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Technology-Enhanced Pedagogical Models In Physical Education: A Systematic Review

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Abstract

Background: The literature is scattered and digital technologies are increasing in physical education (PE). A synthesis that goes beyond technology, and focuses on pedagogical models, is needed to facilitate proper implementation based on evidence.

Objective: This systematic review aimed to provide a Technology-Enhanced Pedagogy in Physical Education (FTEP-PE) derived from the literature on technology-enhanced pedagogical models (TEPMs) in PE (2020 - February 2026).

Methods: The search was performed using the SciSpace Deep Search, SciSpace Full Text Search, Google Scholar and PubMed databases, according to PRISMA 2020 reporting standards. Of the 1107 records found, 607 were excluded before screening, 500 were screened, 249 reports assessed and 199 studies were retained for synthesis. Parameters extracted included publication characteristics, educational context, study design, type of TEPM, type of technology, and conditions for implementation. An adapted version of ROBINS-I was used to assess risk of bias.

Results: Nine TEPM categories were obtained, with the top three being blended learning (22.6%), flipped classroom (19.1%) and AI-assisted instruction (17.6%). Motor outcomes (68 studies) revealed small-to-moderate effects (median d=0.42); 89 studies reported motivation outcomes; knowledge outcomes (74 studies) revealed medium-to-large effects (median d=0.63). Factors that posed the most significant problems for implementation in the 112 studies were balance of screen time (42.9%), inequitable access (48.2%), and lack of professional development (59.8%).

Conclusions: Technology is a tool for pedagogical purposes when combined with ongoing teacher preparation, access, adaptation, intentional feedback and active learning. The resulting FTEP-PE framework can be used as six design principles for educators and researchers.

Keywords: physical education, sport pedagogy, artificial intelligence, gamification, TPACK, ROBINS-I

1. Introduction

Physical education (PE), an important branch of education, is an integral part of education (White, 2021). Unlike many other subjects where digital mediation can substitute substantial classroom time, PE requires learners to move, practice skills, engage with peers, receive timely feedback, and apply knowledge in embodied, real-world contexts. This intrinsic embodied nature creates a productive yet unresolved tension: technology can broaden access to information, provide feedback and assessment, enable personalization, and boost motivation and engagement, yet it can also reduce opportunities for active practice and diminish the social, embodied character of PE (Alli, 2026; Zhu et al., 2026).

The recent pandemic (COVID-19) further accelerated shifts toward online, blended, flipped, video-mediated, and platform-supported learning in PE and health-related education, while advances in artificial intelligence (AI), computer vision, immersive technologies, learning analytics, and gamification have expanded the instructional affordances available to PE teachers and teacher educators (Jiang et al. 2025) Although this literature is extensive, it remains highly dispersed: reviews often focus narrowly on a single technology or pedagogy (for example, blended learning, the flipped classroom, gamification, or specific tools), which makes it difficult for PE practitioners to compare approaches on a common pedagogical basis (Jiang et al. 2025) (Zhu et al., 2026).

2. Literature Review

2.1 TEPM

Researchers need to conduct a comprehensive literature review to identify knowledge gaps, build upon current research and make a meaningful contribution to their respective fields (Paul, 2020). To address these gaps, this review adopts a technology-enhanced pedagogical lens. I term this a technology-enhanced pedagogical model (TEPM): a pedagogical model in which digital technologies are embedded within clear learning objectives, teaching sequences, feedback, assessment, interaction, and practice. PE learning requires continuous practice, demonstration, and social interaction in physical spaces. By framing technology as part of a TEPM, teachers can ensure that tools (e.g., wearables, video feedback, or interactive media) serve embodied practice and social participation rather than displacing them. This aligns with the idea that PK and CK must be meaningfully wired to TK through design decisions that preserve embodied learning moments and environmental constraints (Jiang et al., 2025; Zhu et al., 2026; Zhao et al., 2025; Xiang-ming et al., 2021). One key takeaway of the synthesis is that technology should augment, not eliminate, physical activity. Digital resources are best defended when they enhance preparation, demonstration, feedback, tactical understanding, reflection, and/or assessment with a retention of significant opportunities for movement and practice.

