World Journal of Multidisciplinary Research
worldmultidisciplinaryjournal.com
Online ISSN: 3107-9539
Received: 13-09-2026, Accepted: 13-10-2026, Published: 28-10-2026
Volume 2, Issue 4, 2026, Page No. 19-27

Preparing future-ready physical education teachers: Essential competencies for teaching and sports in the age of artificial intelligence

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Abstract
Artificial intelligence (AI) is beginning to influence physical education (PE) through lesson planning, movement analysis, fitness-data interpretation, personalized feedback, assessment support and professional learning. These developments create opportunities for responsive instruction, but also raise questions about teacher competence, student privacy, algorithmic bias, unequal access and the risk of treating technology-generated outputs as objective truth. This critical integrative review examines the competencies that future-ready school Physical Education Teachers need to use AI purposefully, safely and pedagogically. It draws on research on AI in education and PE, teacher competency frameworks, PE standards and guidance on responsible AI. Rather than claiming an exhaustive systematic review, it uses a concept-led synthesis to organize the literature around eight domains: AI literacy and critical evaluation; AI-enhanced pedagogical design; fitness assessment and data literacy; sports skill analysis; inclusive and student-centred teaching; assessment and reflective practice; ethical and safe use; and professional learning and collaboration. The review argues that technical familiarity alone is insufficient: teachers must connect AI outputs with subject knowledge, direct observation, learner context and professional judgement. A proposed competency framework, staged development pathway and responsible-AI decision cycle are presented for pre-service teacher education and continuing professional development. The paper concludes that AI should augment—not replace—the relational, embodied and context-sensitive work of PE teaching. Implementation should be guided by educational purpose, evidence, consent, data minimization, inclusion and human accountability. Future research should validate competency measures, examine school-based implementation and investigate outcomes across diverse contexts.

Keywords: Artificial intelligence, physical education teachers, teacher competencies, sports technology, AI literacy, teacher education, responsible AI

Introduction

Physical education is a distinctive educational setting in which learning is embodied, social, practical and context-dependent. Teachers help students develop motor competence, movement knowledge, cooperation, confidence, safe participation and positive relationships with lifelong physical activity. Effective PE therefore depends on more than delivering information: teachers observe movement, adapt tasks in real time, manage space and equipment, respond to diverse abilities, assess performance and create a climate in which students feel safe to participate.

Artificial intelligence introduces new possibilities into this environment. Generative AI can assist with lesson ideas, differentiated activity descriptions, rubrics and reflective prompts. Computer vision and pose-estimation systems can estimate aspects of movement from video. Wearable devices and digital platforms can collect activity or performance data, while analytics tools may help teachers identify patterns across lessons. Reviews describe expanding applications in PE but also note that the field is developing and that teacher training, ethical safeguards and stronger empirical evidence remain important concerns (Wang & Wang, 2024; Zhou *et al*., 2024) [8, 9].

The key question is not simply whether PE teachers should use AI, but what they must know and do to decide when AI is educationally appropriate, how to verify its outputs and how to protect students. A tool may produce a plausible movement score while missing the purpose of a task, a student's disability-related adaptation, or a safety concern. An AI-generated lesson plan may look polished but be developmentally unsuitable, equipment-intensive or inconsistent with curriculum requirements. Teachers must remain responsible for decisions that affect learners.

UNESCO's AI Competency Framework for Teachers places human-centred thinking, ethics, AI foundations, AI pedagogy and professional learning at the centre of teacher development (Miao & Cukurova, 2024) [4]. Contemporary PE standards similarly emphasize movement competence, knowledge, social development and personal engagement in physical activity (SHAPE America, 2024) [7]. Bringing these strands together offers a way to define future-ready PE teaching as the integration of professional knowledge, digital judgement and responsible use of AI.

This review focuses on school-level Physical Education Teachers, including pre-service teachers preparing for school appointments and in-service teachers developing new competencies. It does not treat AI as a replacement for physical practice, coaching relationships or professional judgement. Instead, it examines how AI can support teaching, learning, assessment and teacher development.

Problem Statement, Research Gap and Rationale

The rapid expansion of AI tools has outpaced the development of consistent preparation pathways for many teachers. PE adds specific challenges because it involves bodily movement, physical safety, social interaction, changing environmental conditions and sometimes sensitive

information about fitness, health or disability. General digital competence is necessary but not sufficient: teachers also need to judge whether a tool's output is valid for the movement task, age group, learning objective and local facilities.

