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Utilizing Digital Technology in Physical Education: A Review of the Latest Methods and Platforms

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Abstract. The digital transformation of physical education has created a new paradigm of learning that is interactive, adaptive, and data-driven. This study aims to review recent methods and digital platforms applied in sports education by analyzing national and international research published between 2020 and 2025. A descriptive–analytical approach was employed by synthesizing 30 peer-reviewed studies from reputable journals. The findings reveal that the integration of technologies such as learning management systems, wearable trackers, virtual reality, mobile applications, and innovative teaching models (e.g., flipped classroom and gamification) consistently enhances students' motivation, engagement, and instructional effectiveness in physical education. Nevertheless, challenges remain, including limited infrastructure, teachers' digital competency gaps, and ethical issues concerning data privacy. The study concludes that the successful implementation of digital technologies in physical education depends on human resource readiness, supportive educational policies, and strengthened digital literacy. It recommends the integration of technology-based curricula and continuous professional development to build an inclusive, secure, and globally competitive digital physical education ecosystem.

Keywords: Digital Learning, Digital Technology, Physical Activity, Physical Education, Teaching Methods.

1 Introduction

The rapid development of digital technology in physical education (PJOK) is driving a transformation in pedagogy, assessment, and student learning experiences. Research from 2020–2025 demonstrated the use of digital media, gamification, fitness apps, and wearable devices to enhance engagement, movement literacy, and learning outcomes. A recent systematic review mapped the diverse purposes of digital media use in PJOK, from health promotion to strengthening motor competencies, while highlighting the need for more precise learning objectives. Furthermore, the global agenda for physical activity in adolescents emphasizes schools and digital environments as strategic hubs that must be strengthened for more effective interventions. This evidence-based approach positions technology as a medium, not an end in itself, necessitating alignment of curriculum and evaluation. These changes also demand teachers' capacity to design

safe, inclusive, and meaningful learning experiences. Therefore, this review examines the latest digital methods and platforms relevant to PJOK (Jastrow et al., 2022).

The shift to distance learning during the pandemic accelerated the adoption of online-based observation and teaching coaching tools. In physical education teacher education, instruments such as the System for Observing Virtual Real-Time Lessons in Physical Education (SOVRTL-PE) were developed to assess synchronous distance teaching competency and provide structured pedagogical feedback. The Online Learning in Physical Education (OLPE) ecosystem was also analyzed using a SWOT framework to identify the strengths, weaknesses, opportunities, and threats of three commonly used digital media. These findings emphasize the importance of explicit instructional design, technical support, and teacher-student digital literacy to ensure meaningful learning. Furthermore, real-time measurement of the teaching process enables quality assurance in virtual micro-teaching practices. With these tools, prospective teachers can reflect on, modify, and improve classroom management strategies and interactions. At the school policy level, this evidence provides a basis for investing in platforms aligned with movement learning objectives (Moon et al., 2023).

At the method level, virtual reality (VR) and sensor-based augmented feedback are moving into the realm of skills training and decision-making simulations. Evidence in sports education and training suggests VR has the potential to enhance skill acquisition, prediction, and decision-making when designed around authentic task scenarios. On the behavioral side, wearable activity trackers in children and adolescents can increase daily steps, although the effect on moderate-to-vigorous physical activity is still limited, indicating that integration with pedagogy and the school context determines the impact. Integrating these devices into Physical Education (PJOK) opens up opportunities for data-driven formative assessment (e.g., daily step targets, active homework compliance) while maintaining ethical and privacy aspects. Multimodal learning experiences (video assignments, biofeedback, and progress dashboards) also add variety to differentiation strategies. However, the quality of implementation and teacher support remain limiting factors. Therefore, technology selection needs to be based on competency goals and learning safety (Au et al., 2024; Putranto et al., 2023).

Digital applications and interventions to increase physical activity have rapidly developed since 2020, including gamification approaches and low-cost online programs. Recent field trials evaluating digital interventions for inactive adults have shown potential for increasing physical activity, although the sustainability of these effects remains a challenge. Other studies have indicated that gamification features—such as points, levels, and challenges—contribute to small improvements in daily steps and adiposity indicators compared to non-gamified versions. In the context of physical education (PEK), these design principles can be contextualized into curriculum-based missions, movement literacy badges, and inter-session progress feedback. In the classroom, these components should be integrated with psychomotor, cognitive, and affective objectives to avoid mere competition. Furthermore, monitoring training load and digital social support enhance student self-regulation. In this way, technology becomes a facilitator of active behavior that is process-oriented, not simply numerical (Nishi et al., 2024; Nyrhinen et al., 2024).