2.2 TPACK

TPACK emphasizes that knowledge of technology (TK) must co-occur with deep content knowledge (CK) and pedagogical knowledge (PK), and that their intersections (TPK, TCK, PCK) are what enable effective instruction, not technology alone (Wohlfart & Wagner, 2024; Pestaño, 2022; Nilsson & Lund, 2022). In PE, this interaction is particularly crucial because pedagogical content knowledge in this domain is embodied, environment-dependent, and closely linked to demonstration, practice, feedback, tactical decision-making, and social participation. Accordingly, the review treats technology selection as a pedagogical decision rather than a procurement choice (Jiang et al. 2025).

2.3 SDT

The integration of Self-Determination Theory (SDT) into the design and evaluation of gamified learning environments provides a robust theoretical framework for understanding how game-based and gamified strategies can foster intrinsic motivation in education (Muttaqin et al., 2025). SDT posits three core psychological needs autonomy, competence, and relatedness that are essential to intrinsic motivation and meaningful engagement. Effective gamification practices hinge on addressing these needs to generate not just extrinsic rewards but also genuine learner involvement and deeper learning outcomes.(González-López et al., 2025)

a. CURRENT STUDY (2020-2026)

This study systematically reviewed technology-enhanced pedagogical approaches to address gaps in existing research and to examine how technology-enhanced pedagogical models developed in Physical Education. In particular, the following research questions were explored from the teaching practices, student learning and pedagogical outcomes perspectives:

Q1. Which technology-enhanced pedagogical models have been implemented in PE, and how frequently do they appear?

Q2. What effects have been reported for motor skills, knowledge, motivation, engagement, and related student outcomes?

Q3. What facilitators and barriers characterize the implementation of technology-enhanced PE?

Q4. What cross-cutting design principles can be synthesized into an integrative framework for technology-enhanced PE?

3. Methods

The review was conducted and reported with reference to the PRISMA 2020 statement. PRISMA 2020 highlights the need to report the rationale for conducting a review, the process used to identify and select the records, and the process used to synthesize the evidence. The source manuscript states that the review protocol was a priori developed. There is no identifier supplied in the material.

3.1 Database search

SciSpace Deep Search, SciSpace Full-Text Search, Google Scholar, and PubMed were used to search in January 2026. The publication window is January 2020 to February 2026. Additionally, reference lists of included studies and relevant reviews were hand-searched. The principal search expression combined terms for PE/sport pedagogy, technology-enhanced learning, and pedagogical models.

("physical education" OR "PE" OR "kinesiology" OR "sport pedagogy") AND ("technology-enhanced" OR "digital learning" OR "blended learning" OR "flipped classroom" OR "gamification" OR "game-based learning" OR "virtual reality" OR "augmented reality" OR "AI-assisted" OR "online learning" OR "MOOC") AND ("pedagogical model" OR "teaching model" OR "instructional design" OR "curriculum design")

3.2 Eligibility criteria

Studies were eligible when they were published in English between 2020 and 2026 in peer-reviewed journals or conference proceedings; examined a technology-enhanced pedagogical model or instructional approach in PE, kinesiology, sport pedagogy, or a closely related field; reported empirical data using quantitative, qualitative, or mixed-methods designs; and included at least one student-level outcome such as motor skill, knowledge, motivation, engagement, or learning experience. Studies were excluded when they focused exclusively on a technology tool without a pedagogical framework; were opinion pieces, editorials, or commentaries without empirical data; used PE only as a peripheral or secondary context; or were dissertations or unpublished theses.

3.3 Screening and selection

The search record provided 1,107 results (685 in SciSpace Deep Search, 200 in SciSpace Full-Text Search, 200 in Google Scholar, and 22 in PubMed). The number of records eliminated prior to screening was 607, including 318 due to duplication and 289 due to trimming to the target sample. The remaining 500 records were screened for titles/abstracts. A total of 251 were eliminated at this stage because they were not about a pedagogical sport context (n=89), were worked up as a tool (n=76), were non-empirical content (n=52) or were not PE setting (n=34). So, 249 records were moved to the eligibility assessment phase, and 199 records were kept for the final synthesis after 50 full-text exclusions. The inter-rater agreement on abstract screening is high for the source manuscript (κ=0.84). Disagreements were addressed and settled by discussion and consensus. The final evidence set is defined as a set of 199 included studies/records, which were used to develop the framework and for qualitative synthesis.

