2024, Retos, 61, 156-163

What is the learning model of physical education in the digital era? Literature review of various studies

¿Cuál es el modelo de aprendizaje de la educación física en la era digital? Revisión bibliográfica de diversos estudios

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Abstract. The digital age has changed the landscape of physical education (PE), with technology playing an important role in the learning process. This article reviews various studies on the use of technology in physical education to understand the trends, benefits, and challenges in implementing digital learning models. The search in this study used the Harzing Publish or Perish application. The search was initiated using the Scopus database with keywords ("learning model" AND "physical education" OR "sports education" AND "digital era"). Initially, 12.654 publications were identified through the database search (Scopus: 2,831 articles). After following exclusion criteria, only 10 articles remained. The search was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The review showed that technologies such as mobile apps, e-learning, virtual reality, digital media, and video games can improve student motivation, engagement, and understanding. However, challenges such as infrastructure limitations, user readiness, and potential reduction of physical aspects in physical learning need to be considered. Therefore, a balanced approach between the use of technology and physical activity is needed, as well as adequate support to maximize the benefits of technology in physical education. Further research is recommended to explore more effective strategies in integrating technology into physical education learning across different contexts. Although there are many studies on adolescent girls' lack of engagement in Physical Education (PE) in the literature, most only investigate the root causes, while few take initiatives to address the inherent problems.
Keywords: learning model, physical education, digital era, technological advancement

Resumen. La era digital ha cambiado el panorama de la educación física (EF), en la que la tecnología desempeña un papel importante en el proceso de aprendizaje. Este artículo revisa diversos estudios sobre el uso de la tecnología en la educación física para comprender las tendencias, beneficios y desafíos en la implementación de modelos de aprendizaje digital. La búsqueda en este estudio utilizó la aplicación Harzing Publish or Perish. La búsqueda se inició utilizando la base de datos Scopus con las palabras clave («learning model» AND «physical education» OR «sports education» AND «digital era»). Inicialmente, se identificaron 12.654 publicaciones a través de la búsqueda en la base de datos (Scopus: 2.831 artículos). Tras seguir los criterios de exclusión, sólo quedaron 10 artículos. La búsqueda se realizó siguiendo las directrices de los Elementos de Información Preferidos para Revisiones Sistemáticas y Metaanálisis (PRISMA). La revisión mostró que tecnologías como las aplicaciones móviles, el aprendizaje electrónico, la realidad virtual, los medios digitales y los videojuegos pueden mejorar la motivación, el compromiso y la comprensión de los estudiantes. Sin embargo, es necesario tener en cuenta retos como las limitaciones de infraestructura, la preparación de los usuarios y la posible reducción de los aspectos físicos en el aprendizaje físico. Por lo tanto, es necesario un enfoque equilibrado entre el uso de la tecnología y la actividad física, así como un apoyo adecuado para maximizar los beneficios de la tecnología en la educación física. Se recomienda seguir investigando para explorar estrategias más eficaces en la integración de la tecnología en el aprendizaje de la educación física en diferentes contextos. Aunque existen muchos estudios en la literatura sobre la falta de compromiso de las adolescentes en la Educación Física (EF), la mayoría sólo investigan las causas fundamentales, mientras que pocos toman iniciativas para abordar los problemas inherentes.
Palabras clave : modelo de aprendizaje, educación física, era digital, avances tecnológicos

Fecha recepción: 26-08-24. Fecha de aceptación: 10-09-24
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Introduction

The rapid advancement of digital technology has transformed numerous aspects of life, including physical education (Aziz et al., 2023). In today's digital age, integrating technology into the learning process has become essential to enhancing both the effectiveness and efficiency of education (Wayan Mertha & Mahfud, 2022). Physical education learning models are evolving with the incorporation of digital tools, such as mobile applications, software, e-learning platforms, and interactive technologies that are easily accessible to learners (Williamson et al., 2020). The ongoing debate surrounding the role of technology in improving education, particularly in teacher training, has been a prominent discussion within the academic community for several years (Murtagh et al., 2023). The synergy between education and technology is a continuously developing phenomenon (Fawns, 2022).