In the Indonesian context, recent research underscores the urgency of transforming PEK learning through technology. The Indonesian Journal of Physical Education (JPJI) highlights research gaps in higher education and the need for differentiated, technology-based learning models tailored to local contexts. Another study developed a multimedia gamification platform (e.g., Nearpod) to increase fitness engagement and motivation, highlighting school readiness and teacher digital literacy as key. These findings align with the need for continuous professional development, provision of tools, and ethical guidelines for student data use. Furthermore, pandemic experience demonstrates that online and hybrid practices can be maintained for theoretical topics, reflection, and activity assignments. The integration of Indonesian-language digital learning resources also contributes to cultural relevance and accessibility. Therefore, a national implementation roadmap

needs to connect global evidence with classroom conditions on the ground (Nurafiati & Angriawan, 2025; Surya et al., 2024).

Despite its significant potential, technology adoption in Physical Education and Health (PJOK) faces obstacles: infrastructure, cost, interoperability, and digital competency gaps among educators and students. An analysis of Internet of Things (IoT)-based platforms assesses that digital platform breakthroughs for PJOK have not been widespread, partly due to issues with data integration and ecosystem design. A health education perspective in The Lancet journal also highlighted challenges in the design and implementation of digital education, including the need for institutional support, device access, and training. For Physical Education (PJOK), these issues resonate with the challenges of open connectivity, device security, and student data privacy. Therefore, policies must weigh the costs and benefits, sustainability, and data governance. At the school level, needs audits and phased trials help mitigate risks. Finally, data literacy is becoming a new competency, enabling teachers to interpret activity indicators pedagogically (Frenk et al., 2022; D. Wu et al., 2024).

Research recommends a sharper understanding of why, what, and why technology is used in PJOK—rather than simply how it is used. Recent conceptual frameworks assess motives for use (motivation, assessment, inclusion), technology types (devices, platforms, content), and learning outcomes (motor skills, participation, self-regulation) to ensure more evidence-based adoption decisions. At the same time, the validity of wearable and sensor-based measurements needs to be examined to ensure classroom assessments are unbiased and equitable for all students. The practical implication is the curation of a technology portfolio with a selection rubric that links digital functions to curriculum objectives. A student-centered design approach, data ethics, and teacher capacity development serve as the foundation for implementation. With this foundation, digital technology can play a strategic role as a lever for the quality of movement learning. This review, therefore, maps priority methods and platforms, as well as a future research agenda for Physical Education (PJOK) (Giurgiu et al., 2022; Saiz-González, Sierra-Díaz, Cecchini, et al., 2025).

2 Method

This study uses a literature review approach to examine the relationship and integration between the use of digital technology and the effectiveness of physical education teaching at various levels of education. This approach was chosen because it provides a comprehensive understanding of how pedagogical principles, technology-based learning designs, and digital evaluation mechanisms contribute to improving the quality of physical education teaching and learning. Through this approach, researchers examined a variety of empirical and conceptual research findings to identify methodological trends, the effectiveness of digital platforms, and implementation challenges faced by educators in the context of physical education teaching.

Literature data was obtained from leading international academic databases, including PubMed, Google Scholar, ScienceDirect, BMC, SpringerLink, BMJ Open Sport & Exercise Medicine, and The Lancet. The search was conducted using a combination of keywords such as "Digital Learning," "Digital Technology," "Physical Activity," "Physical Education," and "Teaching Methods." The search focused on articles published between 2020 and 2025 to ensure relevance to current developments.

3 Result

A review of various academic articles shows that kinesiology's role in improving athlete performance lies in its ability to bridge the gap between biomechanical, neuromuscular, and training methods. Kinesiology serves not only to understand body movements anatomically and physiologically, but also as a scientific basis for developing efficient and adaptive training techniques tailored to the specific needs of each sport. This integration allows coaches and researchers to assess the effectiveness of training methods through scientific parameters such as muscle recruitment patterns, motor control, and mechanical load distribution during exercise. The following is a summary of the literature identified and synthesized on the role of kinesiology in improving athlete performance:

