sustainability

Article

Influence of Virtual Reality and Gamification Combined with Practice Teaching Style in Physical Education on Motor Skills and Students' Perceived Effort: A Mixed-Method Intervention Study

Diego Fernández-Vázquez [1,2], Víctor Navarro-López [1,2,*], Roberto Cano-de-la-Cuerda [1,2], Domingo Palacios-Ceña [1,3], María Espada [1], Daniel Bores-García [1,3], José Manuel Delfa-de-la-Morena [1] and Nuria Romero-Parra [1,4]

1 Department of Physiotherapy, Occupational Therapy, Rehabilitation and Physical Medicine, Faculty of Health Sciences, Universidad Rey Juan Carlos, 28921 Madrid, Spain; diego.fernandez@urjc.es (D.F.-V.); roberto.cano@urjc.es (R.C.-d.-l.-C.); domingo.palacios@urjc.es (D.P.-C.); maria.espada@urjc.es (M.E.); daniel.bores@urjc.es (D.B.-G.); jose.delfa@urjc.es (J.M.D.-d.-l.-M.)
2 Movement Analysis, Biomechanics, Ergonomics, and Motor Control Laboratory, Faculty of Health Sciences, Universidad Rey Juan Carlos, 28922 Madrid, Spain
3 Research Group of Humanities and Qualitative Research in Health Science of Universidad Rey Juan Carlos (Hum&QRinHS), Department of Physical Therapy, Occupational Therapy, Rehabilitation and Physical Medicine, Universidad Rey Juan Carlos, 28922 Madrid, Spain
4 LFE Research Group, Department of Health and Human Performance, Faculty of Physical activity and Sports Science, Universidad Politécnica de Madrid, 28040, Madrid, Spain
* Correspondence: victor.navarro@urjc.es; Tel.: +34-914-888-913

check for updates

Citation: Fernández-Vázquez, D.; Navarro-López, V.; Cano-de-la-Cuerda, R.; Palacios-Ceña, D.; Espada, M.; Bores-García, D.; Delfa-de-la-Morena, J.M.; Romero-Parra, N. Influence of Virtual Reality and Gamification Combined with Practice Teaching Style in Physical Education on Motor Skills and Students' Perceived Effort: A Mixed-Method Intervention Study. *Sustainability* **2024**, *16*, 1584. https://doi.org/10.3390/su16041584

Academic Editor: David González-Gómez

Received: 4 December 2023
Revised: 8 February 2024
Accepted: 11 February 2024
Published: 14 February 2024

Copyright: © 2024 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (https://creativecommons.org/licenses/by/4.0/).

Abstract: This mixed-method study examined the impact of combining virtual reality (VR) and gamification (GAM) with the practice teaching style (PTS) on students' motor skills and perceived effort in physical education. Participants (n = 75) were divided into three groups: PTS (control), PTS + GAM and PTS + GAM + VR. Each group had two one-hour sessions per week for six weeks. Participants' motor skills and perceived effort were evaluated quantitatively and qualitatively using tests such as the SportComp Motor, flamingo and plate-tapping tests, as well as the handgrip strength test and the Pictorical Children's Effort Rating Table. The results indicate that the PTS group reported a higher perceived effort compared to the other groups ($p < 0.001$). All study groups exhibited improvements in the handgrip strength ($p < 0.001$) and flamingo ($p < 0.05$) tests, while lateral jump test improvements were observed only in the two GAM groups ($p < 0.001$). The VR group showed an improvement in the plate-tapping tests ($p < 0.001$), while the PTS group exhibited a decline in the displacement with support test ($p < 0.05$). Participant perceptions suggest that the activity nature, motivation from competition and rewards influenced the perceived effort and motor skills. In conclusion, GAM techniques are effective in reducing perceived effort in physical education programs, and combining GAM with VR enhances improvements in motor skills.

Keywords: adolescent; gamification; physical education and training; virtual reality

1. Introduction

The spectrum of teaching styles, created by Muska Mosston in 1966, is internationally considered the pedagogical basis in the field of physical education (PE) [1]. The spectrum provides PE teachers with 11 different teaching options, ranging from the most teacher-centred (command style) to the most student-centred (self-teaching style), addressing student diversity and achieving multiple PE objectives (psychomotor, cognitive and affective) of the curriculum [2]. In this regard, the practice teaching style (PTS), in which teachers demonstrate the task and learners practice the task, making decisions previously shifted to them (location, posture, starting time, etc.) [1], despite being traditional, is a commonly used option in PE within the spectrum. This is also because decision-making gradually shifts from the teacher to the student, thereby promoting students' autonomy [3]. This progressive increase in learners' decision making may contribute to education for sustainable development in terms of empowering students to take informed decisions and responsible actions, thus complying with Number 4 of the sustainable development goals. Thereby, the United Nations dedicate a specific section (4.7) to the requirement for learners to acquire knowledge and skills to promote sustainable development for environmental, economic and social integrity for present and future generations [4]. Hence, teaching styles that predominantly rely on the teacher are being replaced with more active methodologies and student-centred options that encourage students' participation and involvement [5]. These methodologies increase motivation and facilitate the teaching–learning process [6]. Delving into these most recent methodologies, gamification (GAM), specifically, has emerged and gained relevance in recent years, consisting of the use of game elements in non-game contexts [7] and is widely used in the educational field [8]. In this environment, the most crucial game elements to include in education are rewards, scoring, narrative, objectives, levels and progression [9]. Although the use of gamification has been shown to increase students' motivation [10,11] and physical fitness [12,13], its impact on learning improvements remains unclear [14]. This is likely due to the lack of unification of criteria to compare gamification didactic proposals [15], as well as the lack of research in the educational field, particularly in PE [16].

In contrast, virtual reality (VR) and interactive video gaming (exergames) are becoming relevant in various areas of science education and are being rapidly adopted for different purposes [17]. VR is the emulation of a real or a fictional setting generated by a computer system, providing users with an immersive experience and the ability to interact with objects within that simulated environment [18–20]. Immersion refers to the degree of inclusion in a virtual setting that an individual feels in comparison to the actual surroundings. Systems projecting images onto a concave surface or employing head-mounted displays are typically classified as immersive systems. In contrast, those utilizing single-screen projection are categorized as semi-immersive, and those relying on desktops, joysticks or pad displays are identified as non-immersive setups [21]. The engagement with the environment can be facilitated by a range of devices, including simple tools like a mouse or joystick, as well as more sophisticated systems incorporating cameras, sensors or haptic (touch) feedback devices [22]. As a result, the extent of the user's physical activity can vary based on the interaction, spanning from relatively sedentary to more dynamic scenarios involving vigorous full-body movements [23].