During the Covid-19 pandemic, digital education became the primary mode of interaction between teachers and students (Williamson et al., 2020), a trend that continues to influence the digital transformation of higher education (Bygstad et al., 2022). The surge in research focused on online teaching and learning has significantly expanded, with studies investigating the lessons learned from remote education during and after the pandemic (Carrillo & Flores, 2020; Harianto et al., 2023; Pokhrel & Chhetri, 2021). These studies not only shed light on the impact of online pedagogy on student achievement (Gopal et al., 2021; Hofer et al., 2021; Rizqika Rizal et al., 2022), but also examine the digital competencies required by teachers to effectively navigate

the online teaching environment(König et al., 2020; Sailer et al., 2021).

Physical education, which plays a crucial role in promoting the physical and mental well-being of students (Jiang Wen Ming et al., 2023; Mariati et al., 2024), also fosters the development of character in younger generations (Malicka et al., 2019). To achieve these goals, students must attain a healthy balance of physical and mental fitness (Silva et al., 2019). Digital-based physical education models offer several benefits, including broader access to learning resources, flexible scheduling, and the ability to tailor learning experiences to individual student needs (Haleem et al., 2022; Laurent et al., 2021; Pelamonia & Puriana, 2023). These models align with 21st-century educational approaches that emphasize digital literacy, collaboration, and problem-solving (Wawrzyniak et al., 2021). However, while theoretical frameworks exist to guide the use of technology in training physical education teachers (Gawrisch et al., 2020; Institute of Medicine, 2013), there remains a lack of comprehensive knowledge regarding best practices for online teaching and learning in physical education.

Despite its many advantages, the implementation of digital-based physical education models faces several challenges. These include limited access to technology in certain regions, the preparedness of both teachers and students to effectively use technological tools, and the need to ensure that technology does not overshadow the physical component of physical education, which remains the core focus of the subject (Yusroni, 2024). Several studies have demonstrated that the use of technology, such as mobile apps and wearable devices, can enhance students' motivation and engagement in physical activities. Research by Casey et al., (2017) indicates that physical activity-based apps can help students monitor their progress and provide real-time feedback, fostering greater participation and commitment to learning.

Studies conducted by Adinda, (2021), emphasized the importance of e-learning platforms in physical education, especially in pandemic situations where face-to-face learning is limited. E-learning allows teachers to deliver theoretical material and provide resources that can be accessed by students at any time (Rozi et al., 2021). However, Athaya also noted that the physical aspect of physical education should still be prioritized and technology should only be used as a complement (Athaya et al., 2023). Study by Friskawati et al., (2020), identified some challenges in implementing technology in physical education, such as limited infrastructure in some schools and lack of training for teachers. In addition, readiness and support from the school and the provision of adequate resources are the keys to success in implementing digital learning models (Aditya, 2021).

Therefore, it is necessary to find solutions to overcome the problems of physical education learning in the digital era. These problems will be reviewed through a literature study on physical education learning in the digital era to provide an overview of how management and methods can be carried out in physical education learning both at the school level and at the campus level in organizing learning.

Materials and Methods

Search Strategy

The search in this study used the Harzing Publish or Perish application. The search began using the Scopus database which is considered one of the leading indexing systems for citations (Samsuddin et al., 2020). Where the source is most frequently visited by previous researchers around the world. The search strategy included a combination of keyword variations ("learning model" AND "physical education" OR "sports education" AND "digital era"). The search was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Mohamed Shaffril et al., 2019; Simplicio et al., 2024). In addition, PRISMA emphasizes review reports that evaluate randomized trials which can also be used as a basis in systematic review reporting for other types of research.

Exclusion Criteria

The exclusion criteria were as follows: (1) Articles not published in journals indexed by the Scimago Journal Rank (SJR), (2) Articles written in languages other than English, (3) Articles published outside the 2019-2024 time frame, and (4) Articles that do not specifically address physical education learning models in the digital era.

Procedure

Initially, 12,654 publications were identified through database searches (Scopus: 2,831 articles). After following the exclusion criteria, only 10 articles remained. Most of the items were discarded because the articles did not address physical education learning models in the digital era. All articles were extracted from the source and analyzed through Mendeley software to remove duplicate articles. The PRISMA flow can be seen in Figure 1.