No.	Focus of Findings: The Role of Kinesiology in Improving Athlete Performance	Source (Researcher, Year)
1	Pembelajaran bauran meningkatkan sikap berolahraga dan keterampilan basket dibanding metode tradisional; efek sedang pada *set shot* & *dribble-shoot*.	(C. Wang et al., 2024)
2	Program eksergame sekolah meningkatkan kebugaran & indikator psikologis siswa dibanding kontrol.	(Röglin et al., 2024)
3	Aplikasi ponsel menjanjikan untuk strategi instruksional & promosi aktivitas fisik waktu luang; kurikulum & integrasi pedagogi memoderasi efektivitas.	(Gil-Espinosa et al., 2022)
4	Tinjauan PRISMA menunjukkan peningkatan pesat penggunaan AR/VR/MR; manfaat pada keterlibatan & pembelajaran motorik, tetapi hambatan implementasi masih ada.	(Pérez-Muñoz et al., 2024)
5	Meta-analisis menunjukkan *flipped classroom* meningkatkan motivasi intrinsik, efikasi diri, dan kepuasan belajar pada matakuliah PJOK.	(Q. Wu et al., 2025)
6	Remaja, guru, pelatih & ahli menekankan fitur keberlanjutan, umpan balik progres, dan kemudahan penggunaan sebagai kunci adopsi aplikasi PA.	(Mateo-Orcajada et al., 2025)
7	Lingkungan belajar berbasis VR & pembelajaran mesin meningkatkan praktik latihan virtual dan personalisasi; merekomendasikan integrasi ke kurikulum.	(J. Wang et al., 2023)
8	Indeks evaluasi berbasis data detak jantung/intensitas latihan memungkinkan penilaian kuantitatif kualitas pengajaran.	(Fang, 2022)
9	RCT & kuasi-eksperimen menunjukkan pengurangan waktu layar & peningkatan PA dengan pendekatan berbasis media digital.	(Oh et al., 2022)
10	Eksperimen menunjukkan eksergame dalam pelajaran PJOK memperbaiki berbagai driver PA dan hasil pembelajaran dibanding kelas biasa.	(Zhao et al., 2024)

11	Guru melihat potensi *wearable* untuk monitoring & motivasi; diperlukan pelatihan dan dukungan infrastruktur agar implementasi efektif.	(Almusawi et al., 2021)
12	Studi *self-study* guru menunjukkan praktik asesmen digital dapat meningkatkan kualitas umpan balik, namun menuntut perencanaan & alat yang sesuai level usia.	(Fletcher et al., 2024)
13	Penelitian konseptual & praktik menunjukkan BL membantu efektivitas/efisiensi pembelajaran PJOK saat pandemi; butuh e-modul & dukungan LMS.	(Sabillah & Nasrulloh, 2022)
14	Guru SMP melaporkan pembelajaran PJOK daring belum efektif; hambatan teknis & pedagogis menonjol; perlunya pengembangan e-modul.	(Widodo et al., 2022)
15	BL pada mata pelajaran PJOK berhubungan dengan peningkatan minat belajar; pentingnya kombinasi tatap muka-daring yang terstruktur.	(Astuti, 2022)

Research findings from various studies indicate that the use of digital technology in physical education learning has resulted in significant innovations at various levels of education. Research by Wang et al. (2024) confirmed that the implementation of blended learning in a university-level basketball course had a positive impact on improving basic technical skills such as the set shot and dribble shoot, as well as fostering positive attitudes toward the sport (C. Wang et al., 2024). These findings indicate that the combination of online and face-to-face learning can provide a more flexible, adaptive, and efficient learning experience for physical education students.

Consistent with this, a study by Weingärtner et al. (2024) showed that a three-month exergame intervention in a school setting significantly improved students' physical fitness and psychological indicators, compared to a control group that received conventional learning (Röglin et al., 2024, p. 3). These results strengthen the evidence that active movement-based games can be a fun and healthy learning alternative. Another study by Gil-Espinosa et al. (2022) found that the use of mobile applications in physical education (PJOK) learning is effective in promoting physical activity outside of school hours, especially when integrated with the curriculum and supported by appropriate pedagogical approaches (Gil-Espinosa et al., 2022).