The number of published studies on the use of these technologies for educational purposes is on the rise [24]. Educational institutions are now moving rapidly to adopt VR as an educational and training tool as it can be directly applied to the teaching–learning process, generating positive learning outcomes in a variety of domains [25]. In addition, and based on the aforementioned education for sustainable development, VR contributes to the digital teaching competence that contributes to build sustainable digital citizenship and it implies the construction of digital culture (e-society). The generation of movement, simulation and interaction in virtual learning environments is possible due to specific levels of immersion, and through the execution of diverse and progressively challenging functional activities involving high levels of repetition and intensity. The process offers real-time multisensory feedback during task-oriented training, facilitating motor learning. The powerful sense of presence and effective immersion created by VR applications provide on-site training in a safe and controlled environment, boosting curiosity among students that the traditional approach could not easily achieve. In addition, for most students, school might be the only place where they can access this technology [26]. Nonetheless, careful consideration of essential educational process elements is needed to design and develop VR learning experiences. This involves incorporating effective pedagogy, mindful planning of teaching time and learning activities, using suitable tools and resources, and fostering active student engagement [27]. Likewise, it is necessary to investigate how children perceive effort, motivation, satisfaction and adherence when undergoing VR activities during PE lessons in school environments [28,29], considering some discrepancies in the literature reporting the absence [30,31] or presence [32,33] of significant learning outcomes when comparing VR with other active learning experiences or with traditional learning, respectively. In addition, there is a lack of previous studies about using VR in PE in comparison to other methodologies. Therefore, this study aimed to analyse the effect of using VR and GAM in combination with the PTS on motor skills and students' perceived effort. From this research, some questions were raised: Can the use of techniques such as VR and GAM improve motor skills (such as coordination, grip strength or balance) in an educational context? Can these techniques reduce the perceived effort of students during lessons compared to the PTS? We hypothesised that the use of VR and GAM would decrease students' perceived effort during PE lessons and improve their motor skills.

2. Materials and Methods

2.1. Study Design

A mixed-method intervention study design with a qualitative component was applied [34,35]. Following a quantitative approach within a concurrent integrated design [34], in the first research step of the study, a non-randomised intervention based on different teaching methodologies was conducted. In educational research, since it is not always possible to randomly distribute students into different groups, a quasi-experimental design is widely used [36]. This study design aims to keep the educational environment as real as possible, with its characteristic heterogeneity, in order to warrant external validity and thus, to generalize results [37]. In the second step, a qualitative methodology [34] based on an interpretive framework was conducted [38], seeking to convey the most relevant information emerging from the phenomenon under study [39]. Qualitative data were collected after VR and GAM interventions to find mechanisms that potentially explain the quantitative results: participants' experience, effort, motivation, satisfaction and adherence. Table 1 summarises the research methodology and illustrates the integrated mixed-methods design by embedding the qualitative method into the quantitative [40]. The integration phase aims to balance the respective strengths and weaknesses of the methods to optimise the performance of the various complementary sources of evidence [34]. This study followed the Best Practices for Mixed Methods Research from the APA Publications and Communications Board Task Force Report [41] and the guidelines for empirical methodological mixed methods research proposed by Fetters and Molina-Azorín [42].

2.2. Quantitative Phase Design: Teaching Methodologies Intervention

2.2.1. Participants

According to the aforementioned quasi-experimental design, no inclusion and exclusion criteria were applied to the groups since they were already predetermined by the educational institution. Accordingly, and given that the participants (n = 75) belonged to three different class groups previously, a different teaching methodology was allocated to each of them: the PTS was administered to the control group (n = 14), PTS + GAM was administered to Experimental Group 1 (n = 32) and the PTS + GAM + VR was administered to Experimental Group 2 (n = 29). Participants' motor skills, based on the aforementioned teaching methodologies, were evaluated prior to and post-intervention, which consisted of two weekly sessions of PE lasting 50 min each for six weeks. Perceived effort was rated after the different activities performed during the sessions.

Table 1. Mixed-methods intervention study summary.

Study	Component	Sampling	Participants	Data Collection	Analysis
Main study	Quantitative Quasi-experimental intervention using different teaching methodologies.	Non-probabilistic.	*N* = 75 high school students PTS (control group) *N* = 14 PTS + G (experimental group 1) *N* = 32 PTS + G + VR (experimental group 2) *N* = 29	Pre-post intervention SportComp Motor Test (to evaluate motor skills). Handgrip and flamingo tests from Eurofit (to measure handgrip strength and balance). Pictorical Children's Effort Rating (to assess perceived effort).	Statistical analysis using the Jamovi software (version 2.3.12). A repeated-measure ANOVA test (time × group). Kolmogorov–Smirnov test for normality. Bonferroni post-hoc test. Effect size (η_p^2).
Embedded study	Qualitative	Purposeful and information power criteria.	*N*= 15 students from the main study PTS (control group) *N* = 5 PTS + G (experimental group 1) *N* = 5 PTS + G + VR (experimental group 2) *N* = 5	Throughout the intervention. In-depth interviews and focus groups based on a question guide.	Thematic inductive analysis was performed.

VR: virtual reality; PTS: practice teaching style; G: gamification.

2.2.2. Data Collection and Outcome Measures

To evaluate motor skills, the SportComp motor test elaborated and validated by Ruiz-Pérez et al. [43] was used. It consists of 5 tests (7-m foot-together run, 7-m single-legged run, lateral jumps, 9-m two-way run and displacement on supports), which determine global motor coordination in individuals aged 12 and 17, with a reliability of ICC = 0.91 (95% IC: 0.88–0.94).

In addition, handgrip, flamingo and plate-tapping tests from Eurofit (1993) [44] were performed to measure, respectively, handgrip strength, balance and hand-eye coordination. Handgrip strength is recognised as an objective index for functional hand assessment, and it was measured with the Jamar® hydraulic hand dynamometer, which consists of a grip handle and a maximum force indicator with a dual scale in pounds (0–198 lb) and kilograms (0–90 kg). Its isometric design and hydraulic system ensure highly accurate and reproducible results. The maximum force indicator remains in place after each reading until it is reset. Each participant performed three attempts on each side, and the average value of the three measurements in kilograms was taken as the result, following the recommendations of Mathiowetz et al. [45]. On the other hand, to perform the flamingo test, participants stood on a long support that was 5 cm in height and 3 cm wide. The subject was told to balance on one leg of their choice, with the free leg flexed at the knee and the foot held close to the buttocks. The stopwatch was started, and participants were instructed to stand in the mentioned position for 1 min. The stopwatch was stopped each time the participants lost balance and started again until they lost balance. The total times they lost balance were registered [46]. Finally, in the plate-tapping test, participants attempted to touch, in a fast manner, two 20 cm plastic disks previously attached to the table, using their preferred hand in a defined order. The distance between the centre of the two disks was 80 cm, with a 10 × 20 cm rectangular plate placed in an equally far area from both disks. The best score was considered the final point [47].

To assess perceived effort, the Pictorical Children's Effort Rating Table (PCERT) was used [48]. This scale has been translated and validated in the Spanish context of PE classes by [49]. It allows participants to rate any effort between 1 (very, very easy) and 10 (so hard I'm going to stop), with an average value of 5 (starting to get hard). Participants carried out familiarisation with the scale prior to the intervention.

2.2.3. Description of the Intervention

The three study groups followed the premises of the PTS [1]. Throughout sessions, the court was divided into 4 different stations, each lasting 10 min, with a different activity based on different underlying curricular contents (physical abilities, motor skills, ...). Activities were previously explained by the teacher and performed by the students until the teacher gave the signal to change to a different station. During execution, the teacher moved through all the stations, providing verbal encouragement and feedback.

The GAM was designed and developed throughout the intervention with the underlying context of the Avatar 2 movie. Researchers provided students with an introductory video prior to the intervention, linking the different activities with this theme. In GAM groups, students were divided into four groups, each assigned a Na'vi badge corresponding to different Avatar characters (Lo'ak, Neitiry, Jake Sully, Colonel Miles Quaritch). An explanation of the score they could achieve in each of the activities was provided, and at the end of each session, each group could exchange the points for a game card that could be used in the following session. The VR group had a specific station equipped with glasses and a Kinect Sports Xbox.