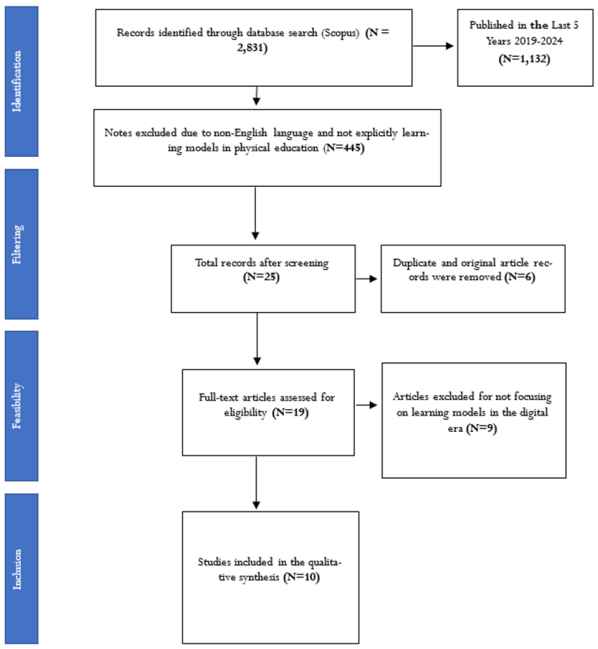

Figure 1. PRISMA Research Flow Diagram

Results

The search results obtained articles totaling 10 which are attached in table 1. this research discusses How is the learning model of physical education in the digital era? In this study, the country category is not displayed, because all articles focus globally on character content in martial arts.

Table 1.
Results of the review of articles that match the research theme

Author and Year	Content	Research Objectives	Research Results
(Chambers & Sandford, 2019)	Model of values fluency education	To examine some of the challenges faced for students and educators with respect to value-based practices in digitally mediated spaces	In this conceptual paper, we propose a value fluency praxis model to help PE teachers support young people to recognize and successfully navigate hybrid spaces, to engage critically with sociotechnical capital and to become adept at transferring and translating values across and between social contexts.
(Trabelsi et al., 2020)	Video-based peer feedback	To investigate the impact of peer-to-peer feedback interactions on adolescent girls' engagement in physical education classes, in addition to assessing the potential of video technology in enhancing the physical education experience.	The findings of this study conclude that peer feedback interactions during physical education classes are inefficient without the mediating role of video technology.
(Vega-Ramírez et al., 2020)	Mobile Applications	To analyze the use of smartphones by 40 Spanish adolescents and assess the satisfaction level of the Polar Beat app in physical education subjects.	The Polar Beat app in physical education classes has enabled them to better understand the content developed; students confirmed that their motivation towards physical and sports activity increased with the knowledge and use of the Polar Beat app and that smartphones are an innovative and effective tool.
(Williams et al., 2020)	Traditional versus online learning	To examine the differences in perceptions and experiences of high school students in traditional versus online physical education and health courses.	The results show that positive perceptions of students in online high school classes can match or exceed positive perceptions of students in traditional face-to-face formats. More and more young people are showing an increased capacity to take online courses. Physical education classes are traditionally organized face-to-face, but need to be further considered as an online platform.
(Kok et al., 2020)	Self-controlled video feedback learning	(1) To examine the effect of self-controlled video feedback on students' motor learning and self-efficacy in a physical education environment when students obtain relatively independent feedback from teachers. (2) To examine the extent to which self-control and self-efficacy during practice predict students' motor learning.	Self-controlled video feedback without teacher guidance on movement technique produced the same learning effects as traditional teacher guidance in a physical education context. Self-control of feedback delivery (i.e. timing and frequency) appeared to have positive effects on self-efficacy and perceived learning effects, but did not lead to better motor learning or perceived enjoyment.
(Segura-Robles et al., 2020)	Flipped Learning and Gamification	To analyze the effect of flipped programs and gamification on Physical Education students' autonomy, competence, relationships with others, satisfaction/enjoyment, intrinsic and extrinsic motivation, and boredom.	The results of the study provide valuable information for education researchers to better understand how flipped learning and gamification affect Physical Education students' personal performance.
(Østerlie & Mehus, 2020)	Flipped Learning on Cog-	to examine whether and how the introduction	The results showed a negative motivational change for male students