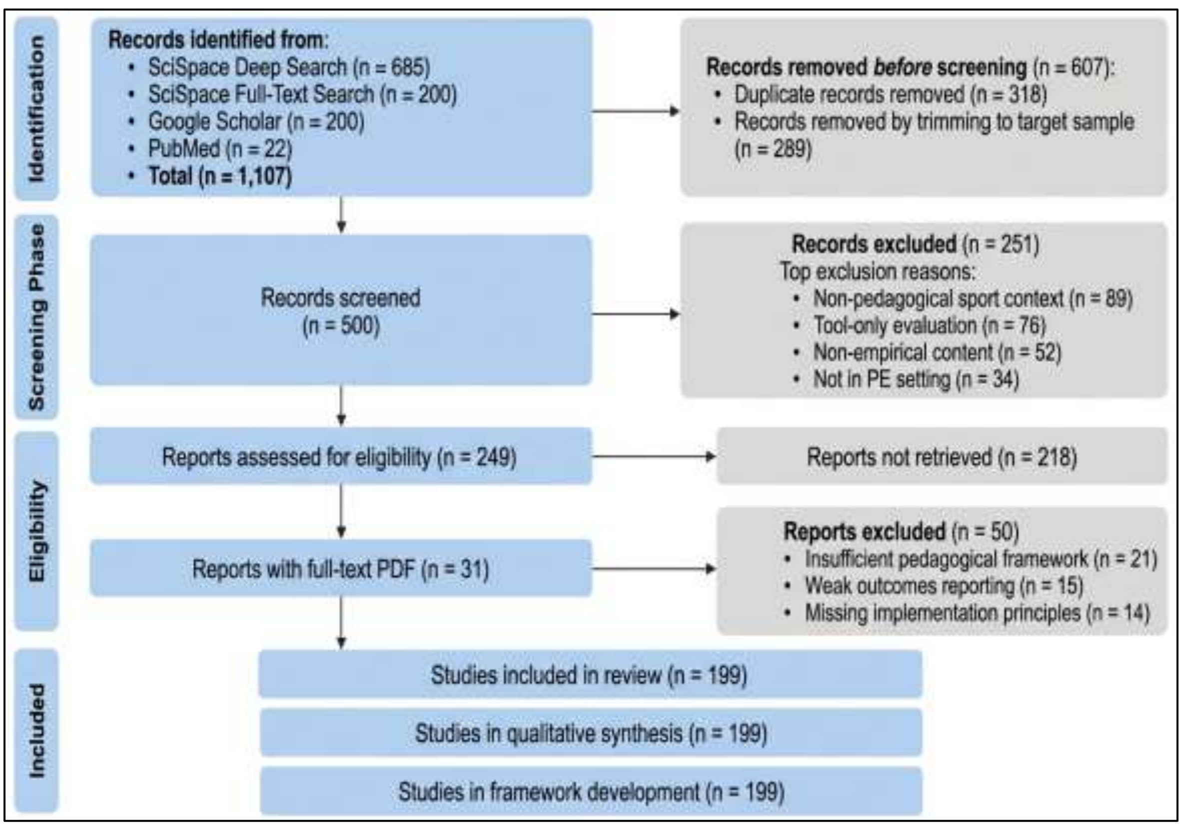

Figure 1. The PRISMA 2020 study selection flow diagram provided in the review data set.

3.4 Data extraction
The information gathered included author and year, country/region, level of education, study design, TEPM category, type of technology, sample size, participant characteristics, outcome variables, effect sizes (when available), and key findings on a standardized extraction form. One reviewer extracted evidence and a second reviewer checked a 20% random sample. Discrepancies were resolved by a third reviewer. If effect sizes are not reported, Cohen's d equivalents were calculated from means, standard deviations and sample sizes as provided by the source manuscript when appropriate data was available.

3.5 Risk-of-bias assessment
The Risk of Bias in Non-randomized Studies of Interventions (ROBINS-I) framework was used to assess risk of bias, which includes assessments of bias arising from confounding, selection of participants, classification of interventions, deviations from intended interventions, missing data, outcome measurement, and selection of reported results. However, the source review identifies that ROBINS-I has been adapted for the mixed evidence base. Judgements were classified as Low, Moderate, Serious, Critical and Unclear. In the overall classification, 33 records were identified as being N/A (Review) and hence were not used as the denominator of the domain-level chart but were primary intervention studies. The labels used for the analysis for this data set contain 33 records which have been classified as 'review', which is likely to be a misclassification that needs to be reviewed against the underlying list of studies.

The denominator used for the primary study is 166 (199 total records, 33 records not applicable to this study). Within these 166 primary-study records, 153 (92.2%) were classified as Unclear, 7 (4.2%) as Serious, 5 (3.0%) as Moderate, 1 (0.6%) as Critical, and 0 as Low. With a 199-record denominator, Unclear is equal to 76.9%, aligning with the overall donut chart provided.