The PTS + GAM + VR group received PTS + GAM as previously described, along with one station of VR technology training (20 min/session; 2 sessions per week; 6 total weeks; 240 total minutes/participant). This training consisted of video-game-based training with commercial video games using the Xbox One video game console and the Kinect (Microsoft Corporation) device, the Nintendo Switch (Nintendo Platform Technology Development) and a head-mounted display called Oculus Quest 2 (Reality Labs, a division of Meta Platforms). All VR training was performed in turn with GAM training. The intensity and perceived effort of each session were recorded for each participant.

The VR training commercial video games used were Just Dance 2022 for the Xbox One; Nintendo Switch Sports for Nintendo Switch and Ragnarock VR, Beat Saber and The Climb 2 for Oculus Quest 2. These games involved different virtual scenarios and movements, such as dancing, playing tennis, climbing or playing bongos. A specific protocol (Table S1), designed by three physical therapists with experience in the field of VR training, was conducted and supervised for this group to ensure compliance of the same curricular contents as non-VR activities. The weekly progression was directed at facilitating motor skills, including weight transfer work, limits of stability, upper and lower limb control, dynamic balance, coordination and reaction times. The training times of the participants were recorded, along with the rewards, scores and marks achieved in each game, to introduce elements of motivation and engagement.

Pre- and post-intervention data collection was performed by two researchers, under the supervision and support of the regular physical PE teacher of all of the study groups. The intervention sessions were always carried out by the PE teacher and another researcher different from the first two. In addition, as aforementioned, sessions with the study group using VR technology were supported by other three different researchers, physical therapists and experts in the VR field.

2.2.4. Data Analysis

Data are presented as the mean ± standard deviation (SD). Power sampling estimation was conducted using the G*Power 3.1.9.7 software (Heinrich Heine Universität Düsseldorf, Düsseldorf, Germany) [50]. The statistical analysis was conducted using Jamovi software for Windows, version 2.3.12 (The Jamovi Project, Sydney, NSW, Australia). A Kolmogorov–Smirnov test for normality was used. A repeated-measures ANOVA test (time and group as factors) was performed to analyse the influence of the teaching methodologies on the dependent variables. Where appropriate, the Bonferroni post-hoc test was applied to examine pairwise comparisons of each significant factor, and the effect size (ES) was calculated by η_p^2, interpreted based on the following: small, moderate and large effect for values greater than 0.010, 0.059 and 0.138, respectively [51]. The alpha level was set at $p < 0.05$.

2.3. Qualitative Phase Design

2.3.1. Participants

Purposeful sampling was performed to recruit participants, selecting those with relevant information [52]. As an inclusion criterion, participants belonging to one of the three study groups that participated in the intervention was set, seeking a balanced representation of five students per group. The sampling process was based on the information power criteria established by Malterud et al. [53], which indicate that the more information the sample has relevant to the study, the fewer participants are required. Therefore, the participants recruited for the qualitative phase of the intervention were previously included in the quantitative phase.

2.3.2. Data Collection

To comply with the study's objectives, motor skills and perceived effort were qualitatively explored through a two-step process: firstly, individual semi-structured interviews (Table S2) were conducted with 5 participants from each study group, and secondly, three 5-participant focus discussion groups (Table S3) were carried out with the three study groups to stimulate dialogue and discussion. Both interviews and discussion groups were recorded and subsequently transcribed to identify further descriptive content and emerging categories.

2.3.3. Data Analysis

An inductive thematic analysis [54,55] was performed to identify the most descriptive content, from which different categories subsequently emerged and groups of units with common meanings were formed [54,55]. No qualitative analysis software was used.

2.4. Ethics

Participants and their parents were informed about the study procedures and then accepted to participate in the study by signing an informed consent form. All procedures complied with the Declaration of Helsinki and were approved by the Universidad Rey Juan Carlos Ethics Committee Board (registration number 1201202302323). Additionally, this research also addressed the principles outlined in the American Psychological Association Code of Ethics [56].

3. Results

The results involved 84 students from a public high school, of whom 9 did not complete all the questionnaires or were not able to attend some sessions. A total of 75 students (53.3% women and 46.7% men; mean age: 13.58 $\pm$ 0.68 years old) completed the study.

The results are reported in the following order: (a) quantitative and intervention results, (b) qualitative results and (c) mixed-method findings (integration).

3.1. Quantitative Findings

Results are presented as the mean $\pm$ SD. Findings from the SportComp, handgrip, flamingo and plate-tapping tests are presented in Table 2, while perceived exertion from PCERT is presented in Figure 1. On average, students rated a higher perceived effort in the PTS than in the other two study groups ($p < 0.001$). Regarding motor skills, the three study groups experienced post-intervention improvements in handgrip ($p < 0.001$) and flamingo tests ($p < 0.05$), while only the two GAM groups showed improvements in lateral jump tests ($p < 0.001$), and only the VR group obtained a better result in the plate-tapping test ($p < 0.001$). Finally, only the PTS study group demonstrated a worsening in the displacement with support test ($p < 0.05$).

Table 2. Participants' results from SportComp, handgrip, flamingo and plate-tapping tests.

		Pre-Intervention			Post-Intervention				Time	Group	Time × Group
7 m feet-together run test	VR + G	3.46	±	0.51	3.42	±	0.51	F =	3.52	2.61	1.50
	G	3.54	±	0.65	3.63	±	0.66	p =	0.065	0.082	0.230
	T	3.61	±	0.76	4.02	±	0.94	η_p^2 =	0.052	0.075	0.045
7 m single-legged run test	VR + G	3.07	±	0.53	3.05	±	0.52	F =	0.98	0.08	1.21
	G	2.96	±	0.55	3.13	±	0.56	p =	0.326	0.924	0.304
	T	3.00	±	0.77	3.03	±	0.70	η_p^2 =	0.015	0.002	0.037
9 m two-way run test	VR + G	12.1	±	1.25	12.0	±	1.11	F =	1.86	0.19	1.60
	G	12.0	±	1.38	12.5	±	1.37	p =	0.177	0.828	0.192
	T	12.1	±	1.43	12.2	±	1.09	η_p^2 =	0.028	0.005	0.050
Displacement with support test	VR + G	17.6	±	3.36	16.6	±	2.87	F =	2.18	0.75	5.26
	G	18.4	±	4.62	18.7	±	4.63	p =	0.145	0.479	0.008
	T	16.6	±	3.92	19.3	±	4.70 *	η_p^2 =	0.033	0.023	0.143
Lateral jumps test	VR + G	31.9	±	6.45	37.3	±	5.08 **	F =	46.23	0.18	0.47
	G	31.8	±	6.49	35.7	±	6.94 **	p =	0.001	0.832	0.630
	T	33.3	±	8.18	36.5	±	5.94	η_p^2 =	0.423	0.006	0.015
Right-hand handgrip test	VR + G	7.29	±	4.97	27.6	±	6.52 **	F =	1939.66	1.52	7.34
	G	7.80	±	5.72	32.3	±	7.61 **	p =	0.001	0.225	0.001
	T	8.50	±	8.40	31.8	±	9.12 **	η_p^2 =	0.967	0.044	0.180
Left-hand handgrip test	VR + G	5.06	±	0.62	25.1	±	6.39 **	F =	2005.04	2.07	6.17
	G	6.37	±	0.56	30.0	±	8.16 **	p =	0.001	0.134	0.003
	T	6.57	±	0.70	30.0	±	8.87 **	η_p^2 =	0.968	0.058	0.156
Plate-tapping test	VR + G	10.9	±	1.67	9.93	±	1.67 **	F =	10.54	1.60	6.28
	G	10.2	±	2.13	10.3	±	2.13	p =	0.002	0.210	0.003
	T	11.0	±	1.45	10.3	±	1.45	η_p^2 =	0.134	0.061	0.156
Flamingo test	VR + G	7.34	±	5.01	3.69	±	3.27 **	F =	51.96	1.64	0.159
	G	9.90	±	4.96	5.76	±	5.08 **	p =	0.001	0.201	0.854
	T	7.57	±	5.39	4.38	±	4.01*	η_p^2 =	0.448	0.049	0.005

VR: virtual reality; G: gamification; T: traditional. * Different from pre ($p < 0.05$); ** Different from pre ($p < 0.001$).