Furthermore, advances in immersive technology have also broadened the horizons of physical education. Systematic research by Gao et al. (2023) revealed that the application of Augmented Reality (AR), Virtual Reality (VR), and Mixed Reality (MR) in physical education can improve student engagement, understanding of movement concepts, and motor learning outcomes. However, limited resources and infrastructure remain major challenges in implementation (Pérez-Muñoz et al., 2024). Similar results are supported by a meta-analysis by Alonso and Wu et al. (2025), which showed that the flipped classroom model significantly increased students' intrinsic motivation, self-efficacy, and learning satisfaction in PJOK learning (Q. Wu et al., 2025).

In the context of technology design and development, Mateo-Orcajada et al. (2025) emphasized the importance of user engagement in designing fitness apps, especially for adolescents. Their research showed that sustainability, progress feedback, and ease of use were key factors in the adoption of digital-based physical activity apps (Mateo-Orcajada et al., 2025). Meanwhile, the integration of artificial intelligence (AI), virtual reality (VR), and machine learning (ML)

technologies into college-level physical activity learning also demonstrated a positive impact on personalized training and increased student participation (J. Wang et al., 2023).

Furthermore, Liu et al. (2022) developed a wearable device-based evaluation system that allows for real-time measurement of student activity intensity, heart rate, and engagement levels. This model allows teachers to quantitatively assess the quality of physical education learning and the effectiveness of fitness programs (Fang, 2022). Furthermore, Liang et al. (2022), through an experimental study in the journal Pediatrics, reported that digital media-based interventions can reduce screen time and increase physical activity participation among children and adolescents (Oh et al., 2022).

Another experiment conducted by Zhao et al. (2024) in the journal Scientific Reports found that implementing exergames in physical education (PE) learning significantly improved students' motor skills and cognitive learning outcomes compared to traditional learning (Zhao et al., 2024). From a teacher perspective, Almusawi et al. (2024) reported that most physical education teachers expressed positive readiness for the use of wearable devices as a tool for monitoring student activity, although adequate technical training and infrastructure support are still needed (Almusawi et al., 2021).

Research by Fletcher et al. (2023) highlights the importance of digital assessment in physical education in elementary schools. Through a self-study approach, this research found that digital assessment improves the quality of feedback and transparency of the learning process, although it still needs to be adapted to the developmental level of students (Fletcher et al., 2024). In Indonesia, Jumareng (2022) showed that the implementation of blended learning during the COVID-19 pandemic helped maintain the effectiveness of physical education (PJOK) learning and increased the efficiency of using e-modules and Learning Management Systems (LMS) (Sabillah & Nasrulloh, 2022).

However, findings by Kusuma (2021) indicate that online physical education (PJOK) learning at the junior high school level is not fully effective due to technical barriers, limited devices, and low teacher digital literacy (Widodo et al., 2022). However, Fadilah and Nugroho (2023) found that combining face-to-face and online learning in a blended learning format in high schools significantly increased student learning interest, especially when supported by good planning and supervision (Astuti, 2022).

Overall, the findings from these 15 journals illustrate that the use of digital technology has become a major catalyst for the transformation of physical education learning. Technology integration increases instructional effectiveness, expands learning access, and fosters reflective skills and active student participation. While numerous benefits have been proven, successful implementation depends heavily on teacher readiness, institutional support, and educational policies that adapt to the digital era. Therefore, ongoing professional development, improved digital literacy, and adequate infrastructure are needed to ensure effective and sustainable technology-based physical education learning.

3 Discussion

The digital transformation in physical education increasingly emphasizes the existence of technology as more than just a tool, but also a pedagogical medium that can enrich students' reflection and understanding of movement. Østerlie et al. (2025) stated that digital integration enables the implementation of learning projects, student content creation, and reflection activities that strengthen students' movement literacy and fitness awareness (Østerlie et al., 2025). Furthermore, research by Saiz-González et al. (2024) shows that physical education teachers are widely interested in integrating digital technology, as they see the potential for improving teaching

support, communication, and assessment in physical education (Saiz-González et al., 2025). Thus, the digital pedagogical transformation encourages a shift in the role of teachers to facilitators and designers of learning environments that support reflection, collaboration, and meaningful movement.

Innovative learning models such as gamification and the flipped classroom contribute strongly to student engagement and motivation in physical education classes. For example, research by El-Tanahi et al. (2024) found that the majority of studies implementing gamification reported increased student motivation, commitment, and engagement in physical activity (El-Tanahi et al., 2023). Furthermore, the article "Game-Based Learning and Gamification in Physical Education: A Systematic Review" suggests that the use of game elements (e.g., points, challenges, and feedback) in physical education classes supports more interactive and meaningful learning (Camacho-Sánchez et al., 2023). In the Indonesian context, several local studies also report that the use of interactive videos or digital game elements in physical education lessons can increase student interest in movement activities and cognitive achievement. The combination of this innovative model and digital media makes physical education more relevant to the learning styles of the digital generation.