4. Results
4.1 Characteristics of the evidence base
The 199 available records were published between 2020 and 2026, with a significant rise from 2022 onwards: 148 records (74.4%) were published after 2022. The geographical distributions in the source manuscript were Asia (39.2%), Europe (22.6%), North America (19.1%) and cross-national collaborations and other (19.1%) distributed across Oceania, South America and Africa. Higher education was the largest education institution (44.7%), followed by K–12 education (33.7%) and physical education teacher education (PETE; 14.1%), with 7.5% of records covering more than one level of education. The most common study design was quasi-experimental pre–post designs without randomization (41.2%), followed by mixed methods (22.1%), randomized controlled trials (18.1%), qualitative studies (12.1%), and descriptive/survey designs (6.5%). The sample sizes varied from 12 to 1,847 participants and the median sample size was reported to be 87.

Table 1 Publication record in distribution 2020-2026

Characteristic	Reported distribution
Publication period	2020-2026; 148 records (74.4%) published from 2022 onward
Asia	39.2%
Europe	22.6%
North America	19.1%
Other regions/collaborations	19.1%
Higher education	44.7%
K–12	33.7%
PETE	14.1%
Multiple levels	7.5%
Quasi-experimental	41.2%
Mixed methods	22.1%
Randomized controlled trials	18.1%
Qualitative	12.1%
Descriptive/survey	6.5%
Sample size	12-1,847; median 87

4.2 Distribution of technology-enhanced pedagogical models
Nine types of TEPM were identified. The most represented categories were blended learning (n=45; 22.6%), flipped classroom (n=38; 19.1%) and AI-assisted learning (n=35; 17.6%). These three categories of evidence

made up 59.3% of the evidence base. 14.1% (n=28) was attributed to Game Based Learning/Gamification. The rest (Sport Education, Teaching Games for Understanding (TGfU), Hybrid Models, MOOC-Integrated approaches and VR/AR) had increasingly smaller percentages.

Table 2 Technology-Enhanced Pedagogical Models

Rank	TEPM category	n	Percentage
1	Blended Learning	45	22.6%
2	Flipped Classroom	38	19.1%
3	AI-Assisted Instruction	35	17.6%
4	Game-Based Learning / Gamification	28	14.1%
5	Sport Education	15	7.5%
6	Teaching Games for Understanding (TGfU)	12	6.0%
7	Hybrid Models	10	5.0%
8	MOOC-Integrated	8	4.0%
9	Virtual Reality / Augmented Reality	5	2.5%
	Total	199	100.0%

4.3 Motor skill outcomes

68 studies provided motor skill results. In these studies, the TEPM was correlated to-small to medium positive effects (Cohen's d=0.30-0.60, with a median of 0.42). AI-Assisted Instruction is identified by the source synthesis as relatively consistent improvements in skills, especially when using real-time/ video-based feedback to correct movements. For motor outcomes, Blended Learning yielded more variable results where the amount of face-to-face practice retained was a factor for its effectiveness. The source review also finds relatively large effects in the small VR/AR evidence base, albeit with only five eligible studies to support its findings and thus restricted in generalizability.

The motor-skill results support the central theme of the PE-specific results: technology seems to be most effective when it enhances the learning loop of physical practice. Technology is not sufficient to provide repeated movement experiences necessary to motor learning. Its role is best thought of in terms of demonstration, observation, identification of error, augmented feedback, self-analysis and individualized practice planning.

4.4 Knowledge and cognitive outcomes

There were 74 studies that reported knowledge outcomes. The effects were medium (Cohen's d 0.50 to 0.80) with a median value of 0.63. The flipped classroom models were especially used in the acquisition of procedural and declarative knowledge, and gamification was often associated with the acquisition of tactical and rules knowledge. The use of adaptive quizzes, intelligent tutoring, or personalized learning pathways also yielded promising knowledge outcomes in the context of AI-assisted approaches.

Theoretically there is a contrast between knowledge and motor output. Digital representation and practice of PE's cognitive elements (rules, tactics, anatomy, training principles, reflective knowledge) may be more readily achieved without compromising instructional fidelity, whereas complex motor skills may be more difficult. This means the most effective TEPMs might deliver learning activities in a strategic way: using digital to prepare, explain, model, assess, and offer feedback; and using face-to-face to provide opportunities for movement, practice, social interaction, and embodied learning.