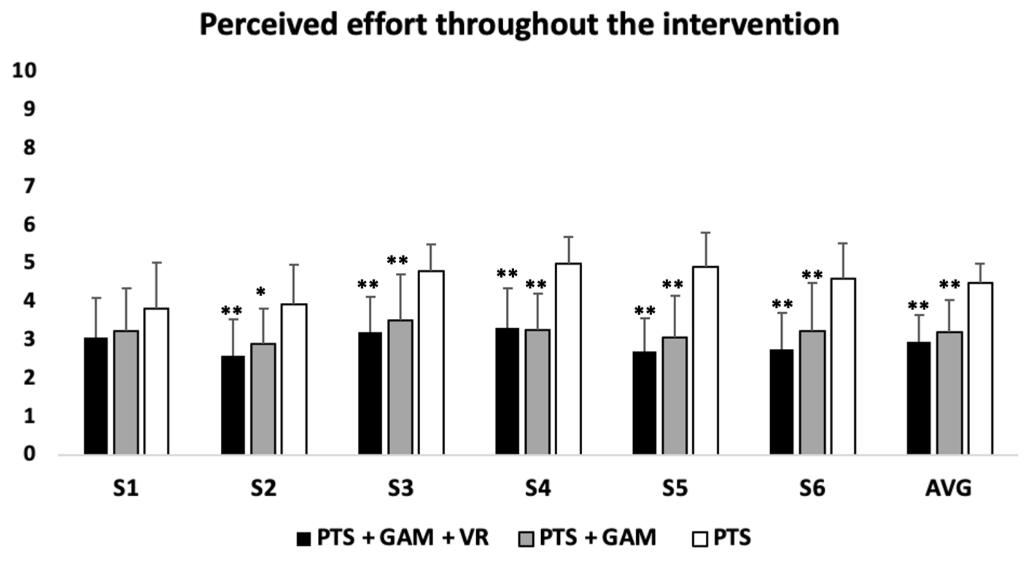

Figure 1. Participants' perceived effort during intervention sessions. S1: sessions' first week; S2: sessions' second week; S3: sessions' third week; S4: sessions' fourth week; S5: sessions' fifth week; S6: sessions' sixth week; PTS: practice teaching style; GAM: gamification; VR: virtual reality; * Different from traditional ($p < 0.05$); ** Different from traditional ($p < 0.001$).

3.2. Qualitative Findings

Two main categories were identified: (a) perceived effort and (b) improvement in motor skills. The results are supported by narratives obtained from the participants, which allow for the traceability and credibility of the results [34,38].

3.2.1. Perceived Effort

Participants from the three groups recognised a diversity of effort demands depending on the day and the activity. A determining factor for perceived effort was participation in the activity. Thus, in activities where all the students participated simultaneously, the perceived effort was always greater. In activities where there was time without activity, such as the relay activity, for example, the perceived effort was lower because there was less time for motor practice and more time for rest.

> 'When there were many breaks because you had to do the exercise one at a time, it gave you plenty of time to rest.' (Participant 2, PTS group)

> 'In the climbing exercise or in the boat circuits, for example, I hardly noticed the fatigue because, even though it was my turn, I did it at full throttle, and then I had many turns to recover.' (Participant 4 PTS + GAM group)

In some activities, some participants pointed out the mental effort, especially in coordination activities such as juggling or keeping the spades in the air.

> 'The activity that cost me the most effort was juggling because I had to be very concentrated the whole time to get more points.' (Participant 4, PTS + GAM + VR group)

> 'Juggling or spades were not physically tiring, but they were mentally tiring because if you got distracted, you would fall, and your team would not win as many points because the time kept running.' (Participant 1, PTS group)

All participants recognised how the feeling of effort increased, knowing that the correct performance of the activity and winning the prize meant obtaining a greater number of points. All agreed that the feeling of effort would not have been as high if there was no prize or competition.

> 'Knowing that you can earn points for your team makes you work harder, of c' (Participant 3, PTS group)

> 'It's that what you do doesn't just benefit or hurt you, but your whole team. That's why you try to give your all.' (Participant 2, PTS + GAM + VR group)

In relation to the specific VR activities, the participants indicated that they were not very physically demanding. The only one to which they attached some importance in terms of physical demand was the climbing game.

> 'The only VR game that was a bit tiring was the climbing game; and not even that. The rest were very much about playing almost stationary, without moving much.' (PTS + GAM + VR discussion group)

> 'The VR games were very quiet, not tiring at all.' (Participant 3, PTS + GAM + VR)

3.2.2. Improvement in Motor Skills

In this area, there was considerable heterogeneity. On the one hand, some participants did not perceive any improvement at a motor or perceptual level:

> 'I don't think anything has changed, just as with health care.' (Participant 1, PTS + GAM + VR group)

> 'I don't know, I think I've done similar in the tests at the beginning and the end.' (Participant 3 PTS group)

> 'I don't think there's been any change. . .we haven't done any training exercises or anything like that either.' (Participant 2, PTS + GAM group)

The typology of the activities, in the form of a team game, did not give the participants the feeling that it was influencing their motor level. Some alluded to the time of the intervention as a factor for improvement:

> 'In six weeks, there is not much time to improve things, I don't know. . .' (Participant 1, PTS group)

On the other hand, some participants expressed that they felt more competent, mainly in the area of hand-eye coordination and in the area of reaction speed.

> 'I think that the boat exercises that we have done...the ones of doing a circuit and so on, have helped me improve my coordination.' (Participant 2, PTS + GAM + VR group)

> 'The game of turning around quickly to hit the ball with the rackets or the game of spades helps to be quicker and react faster.' (Participant 4, PTS group)

In the specific case of the VR activities, no participant expressed that any of the activities within the realm of VR produced any improvement in their motor skills. Some participants emphasised the poor transferability of the virtual activity to real life:

> 'For example, the climbing game has nothing to do with real climbing. In the game, you don't have to use force with your legs or arms, and when you climb the climbing wall, you realise that it is very hard and your arms and legs hurt.' (Participant 3, PTS + GAM + VR group)

3.3. Mixed Method Findings (Integration)

The results of the integration showed elements of confirmation, expansion and discordance [40] (Table 3).

Table 3. Combined display of the quantitative and qualitative findings.