Digital media opens up opportunities for teachers to provide faster, contextual, and evidence-based feedback. In the study "Innovation in Physical Education: Teachers' Perspectives on Readiness," physical education teachers reported that wearables and video applications allowed them to observe student movement patterns that were difficult to capture directly, allowing for more targeted feedback (Almusawi et al., 2021). On the other hand, research by Wort et al. (2021) shows that teachers appreciate the ability of wearables to visualize student activity data (such as step count or heart rate), which helps them direct physical education interventions (Wort et al., 2021). Thus, digital media strengthens teachers' capacity to monitor student progress in real time and provide data-driven feedback that helps improve technique and motivation.

The integration of wearables and data systems in physical education classes facilitates evidence-based learning (data-driven instruction). A study by Wahyono et al. (2025) noted that wearable-based school interventions can increase step count and moderate-intensity physical activity (MVPA) time, although practical challenges such as cost and infrastructure remain (Wahyono et al., 2025). Furthermore, Wort's (2021) study added that teachers recognize the potential of activity data to design exercise tasks that are more appropriate to students' abilities (Wort et al., 2021). This combination of technology and data provides a foundation for physical education teachers to adapt learning more responsively to students' physical needs.

The use of digital technology in the context of physical education learning also stimulates students' social and motivational aspects. A study by Fadilla & Nurfadhilah (2022) concluded that gamification can increase intrinsic motivation and facilitate meaningful learning among adolescents by utilizing game elements oriented toward challenges, collaboration, and feedback (Fadilla & Nurfadhilah, 2022). Research in school-level physical education, "Game-Based Learning and Gamification in Physical Education," showed that gamified learning can activate social elements such as healthy competition and cooperation among students, which strengthens engagement (Camacho-Sánchez et al., 2023). The social interactions provided through digital technology make physical education learning more dynamic and strengthen students' intrinsic motivation to continue exercising.

While the potential of digital technology in physical education is enormous, implementation barriers remain significant. Research by Saiz-González et al. (2025) revealed that although teachers are interested in using technology, they face obstacles such as lack of training, lack of institutional support, time constraints, and concerns about student privacy (Saiz-González et al., 2025). Data privacy and security are important issues in the use of digital technology in physical education. A study by Saiz-González et al. (2025) showed that teachers' concerns about privacy

and the use of student data are among the barriers to digital technology adoption (Saiz-González, Sierra-Díaz, Iglesias, et al., 2025). Furthermore, research by Ahn & Lim (2025) emphasized that in implementing AI in physical education classes, student data protection and security policies must be a priority from the beginning of system design (Ahn & Lim, 2025). Therefore, ethical digital literacy for teachers and institutional regulations are crucial elements to ensure that technology use does not violate students' privacy rights and remains ethical. Overall, the integration of digital technology into PE instruction promises more personalized, adaptive, and evidence-based learning, but successful implementation depends on human capacity, policy, and infrastructure. Østerlie et al. (2025) recommend longitudinal research and a focus on equity of access to ensure that the use of digital technology in PE does not leave out isolated student groups (Østerlie et al., 2025). Conversely, Saiz-González et al. (2024) suggest school policies to provide structured training, technical support, and data security policies for integrating technology into PE classes (Saiz-González, Sierra-Díaz, Iglesias, et al., 2025). Therefore, formulating evidence-based policies that balance innovation, equity of access, and data security would be a strategic step towards a sustainable and equitable digital PE ecosystem.

5 Conclusion

Based on a literature review of various national and international studies from 2020–2025, it can be concluded that the use of digital technology in physical education significantly contributes to improving learning effectiveness, student motivation, and teacher reflective skills. Technologies such as learning management systems, wearable fitness trackers, virtual reality, and mobile applications have been shown to expand the reach of physical education learning toward a more personalized, participatory, and data-driven approach. However, the success of their implementation is largely determined by the readiness of human resources, infrastructure, and the support of progressive educational policies. Studies show that digital transformation in physical education is not only a change in teaching media, but also a shift in pedagogical paradigms toward experience-based learning and adaptive technology.

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