	nitive Knowledge Learning and Intrinsic Motivation	of a flipped learning (FL) framework in Norwegian junior and senior secondary school physical education (PE) can influence students' situational motivation and health-related fitness knowledge (HRFK).	unless the activity change was placed within the reason for explanation through FL. The application of FL led to more cognitive knowledge learning, which resulted in higher levels of HRFK among girls and boys
(Cheng, 2021)	Embedded web systems and virtual reality	To demonstrate the important role of virtual reality immersive physical education model in current physical education and analyze the virtual reality immersive physical education model.	Students' interest in learning will increase, and efficiency will also be greatly improved. Virtual reality can not only provide students with new learning experiences but also can be used to strengthen teachers' teaching skills. Since virtual reality can simulate a real teaching environment, teachers can use this set of tools to try out new course materials and improve classroom management capabilities.
(Greve et al., 2022)	Digital media	Design, implement and evaluate teaching units for the use of digital media in physical education	The use of digital media opens up new possibilities in the context of learning and movement experiences. In addition to the function of learning with media, the use of digital media in physical education also means that students learn something about the media, for example when the use of media generates personal data that is used by students and teachers.
(Merino-Campos et al., 2023)	Video Games	To explore how elements such as technological competence, game-based learning, accessibility and fun are relevant factors that influence the acceptance of using video games as learning aids in the context of physical education, as well as their influence on academic performance in the subject itself.	Our findings show that the factors studied, namely accessibility, fun, technological competence, and learning through video games, have an impact on students' acceptance of video games as an educational tool and how this positive relationship leads to improved academic performance in physical education.

Discussion

It is well known that technology has made a significant impact on modern society. Research shows that by 2017, nearly 3.5 billion people worldwide were using the Internet, and smartphone subscriptions were approaching 8 billion. Moreover, 70% of global internet users aged between 15 and 24 were online, with a significantly higher percentage (71%) of this age group using the Internet compared to the general population (48%) (Union, 2015). Given these statistics, it is no surprise that digital communication, surpassing traditional and analog media, has become the most widely used form of communication globally (Jill Attewell & Douch, 2009). In our study, we examined various research papers on the integration of technology in physical education to identify current trends, benefits, and challenges associated with implementing this learning model.

Based on this review, the objectives and outcomes of the research they developed can be divided into three groups.

Models of values fluency education, traditional versus online learning and embedded web systems and virtual reality: In this first group, there are three articles that discuss learning models in physical education. The first article aims to examine some of the challenges faced for students and educators with respect to values-based practices in digitally mediated spaces. In this conceptual paper, it proposes a model of value fluency praxis to help physical education teachers support young people to recognize and successfully navigate hybrid spaces, to engage critically with sociotechnical capital and to become adept at transferring and translating values across and between social contexts (Chambers & Sandford, 2019). The second article aimed to examine the differences in perceptions and experiences of high school students in traditional versus online physical education and health courses. The results suggest that positive perceptions of students in online high school classes can match or exceed positive perceptions of students in traditional face-to-face formats. More and more young people are showing an increased capacity to take online courses. Physical education classes are traditionally organized face-to-face, but need further consideration as an online platform (Williams et al., 2020). The third article aims to show the important role of the virtual reality immersive physical education model in current physical education and analyze the virtual reality immersive physical education model. Students' interest in learning will increase, and efficiency will also be greatly improved. Virtual reality can not only provide students with new learning experiences but also can be used to strengthen teachers' teaching skills. Since virtual reality can simulate a real teaching environment, teachers can use this set of tools to try out new course materials and improve classroom management capabilities (Cheng, 2021).

In this second group, there are four articles that discuss learning models in physical education in the digital era, namely Video-based peer feedback (Trabelsi et al., 2020), mobile applications (Vega-Ramírez et al., 2020), digital media (Greve et al., 2022), and video games (Merino-Campos et al., 2023). The first article aimed to investigate the impact of peer feedback interactions on adolescent girls' engagement in Physical Education classes, in addition to assessing the potential of video technology in enhancing the experience. The findings of this study concluded that peer feedback interactions during physical education classes are inefficient without the mediating role of video technology (Trabelsi et al., 2020). The second article aimed to analyze the use of smartphones by 40 Spanish adolescents and assess the satisfaction level of the Polar Beat application in physical education subjects. Results showed that the Polar Beat application in physical education classes has allowed them to better understand the developed content; students confirmed that their motivation towards physical and sports activity increased with the knowledge and