Outcome Measures	Quantitative Findings	Qualitative Findings
PCERT (Pictorical Children's Effort Rating Table): Effort rates between 1 (very, very easy) and 10 (so hard I'm going to stop) with an average value of 5 (starting to get hard).	Students rated a higher perceived effort in the PTS than in the other two study groups ($p < 0.001$).	Effort was experienced when performing activities that required continuity without pause times. On the other hand, activities that required greater mental effort were of the juggling type or those requiring motor control, coordination and handling of objects in the air. The feeling of effort increased whenever the activity was rewarded, and the team score depended on its success. Finally, the VR activities did not require much effort from the participants.
SportComp motor test: Determines global motor coordination in people between 12 and 17 years through 5 tests (7-m foot-together run, 7-m single-legged run, lateral jumps, 9-m two-way run and displacement on supports). Handgrip, flamingo and plate-tapping tests from the Eurofit battery tests: Measures handgrip strength and balance	The three study groups experienced post-intervention improvements in handgrip ($p < 0.001$) and flamingo tests ($p < 0.05$). Only the two GAM groups showed improvements in lateral jump tests ($p < 0.001$). Only the VR + GAM + PTS group obtained a better result in the plate-tapping test ($p < 0.001$). Only the PTS study group obtained a worsening in the displacement with support test ($p < 0.05$).	The team activities did not demonstrate motor improvement in the participants, who justified these results in the lack of time to continue developing these activities. Finally, the specific VR activities did not require physical effort and were considered of little use for improving physical performance in non-virtual environments. However, the areas that could be improved through VR were activities related to hand-eye coordination and reaction speed.

4. Discussion

This research evaluated the influence of including VR and GAM combined with the PTS in PE lessons on high school students' motor skills and perceived effort. Our results suggest that the combination of the PTS with GAM and VR seemed to have had a positive effect on some students' motor skills post-intervention, as observed from the plate-tapping test's results ($p < 0.001$). In fact, based on the qualitative results, some participants highlighted that they felt more competent in hand-eye coordination and reaction speed tasks. Moreover, intriguingly, improvements were not only reported by participants from the PTS + GAM + VR group but also by those from the PTS group. Post-intervention improvements in handgrip strength and balance were observed in all the study groups, suggesting that differences in motivation for PE and physical activity, particularly for VR games, may have influenced students' perceptions in terms of motor skills. This coincides with previous evidence showing that motivation is tied to both actual and perceived levels of movement competence in adolescents [57], suggesting a field to explore to understand how motivation underlies the perceptions of physical endeavours. In addition, some participants from different study groups did not appreciate such improvements and indicated that VR was perceived as limited in terms of real-world transferability since it may not accurately replicate the physical demands of the real world, thus limiting its effectiveness in improving motor skills. This lack of skill transfer from VR to the real world [58] needs to be addressed in future research. Although some participants did not perceive improvements in their motor skills, the capacity of VR to elicit the acquisition of motor skills may, therefore, seem doubtful in an educational context. However, it has been observed that the use of VR may be relevant for improving motor abilities such as spatial orientation, muscular strength, or cardiorespiratory endurance [59,60]. Furthermore, it has been observed that VR involves both specific motor skills and cognitive abilities, as well as the ability to optimise the desired movement's trajectory [61], suggesting its interest in the development and improvement of motor skills. It is possible that participants in the current study did not perceive this type of improvement because of the short intervention time or because the outcome measures used were not sufficiently sensitive. Therefore, studies with longer protocols or more specific means may be needed.

Nonetheless, despite students' aforementioned impairments in observing motor function improvements through VR use, this technology may serve as an optimal complement to other teaching techniques and methodologies like GAM and the PTS, thereby enhancing its effectiveness in improving physical function compared to methodologies predominantly based on more teacher-centred options. This is evidenced by the improvements in the lateral jump test in both GAM study groups in comparison to the PTS study group ($p < 0.001$). Additionally, the PTS study group, together with the latter, showed a post-intervention worsening in support displacement test performance ($p < 0.05$), possibly explained by a speculative lack of motivation in this group compared to the GAM groups and not by a motor skill worsening per se. Although the influence of GAM on motivation towards PE is beyond the scope of the present study, motivation might also be considered as a potential determinant of participants' perceived effort in the present study, which, interestingly, was rated lower by both GAM study groups in comparison to the PTS group ($p < 0.001$). According to qualitative results, some participants did not perceive VR activities as demanding at all, suggesting a distracting effect of VR in the PTS + GAM + VR group. Moreover, the significantly lower perceived effort in both GAM groups (in combination with VR or not) coincided with the fact that participants relativised their perception of effort to the type of activity and participation format. Hence, activities in which all students participated simultaneously generated a higher perception of effort, while relay-style activities provided more rest time and, as a result, a lower perception of effort. Another aspect mentioned by participants was that activities requiring more mental effort, such as juggling or keeping objects in the air, generated mental fatigue but not physical fatigue. The perception of mental fatigue may be related to a decrease in physical performance [62,63], so it would be important to alternate between exercises that focus on attentional processes and those that require physical effort with less cognitive demand [64,65]. Participants also highlighted that competition between groups and the opportunity to win serve as motivating factors that correlate with performance levels and the perception of effort. Competition and prizes are inherent components of GAM, which has been widely shown to increase motivation and enhance students' engagement in the learning process [66]. Again, despite being beyond the scope of the present research, motivation arises as a key aspect in generating effort, especially in high school students, as intrinsic motivation, such as fun activities and challenges, can lead to greater adherence than extrinsic motivations [67]. Therefore, it is a key element to consider in teaching, particularly in fields related to performance, such as PE [68]. Additionally, in terms of VR use, a correlation analysis revealed that understanding VR was an important feature for increasing intrinsic motivation. It was observed that young adults have a higher level of understanding of VR when experiencing its use more frequently. In addition, another source of increased motivation during the use of VR is the enjoyment during its use [61], derived from stimulating and visually attractive actions and challenges at multiple levels. These qualities can explain why many young people are more motivated to exercise using it instead of traditional exercise [69]. Its use with GAM seems to be linked to a higher frequency of participation of adolescents in physical exercise, although VR interventions with GAM appear to have greater adherence throughout a physical activity protocol [70].

The incorporation of VR in the educational environment can play a key role in realizing the fourth objective of the sustainable development goals, adjusting to accommodate diverse needs and pedagogical methods, addressing the unique abilities and preferences of each student, offering more engaging and visual educational experiences [4]. Additionally, the application of VR, along with gamification strategies, can contribute to sustainable development in this context, involving teaching methodologies that guarantee the persistence, excellence, and positive influence of education over time, without jeopardizing the requirements of future generations [71].

VR and gamification can enhance the quality of education and the active participation of students, fostering a more profound comprehension, serving as a solution to innovate an appealing educational model for upcoming generations of students [71,72]. Lastly, the implementation of sustainable practices in technology usage, such as the creation of energy-saving applications and contemplation of their ecological impact, can promote a conscientious use of technology, in harmony with the tenets of sustainable development [72].

Strengths and Limitations of the Study

This research presents several strengths that are worth being mentioned. Firstly, the results of this paper could be easily applied and implemented in an educational context in children with similar conditions as we presented in this research. Secondly, validated tools were used to assess the outcome measures. Thirdly, a mixed-method intervention study was conducted to also incorporate the subjective opinion of the sample through a qualitative analysis. Finally, the ethical principles of the Helsinki declaration and the American Psychological Association Code of Ethics (i.e., Beneficence and Nonmaleficence, Informed Consent, Design of Education and Training Programs, Descriptions of Education and Training Programs or anonymous data processing) were followed, strengthening the design of this work.