4.5 Motivation and engagement

There were 89 reports of motivational outcomes, with 67.4% of these outcomes focused on self-report measures. The findings on motivation were the most consistently positive, that of Game Based Learning and Gamification, especially around intrinsic motivation and situational interest with K-12 students. Moderate motivational benefits were observed in both blended and Flipped learning models, but some studies reported learners' resistance when they had limited experience with digital tools. When digital scorecards, team statistics and role structures were implemented, other outcomes of technology-supported Sport Education were linked to peer accountability and class-community outcomes.

Self-report measures are an important limitation of the method. Future studies should explore the multiple measures of motivation (along with attendance, activity time, persistence, observed engagement, task completion and longitudinal participation) instead of one questionnaire after an intervention.

4.6 Implementation facilitators and barriers

There were 112 studies available for implementation data. Three common facilitators were found to be teacher TPACK proficiency, institutional infrastructure and availability of devices, and student digital literacy. The most common barriers reported were the lack of professional learning (n=67; 59.8%), lack of access to devices (n=54;

48.2%), and screen time and physically active learning conflicts (n=48; 42.9%). Technology enhanced pedagogy cannot be assessed apart from the local resources and this was reported especially often in low- and middle-income contexts.

Table 3 Implementation Factors Influencing Technology-Enhanced Pedagogical Models in PE

Implementation factor	n	Percentage of 112 studies	Interpretation
Inadequate professional development	67	59.8%	Most frequently reported barrier
Inequitable device access	54	48.2%	Equity and infrastructure constraint
Screen time vs. active learning tension	48	42.9%	PE-specific pedagogical tension
Teacher TPACK proficiency			Frequently identified facilitator
Institutional infrastructure/device access			Frequently identified facilitator
Student digital literacy			Frequently identified facilitator

4.7 Risk of bias

The overall risk-of-bias analysis indicates that there is significant methodological uncertainty of the evidence base. The supplied analysis classifies 153 of 199 records (76.9%) as Unclear, 33 (16.6%) as N/A Review, 7 (3.5%) as Serious, 5 (2.5%) as Moderate, 1 (0.5%) as Critical, and none as Low. The N/A category for Review must be handled separately as the review is not a primary intervention study and should not be interpreted as a causal bias study as would be done for empirical intervention studies.

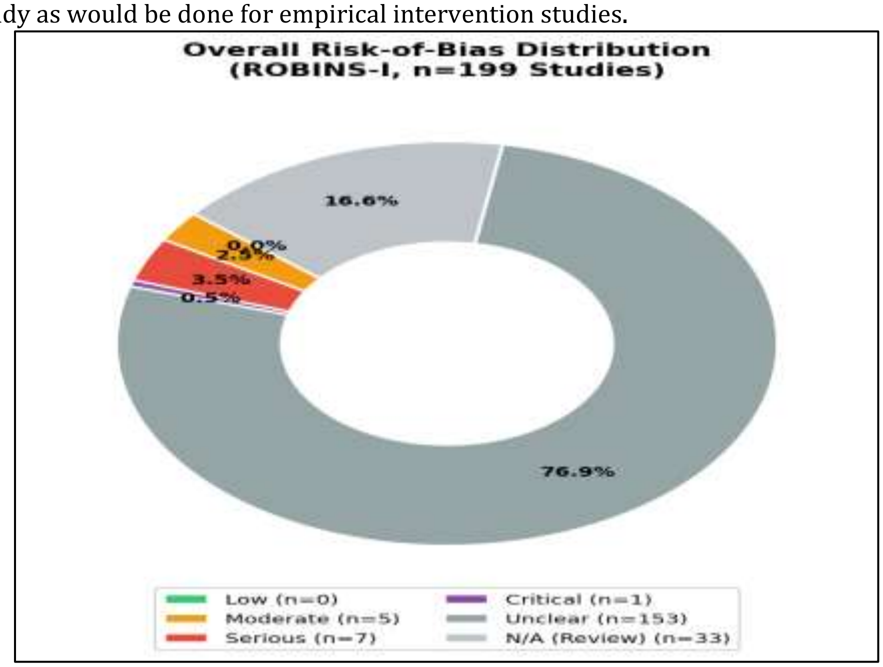

Figure 2. ROBINS-I distribution of included records (N = 199).