use of the Polar Beat application and that smartphones are an innovative and effective tool (Vega-Ramírez et al., 2020). The third article aims to design, implement and evaluate a teaching unit for the use of digital media in physical education. The use of digital media opens up new possibilities in the context of learning and movement experiences. In addition to the learning function with media, the use of digital media in physical education also means that students learn something about the media, for example when the use of media generates personal data that is used by students and teachers (Greve et al., 2022). Finally, the fourth article explores how elements such as technological competence, game-based learning, accessibility and fun are relevant factors that influence the acceptance of using video games as learning aids in the context of physical education, as well as their influence on academic performance in the subject itself. Our findings show that the factors studied, namely accessibility, fun, technological competence and learning through video games, have an impact on students' acceptance of video games as an educational tool and how this positive relationship leads to improved academic performance in physical education (Merino-Campos et al., 2023).

Furthermore, in this third group, there are three articles that discuss learning models in physical education in the digital era, namely self-controlled video feedback learning (Kok et al., 2020), flipped learning and gamification (Segura-Robles et al., 2020)and flipped learning on cognitive knowledge learning and intrinsic motivation (Østerlie & Mehus, 2020). The first article aims (1) To examine the effect of self-controlled video feedback on students' motor learning and self-efficacy in a physical education setting when students obtain feedback relatively independent of the teacher. (2) To examine the extent to which self-control and self-efficacy during practice predict students' motor learning. Results indicated self-controlled video feedback without teacher guidance on movement technique produced similar learning effects as traditional teacher guidance in a physical education context. Self-control over feedback delivery (i.e. timing and frequency) appeared to have a positive effect on self-efficacy and perceived learning effects, but did not lead to better motor learning or perceived enjoyment (Kok et al., 2020). The second article aimed to analyze the effect of flipped programs and gamification on Physical Education students' autonomy, competence, relationships with others, satisfaction/enjoyment, intrinsic and extrinsic motivation, and boredom. The results provided valuable information for education researchers to better understand how flipped learning and gamification affect Physical Education students' personal performance. (Segura-Robles et al., 2020). Finally, the third article aimed to examine whether and how the introduction of a flipped learning (FL) framework in Norwegian junior and senior secondary school physical education (PE) could affect students' situational motivation and health-related fitness knowledge (HRFK). The results showed negative motivational changes for male students unless activity changes were placed within the explanatory rationale through FL. The implementation of FL led to more cognitive knowledge learning, which resulted in higher levels of HRFK among girls and boys (Østerlie & Mehus, 2020).

This research reviewed studies on the use of technology in physical education, focusing on the trends, benefits and challenges of implementing digital learning models. For that purpose, only research articles that discuss physical education learning models in the digital era were reviewed. Based on this review, it is divided into four categories namely (i) Author and Year, (ii) Content, (iii) Research Objectives, and (iv) Research Results. Overall, this review shows that digital technologies offer a range of opportunities to enhance learning in physical education, but also present challenges that need to be managed well. Physical education learning models in the digital era offer a range of potentials to improve the quality of learning (Bodsworth & Goodyear, 2017; Koekoek et al., 2018; Palao et al., 2015). However, its successful implementation is highly dependent on infrastructure readiness, teacher competence and a balanced approach between the use of technology and physical activity (Paličk a et al., 2016). Further research is needed to address these challenges and explore innovative ways to integrate technology in physical education.

Conclusion

A literature review of studies on physical education learning models in the digital era shows that technology integration has great potential to improve the quality and effectiveness of learning. Digital technologies, such as mobile apps, e-learning platforms, virtual reality, digital media and video games, have been shown to increase students' motivation, engagement and understanding of physical education materials. However, the implementation of digital learning models is also faced with several challenges. These include infrastructure limitations, teacher and student readiness to utilize technology, and the risk of reducing the physical aspect of physical learning, which is at the core of the subject. Nonetheless, the studies reviewed show that the use of technology, when balanced with the right approach, can yield positive results and even match or surpass traditional learning. In conclusion, physical education learning models in the digital era should integrate technology wisely and in balance with physical activity. Adequate support from infrastructure, teacher training, as well as innovative pedagogical strategies are essential to maximize the benefits of technology in physical education. Further research is needed to explore more effective and adaptive approaches to the challenges and to continue developing relevant learning models in this digital era. Future researchers can add other keywords and databases such as ERIC, EBSCO (SPORTDiscus and Psy-chology & Behavioral Sciences Collection) and other databases in the article search.

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