On the other hand, the first limitation to state is the low volume of VR integrated into PE classes, which was only possible for 20 min per session, and a total of 240 min during the entire protocol. This might have reduced the effect of VR on the results obtained. In addition, the different participants' number in study groups and heterogeneity of participants within groups in terms of height, body composition or fitness level may also have affected the results, although as a counterpoint these drawbacks provide a lifelike reflection of the educational environment. Finally, since motivation seems to play a key role in students' perceptions of effort and motor skills, its evaluation would have added interesting information for a better interpretation of the results, and its evaluation may clarify the results of the present research.

5. Conclusions

The GAM technique seems to be useful in reducing perceived effort in PE programs for adolescents in comparison to the PTS. However, students suggest that this perception depends on various aspects of session and task design, such as breaks or cognitive implications. GAM, when combined with VR, enhances improvements in motor skills related to hand-eye coordination.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/su16041584/s1, Table S1: VR training with XBOX ONE, Nintendo Switch and Oculus Quest 2.0.; Table S2: Semi-structured interview script for participants; Table S3: Focus group discussion script with participants.

Author Contributions: Conceptualization, M.E. and R.C.-d.-l.-C.; methodology, M.E., D.P.-C., D.B.-G. and J.M.D.-d.-l.-M.; software, D.F.-V. and V.N.-L.; formal analysis, N.R.-P. and D.B.-G.; investigation, J.M.D.-d.-l.-M. and D.B.-G.; resources, R.C.-d.-l.-C.; data curation, N.R.-P.; writing—original draft preparation, D.F.-V., V.N.-L. and R.C.-d.-l.-C.; writing—review and editing, N.R.-P.; supervision, M.E. and D.P.-C.; project administration, M.E.; funding acquisition, M.E. All authors have read and agreed to the published version of the manuscript.

Funding: This work is part of the research ID A538 entitled Application of Virtual Reality and Gamification through Practice Teaching Style in Physical Education Lessons, which was funded by the Spectrum Institute for Teaching and Learning (SITL), Spectrum Research Grant Program 2023.

Institutional Review Board Statement: All procedures complied with the Declaration of Helsinki and were approved by the Universidad Rey Juan Carlos Ethics Committee Board (registration number 1201202302323). The principles outlined in the American Psychological Association Code of Ethics were also addressed.

Informed Consent Statement: Participants and their parents were informed about study procedures and accepted to participate in the study through the signature of an informed consent form.

Data Availability Statement: Data is contained within the article and Supplementary Materials.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Mosston, M.; Ashworth, S. Teaching physical education. In *Spectrum Institute for Teaching and Learning*, 1st ed.; Benjamin-Cummings: San Francisco, CA, USA, 2008.
2. Sanchez, B.; Byra, M.; Wallhead, T.L. Students' perceptions of the command, practice, and inclusion styles of teaching. *Phys. Educ. Sport Pedagog.* **2012**, *17*, 317–330. [CrossRef]
3. Syrmpas, I.; Papaioannou, A.; Digelidis, N.; Erturan, G.; Byra, M. Higher-Order Factors and Measurement Equivalence of the Spectrum of Teaching Styles' Questionnaire Across Two Cultures. *J. Teach. Phys. Educ.* **2021**, *40*, 245–255. [CrossRef]
4. UNESCO. *Education for Sustainable Development Goals: Learning Objectives*; UNESCO: Paris, France, 2017; pp. 18–20.
5. Luelmo del Castillo, M.J. Origen y Desarrollo de las Metodologías Activas dentro del Sistema Educativo Español. *Encuentro J.* **2018**, *27*, 4–21. [CrossRef]
6. Muntaner Guasp, J.J.; Pinya Medina, C.; Mut Amengual, B. El Impacto de las Metodologías Activas en los Resultados Académicos. *Profr. Rev. Curric. Form. Profr.* **2020**, *24*, 96–114. [CrossRef]
7. Deterding, S.; Dixon, D.; Khaled, R.; Nacke, L. From Game Design Elements to Gamefulness. In *Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments*; ACM: New York, NY, USA, 2011; pp. 9–15. [CrossRef]
8. Klock, A.C.T.; Gasparini, I.; Pimenta, M.S.; Hamari, J. Tailored Gamification: A Review of Literature. *Int. J. Hum. Comput. Stud.* **2020**, *144*, 102495. [CrossRef]
9. Toda, A.M.; Oliveira, W.; Klock, A.C.; Palomino, P.T.; Pimenta, M.; Gasparini, I.; Shi, L.; Bittencourt, I.; Isotani, S.; Cristea, A.I. A Taxonomy of Game Elements for Gamification in Educational Contexts: Proposal and Evaluation. In Proceedings of the 2019 IEEE 19th International Conference on Advanced Learning Technologies (ICALT), Maceio, Brazil, 15–18 July 2019; pp. 84–88.
10. Ferriz-Valero, A.; Østerlie, O.; García Martínez, S.; García-Jaén, M. Gamification in Physical Education: Evaluation of Impact on Motivation and Academic Performance within Higher Education. *Int. J. Environ. Res. Public Health* **2020**, *17*, 4465. [CrossRef]
11. González-González, C.; Río, N.G.; Navarro-Adelantado, V. Exploring the Benefits of Using Gamification and Videogames for Physical Exercise: A Review of State of Art. *Int. J. Interact. Multimed. Artif. Intell.* **2018**, *5*, 46. [CrossRef]
12. Mora-Gonzalez, J.; Pérez-López, I.J.; Esteban-Cornejo, I.; Delgado-Fernández, M. A Gamification-Based Intervention Program that Encourages Physical Activity Improves Cardiorespiratory Fitness of College Students: 'The Matrix rEFvolution Program'. *Int. J. Environ. Res. Public Health* **2020**, *17*, 877. [CrossRef]