If the 33 N/A-review records are dropped from the denominator, the denominator is 166. The 153 Unclear classifications then represent 92.2% of primary studies. This is a more suitable assessment of the quality of the evidence than the isolated 76.9%. The percentage of Unclear ratings indicates that there is limited reporting of confounding control, participant selection, intervention classification, missing data, and outcome measurement. It also implies that the apparent positive effects should not be taken as applying across the board as a cause.

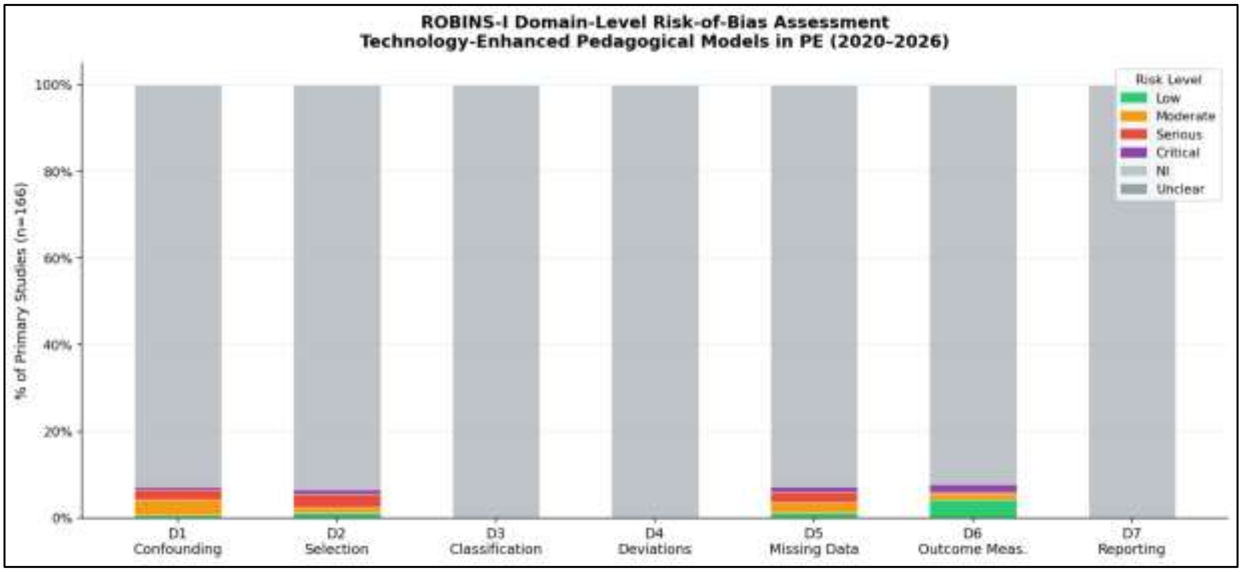

Figure 3. ROBINS-I risk-of-bias assessment reproduced at the domain level from the analysis output provided.

The denominator for the primary-study is n=166. The underlying domain frequency (count) was not provided as a numeric table, so the domain percentages derived from the visual coding may not be accurate and should be compared with the underlying ROBINS-I data prior to submission.

Table 4. Overall Risk-of-Bias Classification of the Included Studies

Overall classification	n	Percentage of 199	Percentage of 166 primary studies
Low	0	0.0%	0.0%
Moderate	5	2.5%	3.0%
Serious	7	3.5%	4.2%
Critical	1	0.5%	0.6%
Unclear	153	76.9%	92.2%
N/A (Review)	33	16.6%	Not applicable
Total	199	100.0%	166 primary studies + 33 reviews

5. DEVELOPMENT OF THE FTEP-PE FRAMEWORK

The review results were summarized into the Framework for Technology-Enhanced Pedagogy in Physical Education (FTEP-PE). The framework is not meant to be yet another list of technologies. Instead, it offers a decision logic to consider when determining whether, why, and when technology should be used in PE. These six principles were strongly experienced throughout the TEPM categories and outcome domains.

Table 5. FTEP-PE Design Principles and Their Operational Implications

Principle	FTEP-PE design principle	Operational implication
1	Pedagogical alignment before technological selection	Start with the learning objective, learning task, and assessment requirement; select technology only when it adds a defensible pedagogical function.
2	Teacher professional development as infrastructure	Treat sustained, collaborative, context-specific TPACK development as a core implementation component rather than a one-time training event.
3	Equitable access as a design constraint	Plan for device, connectivity, affordability, accessibility, and digital-literacy differences from the beginning of the intervention.
4	Context-sensitive implementation	Adapt implementation to education level, class size, facilities, student characteristics, curriculum demands, and local resources while protecting core pedagogical components.

