismic dialectical perspective. In Edward L. Deci and Richard M. Ryan (Ed.), *Handbook of self-determination research* (pp. 3–33). Rochester University Press.

Sañudo, B., Sánchez-Trigo, H., Domínguez, R., Flores-Aguilar, G., Sánchez-Oliver, A., Moral, J. E., & Oviedo-Caro, M. (2024). A randomized controlled mHealth trial that evaluates social comparison-oriented gamification to improve physical activity, sleep quantity, and quality of life in young adults. *Psychology of sport and exercise, 72*. https://doi.org/10.1016/j.psychsport.2024.102590

Schempp, P. G. (1993). Constructing professional knowledge - a case-study of an experienced high-school teacher. *Journal of teaching in physical education, 13*(1), 2–23. https://doi.org/10.1123/jtpe.13.1.2

Sotos-Martínez, V., Baena-Morales, S., Sánchez-De Miguel, M., & Ferriz-Valero, A. (2024). Playing towards Motivation: Gamification and University Students in Physical Activity! *Education sciences, 14*(9). https://doi.org/10.3390/educsci14090965

Standage, M., Duda, J., & Ntoumanis, N. (2003). Predicting motivational regulations in PE: The interplay between dispositional goal orientations, motivational climate and perceived competence. *Journal of Sport Science, 21*, 631–647.

Stefanou, C. R., Perencevich, K. C., DiCintio, M., & Turner, J. C. (2004). Supporting autonomy in the classroom: Ways teachers encourage student decision making and ownership. *Educational psychologist, 39*(2), 97–110. https://doi.org/10.1207/s15326985ep3902_2

Stroet, K., Opdenakker, M.-C., & Minnaert, A. (2013). Effects of need supportive teaching on early adolescents' motivation and engagement: A review of the literature. *Educational research review, 9*, 65–87. https://doi.org/10.1016/j.edurev.2012.11.003

Thomas, C. L. (2022). Predicting test anxiety using the 3x2 achievement goal model. *International journal of school & educational psychology, 10*(2), 232–242. https://doi.org/10.1080/21683603.2020.1816237

Tinning, R. (2002). Engaging siedentopian perspectives on content knowledge for physical education. *Journal of teaching in physical education, 21*(4), 378–391. https://doi.org/10.1123/jtpe.21.4.378

Toohey, K. M., Taylor, T. L., & Vescio, J. A. (1999). An exploration of sports participation by girls from non-English speaking backgrounds. *ACHPER Australia Healthy Lifestyles Journal, 46*(2–3), 14–19.

Vansteenkiste, M., Niemiec, C. P., & Soenens, B. (2010). The development of the five mini-theories of self-determination theory: an historical overview, emerging trends, and future directions. In T. C. Urdan & S. A. Karabenick (Eds.) *Decade ahead: theoretical perspectives on motivation and achievement* (Vol. 16, pp. 105–165). https://doi.org/10.1108/S0749-7423(2010)000016A007

Vansteenkiste, M., Sierens, E., Goossens, L., Soenens, B., Dochy, F., Mouratidis, A., Aelterman, N., Haerens, L., & Beyers, W. (2012). Identifying configurations of perceived teacher autonomy support and structure: Associations with self-regulated

learning, motivation and problem behavior. *Learning and instruction, 22*(6), 431–439. https://doi.org/10.1016/j.learninstruc.2012.04.002

Velázquez-Buendía, R. (2007). ¿Qué educación física? ¿Qué educación? *Tándem: Didáctica de la Educación Física, 23*, 7–17.

Velázquez-Callado, C., Fraile Aranda, A., & López Pastor, V. M. (2014). Cooperative learning in Physical Education. *Movimento, 20*(1), 239–259.

Werbach, K., & Hunter, D. (2012). *For the win: how game thinking can revolutionize your business*. Wharton Digital Press.

Wermke, W., Rick, S. O., & Salokangas, M. (2019). Decision-making and control: perceived autonomy of teachers in Germany and Sweden. *Journal of curriculum studies, 51*(3), 306–325. https://doi.org/10.1080/00220272.2018.1482960

Zichermann, G., & Cunningham, C. (2011). *Gamification by Design: Implementing Game Mechanics in Web and Mobile Apps*. O'Reilly Media.