13. Melero-Cañas, D.; Morales-Baños, V.; Manzano-Sánchez, D.; Navarro-Ardoy, D.; Valero-Valenzuela, A. Effects of an Educational Hybrid Physical Education Program on Physical Fitness, Body Composition and Sedentary and Physical Activity Times in Adolescents: The Seneb's Enigma. *Front. Psychol.* **2021**, *11*, 629335. [CrossRef]
14. Robson, K.; Plangger, K.; Kietzmann, J.H.; McCarthy, I.; Pitt, L. Is it all a game? Understanding the principles of gamification. *Bus. Horiz.* **2015**, *58*, 411–420. [CrossRef]
15. Prieto Andreu, J.M. Metaanálisis sobre experiencias didácticas gamificadas en Educación Física. *Rev. Complut. Educ.* **2023**, *34*, 179–190. [CrossRef]
16. Fernandez-Rio, J.; de las Heras, E.; González, T.; Trillo, V.; Palomares, J. Gamification and physical education. Viability and preliminary views from students and teachers. *Phys. Educ. Sport Pedagog.* **2020**, *25*, 509–524. [CrossRef]
17. Broisin, J.; Venant, R.; Vidal, P. Lab4CE: A Remote Laboratory for Computer Education. *Int. J. Artif. Intell. Educ.* **2017**, *27*, 154–180. [CrossRef]
18. Luna-Oliva, L.; Ortiz-Gutiérrez, R.M.; Cano-de la Cuerda, R.; Piédrola, R.M.; Alguacil-Diego, I.M.; Sánchez-Camarero, C.; Martínez Culebras, M.D.C. Kinect Xbox 360 as a therapeutic modality for children with cerebral palsy in a school environment: A preliminary study. *NeuroRehabilitation* **2013**, *33*, 513–521. [CrossRef] [PubMed]
19. Ortiz Gutierrez, R.; Galán del Río, F.; Cano de la Cuerda, R.; Alguacil-Diego, I.M.; Arroyo González, R.; Miangolarra Page, J.C. A telerehabilitation program by virtual reality-video games improves balance and postural control in multiple sclerosis patients. *NeuroRehabilitation* **2013**, *33*, 545–554. [CrossRef]
20. Ortiz-Gutiérrez, R.; Cano-de-la-Cuerda, R.; Galán-del-Río, F.; Alguacil-Diego, I.M.; Palacios-Ceña, D.; Miangolarra-Page, J.C. A Telerehabilitation Program Improves Postural Control in Multiple Sclerosis Patients: A Spanish Preliminary Study. *Int. J. Environ. Res. Public Health* **2013**, *10*, 5697–5710. [CrossRef]
21. Ortiz, R.; Bermejo, A.; Cano-de la Cuerda, R. Realidad virtual y videojuegos. In *Nuevas Tecnologías en Neurorrehabilitación. Aplicaciones Diagnósticas y Terapéuticas*, 1st ed.; Cano-de la Cuerda, R., Ed.; Panamericana: Madrid, Spain, 2018.
22. Park, M.J.; Kim, D.J.; Lee, U.; Na, E.J.; Jeon, H.J. A Literature Overview of Virtual Reality (VR) in Treatment of Psychiatric Disorders: Recent Advances and Limitations. *Front. Psychiatry* **2019**, *10*, 505. [CrossRef] [PubMed]
23. Cano-Mañas, M.J.; Collado-Vázquez, S.; Rodríguez Hernández, J.; Muñoz Villena, A.J.; Cano-de-la-Cuerda, R. Effects of Video-Game Based Therapy on Balance, Postural Control, Functionality, and Quality of Life of Patients with Subacute Stroke: A Randomized Controlled Trial. *J. Healthc. Eng.* **2020**, *2020*, 5480315. [CrossRef]
24. Arici, F.; Yildirim, P.; Caliklar, Ş.; Yilmaz, R.M. Research trends in the use of augmented reality in science education: Content and bibliometric mapping analysis. *Comput. Educ.* **2019**, *142*, 103647. [CrossRef]
25. Kavanagh, S.; Luxton-Reilly, A.; Wuensche, B.; Plimmer, B. A systematic review of Virtual Reality in education. *Themes Sci. Technol. Educ.* **2017**, *10*, 85–119.
26. Yavuzer, G.; Senel, A.; Atay, M.B.; Stam, H.J. "Playstation eyetoy games" improve upper extremity-related motor functioning in subacute stroke: A randomized controlled clinical trial. *Eur. J. Phys. Rehabil. Med.* **2008**, *44*, 237–244.
27. Buentello-Montoya, D.A.; Lomelí-Plascencia, M.G.; Medina-Herrera, L.M. The role of reality enhancing technologies in teaching and learning of mathematics. *Comput. Electr. Eng.* **2021**, *94*, 107287. [CrossRef]
28. Polechoński, J.; Nierwińska, K.; Kalita, B.; Wodarski, P. Can Physical Activity in Immersive Virtual Reality Be Attractive and Have Sufficient Intensity to Meet Health Recommendations for Obese Children? A Pilot Study. *Int. J. Environ. Res. Public Health* **2020**, *17*, 8051. [CrossRef]
29. Stansfield, S.; Dennis, C.; Suma, E. Emotional and performance attributes of a VR game: A study of children. *Stud. Health Technol. Inform.* **2005**, *111*, 515–518. [PubMed]
30. Klahr, D.; Triona, L.M.; Williams, C. Hands on what? The relative effectiveness of physical versus virtual materials in an engineering design project by middle school children. *J. Res. Sci. Teach.* **2007**, *44*, 183–203. [CrossRef]
31. Moro, C.; Phelps, C.; Redmond, P.; Stromberga, Z. HoloLens and mobile augmented reality in medical and health science education: A randomised controlled trial. *Br. J. Educ. Technol.* **2021**, *52*, 680–694. [CrossRef]
32. Johnson-Glenberg, M.C.; Megowan-Romanowicz, C. Embodied science and mixed reality: How gesture and motion capture affect physics education. *Cogn. Res. Princ. Implic.* **2017**, *2*, 24. [CrossRef] [PubMed]
33. Liu, R.; Wang, L.; Lei, J.; Wang, Q.; Ren, Y. Effects of an immersive virtual reality-based classroom on students' learning performance in science lessons. *Br. J. Educ. Technol.* **2020**, *51*, 2034–2049. [CrossRef]
34. Creswell, J.W. *A Concise Introduction to Mixed Methods Research*, 2nd ed.; SAGE Publications: Thousand Oaks, CA, USA, 2022.
35. O'Cathain, A. *A Practical Guide to Using Qualitative Research with Randomized Controlled Trials*; Oxford University Press: Oxford, UK, 2018.
36. Ary, D.; Jacobs, L.C.; Sorensen, C. *Introduction to Research in Education*; Wadsworth, C.L., Ed.; Cengage Learning: Boston, MA, USA, 2010.
37. Hérnandez, F.; Maquillón, J.J. Introducción a Los Diseños de Investigación Educativa. In *Principios, Métodos y Técnicas Esenciales Para la Investigación Educativa*; Dialnet: Delhi, India, 2012; pp. 109–126.
38. Mannay, D.; Ward, M.R.M. The Coffee Club: An Initiative to Support Mature and Non-Traditional Higher Education Students in Wales. In *Strategies for Supporting Inclusion and Diversity in the Academy*; Springer International Publishing: Cham, Switzerland, 2022; pp. 225–245.
39. Quintanal, J.; García, B. *Fundamentos Básicos de Metodología de Investigación Educativa*; CCS: Madrid, Spain, 2012.