5	Formative feedback integration	Embed structured cycles of demonstration, practice, observation, feedback, correction, and re-practice; technology should make feedback more timely or individualized.
6	Student-centered active learning preservation	Use technology to amplify participation and learning without allowing screens to replace movement, social interaction, practice, or embodied learning.

5.1 Principle 1: Pedagogical alignment before technological selection

Pedagogy first, technology second, is the first principle. Teachers should identify what the student(s) need to learn, do, experience, or demonstrate and determine whether a digital resource enhances the learning process. The use of a video analysis application justifies itself, for example, when the learning goal is movement observation and correction; only because video technology is available is no justification.

5.2 Principle 2: Teacher professional development as infrastructure

Successful TEPM implementation requires professional development. The training should not be limited to the actual operation of the software but should also cover lesson design, assessment, feedback, classroom management, privacy, accessibility and a balance of digital and face-to-face activity. Rather than single technical workshops, peer collaboration and multiple chances to explore and prototype lesson designs are better aligned with the evidence.

5.3 Principle 3: Equitable access as a design constraint

When learning relies on personal devices, fast internet, costly subscriptions or a high level of digital literacy, there is the risk that these factors will inadvertently exacerbate inequities in technology enhanced PE. Equity consequently must be woven into the design, not be a post-design concern. Where appropriate, alternatives of some sort can be used offline, shared devices, school-based access, low-bandwidth resources, and accessible formats can be used.

5.4 Principle 4: Context-sensitive implementation

A model that has been successful in a university lab where the classes are small and there is a lot of equipment is not going to be as successful in a larger classroom or a rural school or a school with less infrastructure. In the framework, core pedagogical functions are thus differentiated from features for more flexible implementation. The logic of learning must be safeguarded in fidelity while local adaptations of tools, schedules, grouping, and delivery are allowed.

5.5 Principle 5: Formative feedback integration

Technology's most educationally impactful applications include those that enhance feedback. Learning information can be made more visible and actionable through video replay, computer vision, peer feedback, teacher annotations, automated quizzes and analytics. But feedback should follow a cycle of practice and correction and not be a repository of comments or scores.

5.6 Principle 6: Student-centered active learning preservation

This is the only principle that is a PE safeguard in FTEP-PE. Digital activities are not an alternative to active learning time but should be designed to fit into the time allocated for active learning. A well-designed TEPM may engage students in a short digital preparation task before class, a short period of video analysis or feedback during practice and a reflection digital task after class keeping the bulk of class time for movement and interaction.

6. Discussion And Findings

6.1 Principal findings

This systematic review highlights a quickly diversifying field where blended, flipped classroom and AI-assisted instruction are the most prevalent in the published research. 59.3% of the total suggests that isolated experiences with a single tool have been replaced by more systematic teaching models. Equally, the limited evidence base for VR/AR, MOOC-integrated models, and some hybrid models suggests that these new technologies are still not as developed as pedagogical models in PE. The result pattern is also an interesting one. Reported effects for knowledge outcomes were mostly larger than those reported for motor outcomes, and effects for motor outcomes were positive, but were generally smaller. It doesn't mean that technology is not suitable for motor learning. Rather, it is argued that technology has its greatest value as an aid too, not a replacement for physical practice. The usefulness of digital technology can then be the opportunity to get learners ready for practice, to make performance visible, to provide feedback, to allow reflection and to personalize instruction.

The results are like that of previous study (Xu & Ouyang, 2022) which suggests that the technology use in education is still in the process of development and diversification. The shift towards a digitally supported, learner-centred and data-informed approach to teaching and learning is a wider trend, with the adoption of technology-based pedagogical models in Physical Education emerging along these lines. Like the findings of the review of the technology supported education literature, the literature in the current review shows that the college and university student population is a significant research population in studies exploring technology enhanced pedagogical models in Physical Education. This may be due to the convenience of having higher education institutions as the study environment and a high number of participants can be recruited, and technology-based pedagogical interventions can be easily conducted (Zhang et al., 2023a, b). Moreover, it is generally accepted that university students know more about digital technologies and are more academically mature in engaging in technology mediated learning activities and providing meaningful feedback and engaging in complex empirical research. However, the current literature might be skewed towards Higher Education students, due to their accessibility, but also because they are more likely to be the appropriate target group to assess new pedagogical approaches in Physical Education via technology.

The current findings suggest that gamification and game-based methods are effective in motivation; however, this is with limited certainty due to the use of self-report measures. Motivation should be increasingly examined as a multidimensional and longitudinal process in which there is a perceived interest in the learning activity as well as observable participation, persistence, efforts and continued engagement into the activity.

6.2 Implications for PE teachers

1. Start lesson planning with the PE learning objective and success criterion and not the digital tool.
2. Apply technology to tasks that a typical instruction method would not be able to effectively perform, including repeated video replay, individualized feedback, adaptive knowledge checks, and asynchronous preparation.
3. Respect dedicated learning time. Digital tasks should be brief, focused and linked to physical activity.
4. To incorporate the use of formative feedback loops that involve student action in the learning process.
5. Design alternative pathways for students who don't have devices, internet access or digital literacy.
6. Assess how technology enhances learning, teaching effectiveness, and/or the learning experience, and eliminate technology that causes complexity with little pedagogical benefit.

6.3 Implications for PETE and teacher education

This is important to consider because pre-service teacher preparation is when pedagogical habits are formed (and this is where PETE is underrepresented: 14.1%). Therefore, technology-enhanced pedagogy should be infused throughout methods courses, practicum experiences, assessment courses, and curriculum design, not as a stand-alone technology course. Pre-service teachers need to be able to justify pedagogically the selection of technology, plan for low-tech and high-tech solutions, assess digital feedback, and safeguard active learning time.

6.4 Implications for institutional leaders and curriculum designers

The directly policy-implied outcome of this finding is that the investment in technology and staff development should be considered as one investment in the studies that reported inadequate professional development findings. Infrastructure, teacher workload, technical support, privacy, accessibility, and continuous professional learning are factors to consider when implementing technology-based PE.

FTEP-PE can be used as a validation checklist for curriculum designers. An anticipated digital intervention must define the pedagogical model that it will support, what competencies the teacher must possess, what are the assumptions of the infrastructure, what feedback it will offer to the teacher and what measures it will take to ensure the maintenance of an active pedagogical model.

6.5 Equity and inclusion

Equity is more than an infrastructure problem. It also relates to the accessibility of instructional formats, language, digital literacy, disability access and meaningful participation in technology-mediated tasks by students. A TEPM with good overall results but which systematically excludes learners with limited access and/or accessibility needs cannot be considered fully effective. Implementations findings should be interpreted across context by reporting access conditions of participants.

6.6 AI and emerging technologies

One of the biggest areas of the evidence base is AI-assisted instruction, and a major future direction. Adaptive feedback, automatic movement analysis, individual learning pathways and conversational support are possible benefits. For AI, however, there are methodological and ethical issues that are not as much on the forefront in traditional digital learning, such as validity of assessment, algorithmic bias, transparency, data privacy, and potential over-reliance on the automated judgment.

These issues are very relevant in PE as there are many factors that influence movement varying across people's body type, skill levels, disability status, cultural backgrounds and environmental conditions. Therefore, automated systems should be considered as a decision-making aid and not an absolute judge of performance. However, human teacher supervision is still required.

7. Conclusions

This systematic review aims to gather evidence regarding technology enhanced pedagogical model used in PE between 2020 and February 2026. There is a wide array of evidence, including nine identified TEPM categories and an increase in blended, flipped, AI-assisted, and game-based approaches. Technology-enhanced pedagogy is associated with beneficial outcomes across motor skills, knowledge, motivation, and engagement, but the strength of inference is constrained by methodological heterogeneity and substantial uncertainty in risk-of-bias reporting. The most important conclusion is not that PE should become more digital. Rather, technology should become more pedagogically intentional. The FTEP-PE framework translates this conclusion into six principles: pedagogical alignment, professional development, equity, contextual adaptation, formative feedback, and preservation of active learning. Together, these principles position technology as an instructional amplifier rather than a replacement for the movement-rich, social, and embodied character of physical education.

Disclosure of Interest

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Ethics Statement

For this study no ethical approval was needed as this is a systematic review of previously published literature without collecting new data from human participants or animals.

Generative AI Disclosure

As part of the preparation of this manuscript, the authors utilized Claude (Anthropic) for literature review synthesis and conceptualization of the study framework, Jenni AI to organize and draft parts of the literature review, and Scite.ai to verify citations and locate supporting and contrasting literature. These tools were employed only to assist in the work of the authors, and all work was thoroughly checked, edited and verified for accuracy. In line with the Taylor & Francis AI Policy, the authors assume full responsibility for the content, interpretations and conclusions of this manuscript.

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