40. Fetters, M.D.; Curry, L.A.; Creswell, J.W. Achieving Integration in Mixed Methods Designs—Principles and Practices. *Health Serv. Res.* **2013**, *48*, 2134–2156. [CrossRef]
41. Levitt, H.M.; Bamberg, M.; Creswell, J.W.; Frost, D.M.; Josselson, R.; Suárez-Orozco, C. Journal article reporting standards for qualitative primary, qualitative meta-analytic, and mixed methods research in psychology: The APA Publications and Communications Board task force report. *Am. Psychol.* **2018**, *73*, 26–46. [CrossRef]
42. Fetters, M.D.; Molina-Azorin, J.F. A Checklist of Mixed Methods Elements in a Submission for Advancing the Methodology of Mixed Methods Research. *J. Mix. Methods Res.* **2019**, *13*, 414–423. [CrossRef]
43. Ruiz-Pérez, L.M.; Barriopedro-Negro, M.I.; Ramón-Otero, I.; Palomo-Nieto, M.; Rioja-Collado, N.; García-Coll, V.; Navia-Manzano, J.A. Evaluar la Coordinación Motriz Global en Educación Secundaria: El Test Motor SportComp. [Motor co-ordination assessment in Secondary Education: The SportComp Test]. *RICYDE Rev. Int. Ciencias Deport.* **2017**, *13*, 285–301. [CrossRef]
44. Council of Europe Committee of Experts on Sports Research. *EUROFIT: Handbook for the EUROFIT Tests of Physical Fitness*, 2nd ed.; Council of Europe Committee of Experts on Sports Research: Strasbourg, France, 1993.
45. Figueiredo, I.M.; Sampaio, R.F.; Mancini, M.C.; Silva, F.C.M.; Souza, M.A.P. Test of grip strength using the Jamar dynamometer. *Acta Fisiátrica* **2007**, *14*, 104–110. [CrossRef]
46. Rami, P.V.; Prabhakar, M.M. Comparison of Static Balance in Male Football and Basketball Players by Using Flamingo Balance Test. *Int. J. Physiother.* **2018**, *5*, 162–166. [CrossRef]
47. Berisha, M.; Cilli, M. Comparison of Eurofit Test Results of 11-17-Year- Old Male and Female Students in Kosovo. *Eur. Sci. J. ESJ* **2017**, *13*, 138. [CrossRef]
48. Yelling, M.; Lamb, K.L.; Swaine, I.L. Validity of a Pictorial Perceived Exertion Scale for Effort Estimation and Effort Production During Stepping Exercise in Adolescent Children. *Eur. Phys. Educ. Rev.* **2002**, *8*, 157–175. [CrossRef]
49. Hernández-Álvarez, J.L.; del-Campo-Vecino, J.; Martínez-de-Haro, V.; Moya-Morales, J.M. Percepción de esfuerzo en Educación Física y su relación con las directrices sobre actividad física. *Rev. Int. Med. Ciencias Act. Física Deport.* **2010**, *10*, 609–619.
50. Faul, F.; Erdfelder, E.; Lang, A.G.; Buchner, A. G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behav. Res. Methods* **2007**, *39*, 175–191. [CrossRef]
51. Cohen, J. *Statistical Power Analysis for the Behavioral Sciences*; Routledge: Oxfordshire, UK, 2013.
52. Ward, M.R.M.; Delamont, S. *Handbook of Qualitative Research in Education*; Edward Elgar Publishing: Cheltenham, UK, 2022.
53. Malterud, K.; Siersma, V.D.; Guassora, A.D. Sample Size in Qualitative Interview Studies. *Qual. Health Res.* **2016**, *26*, 1753–1760. [CrossRef]
54. Braun, V.; Clarke, V. Using thematic analysis in psychology. *Qual. Res. Psychol.* **2006**, *3*, 77–101. [CrossRef]
55. Nowell, L.S.; Norris, J.M.; White, D.E.; Moules, N.J. Thematic Analysis. *Int. J. Qual. Methods* **2017**, *16*, 160940691773384. [CrossRef]
56. Ethical principles of psychologists and code of conduct. *Am. Psychol.* **2002**, *57*, 1060–1073. [CrossRef]
57. Estevan, I.; Bardid, F.; Utesch, T.; Menescardi, C.; Barnett, L.M.; Castillo, I. Examining early adolescents' motivation for physical education: Associations with actual and perceived motor competence. *Phys. Educ. Sport Pedagog.* **2021**, *26*, 359–374. [CrossRef]
58. Juliano, J.M.; Liew, S.L. Transfer of motor skill between virtual reality viewed using a head-mounted display and conventional screen environments. *J. Neuroeng. Rehabil.* **2020**, *17*, 48. [CrossRef]
59. Bae, M.H. The Effect of a Virtual Reality-Based Physical Education Program on Physical Fitness among Elementary School Students. *Iran. J. Public Health* **2023**, *52*, 371. [CrossRef] [PubMed]
60. Gómez-García, M.; Trujillo-Torres, J.M.; Aznar-Díaz, I.; Cáceres-Reche, M.P. Augment reality and virtual reality for the improvement of spatial competences in Physical Education. *J. Hum. Sport Exerc.* **2018**, *13*, S189–S198.
61. Dong, Y.; Liu, X.; Tang, M.; Huo, H.; Chen, D.; Du, X.; Wang, J.; Tang, Z.; Qiao, X.; Guo, J.; et al. Age-related differences in upper limb motor performance and intrinsic motivation during a virtual reality task. *BMC Geriatr.* **2023**, *23*, 251. [CrossRef] [PubMed]
62. Marcora, S.M.; Staiano, W.; Manning, V. Mental fatigue impairs physical performance in humans. *J. Appl. Physiol.* **2009**, *106*, 857–864. [CrossRef] [PubMed]
63. Van Cutsem, J.; Marcora, S.; De Pauw, K.; Bailey, S.; Meeusen, R.; Roelands, B. The Effects of Mental Fatigue on Physical Performance: A Systematic Review. *Sport. Med.* **2017**, *47*, 1569–1588. [CrossRef] [PubMed]
64. Audiffren, M.; André, N. The exercise–cognition relationship: A virtuous circle. *J. Sport. Heal. Sci.* **2019**, *8*, 339–347. [CrossRef] [PubMed]
65. Shenhav, A.; Musslick, S.; Lieder, F.; Kool, W.; Griffiths, T.L.; Cohen, J.D.; Botvinick, M.M. Toward a Rational and Mechanistic Account of Mental Effort. *Annu. Rev. Neurosci.* **2017**, *40*, 99–124. [CrossRef]
66. Koivisto, J.; Hamari, J. The rise of motivational information systems: A review of gamification research. *Int. J. Inf. Manag.* **2019**, *45*, 191–210. [CrossRef]
67. Kilpatrick, M.; Hebert, E.; Bartholomew, J. College Students' Motivation for Physical Activity: Differentiating Men's and Women's Motives for Sport Participation and Exercise. *J. Am. Coll. Health* **2005**, *54*, 87–94. [CrossRef]
68. Arufe-Giráldez, V.; Sanmiguel-Rodríguez, A.; Ramos-Álvarez, O.; Navarro-Patón, R. Gamification in Physical Education: A Systematic Review. *Educ. Sci.* **2022**, *12*, 540. [CrossRef]
69. Staiano, A.E.; Calvert, S.L. Exergames for Physical Education Courses: Physical, Social, and Cognitive Benefits. *Child Dev. Perspect.* **2011**, *5*, 93–98. [CrossRef] [PubMed]
70. Patricio, D.; Aires, Y.R.; Medeiros, C.M. Gamification: A Tool to Increase the Frequency of Physical Activity in Overweight Adolescents. *J. Exerc. Physiol. Online* **2020**, *23*, 13–24.

71. Criollo-C, S.; Guerrero-Arias, A.; Guaña-Moya, J.; Samala, A.D.; Luján-Mora, S. Towards Sustainable Education with the Use of Mobile Augmented Reality in Early Childhood and Primary Education: A Systematic Mapping. *Sustainability* **2024**, *16*, 1192. [CrossRef]
72. Brady, S.; Kang, E.; Louime, E.; Naples, S.; Katz, A.; Hira, A. Emerging Learning Technologies for Education on Sustainability Topics. In Proceedings of the 9th Research in Engineering Education Symposium and 32nd Australasian Association for Engineering Education Conference, REES AAEE 2021: Engineering Education Research Capability Development, Perth, Australia, 5–8 December 2021; pp. 202–214.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.