Reviews have discussed AI applications in PE, teacher-training needs and AI-supported feedback (Wang & Wang, 2024; Zhou *et al*., 2024) [8, 9]. A teacher-facing synthesis remains useful when it translates broad application areas into observable competencies, learning experiences and safeguards for school practice. This review does not claim that no such frameworks exist; rather, it addresses the practical need to connect AI applications with the professional decisions PE teachers make.

The rationale is threefold: pre-service programmes need clear learning outcomes rather than tool demonstrations alone; in-service teachers need professional development that builds critical evaluation and safe implementation; and school leaders need criteria for selecting tools and evaluating whether their use improves learning without undermining inclusion, privacy or student agency.

Aim, Objectives and Review Questions

1. Aim

To synthesize relevant literature and propose a practical competency framework for future-ready school Physical Education Teachers working in an AI-enabled educational environment.

2. Objectives

Identify the main ways AI may support school PE teaching, assessment, movement learning and professional development.

Organize essential AI-related competencies within the distinctive pedagogical and practical requirements of PE.

Examine ethical, pedagogical, technical and equity-related risks associated with AI use in PE.

Propose a staged development pathway and practical indicators for assessing teacher competence.

Identify priorities for teacher education, school policy and future empirical research.

3. Review Questions

- Which AI applications are most relevant to school PE teaching and sports learning?
- What competencies enable teachers to evaluate and use these applications appropriately?
- What risks and contextual barriers should teachers and institutions address?
- How can teacher education programmes develop and assess these competencies?

Review Methodology

This paper uses a critical integrative review approach. The aim is conceptual synthesis across research on AI in PE, teacher competence, educational technology and responsible AI, rather than a pooled estimate of intervention effects. The review was informed by targeted searches of scholarly and institutional sources, including Google Scholar and publisher platforms, and official guidance from UNESCO and SHAPE America. Search concepts included combinations of "artificial intelligence," "physical education," "PE teacher," "teacher competencies," "sports skill analysis," "movement analysis," "fitness assessment," "AI literacy," "teacher education," "privacy" and "responsible AI."

Priority was given to peer-reviewed reviews and empirical studies relevant to PE teaching, teacher preparation or movement-related applications, as well as authoritative standards and policy frameworks. Material was considered for conceptual relevance, connection to school or teacher education contexts, and usefulness in explaining competencies, applications or risks. The material was synthesized thematically under AI literacy, pedagogy, data and movement analysis, inclusion, assessment, ethics and professional learning.

This is not presented as a systematic review or meta-analysis. A reproducible systematic review would require a predefined protocol, database-by-database search strings, documented dates, duplicate removal, independent screening, a study-flow diagram and appraisal of included studies. The present article does not claim exhaustive retrieval or calculate an overall effect size. Its contribution is a reasoned, literature-informed framework that can be tested and refined through future research.

1. Review Limitations

The literature on AI in PE is heterogeneous in technologies, age groups, settings and outcomes. Some research concerns university or specialist sport contexts rather than ordinary school PE, so transfer must be cautious. Tools change quickly, and published studies may not capture the current performance or risks of every commercial system. The framework is a proposed synthesis, not a validated measurement instrument.

Conceptual Foundations

1. Future-Ready Physical Education Teacher

A future-ready PE teacher is not simply a teacher who can operate new software. The term refers to a professional who preserves the educational purposes of PE while evaluating and adapting emerging tools. Such a teacher combines disciplinary knowledge, pedagogical judgement, movement observation, assessment literacy, inclusion, digital competence and ethical responsibility. Future readiness also includes the capacity to decline technology when it is inaccurate, unnecessary, unsafe or inconsistent with the lesson objective.

2. Human-Centred AI and Teacher Agency

UNESCO's framework organizes teacher AI competence around human-centred thinking, AI ethics, AI foundations and applications, AI pedagogy and professional learning, with progression from acquiring basic understanding to deepening practice and creating new approaches (Miao & Cukurova, 2024) [4]. Applied to PE, teachers should explain what a tool does, test whether its output is appropriate, communicate its use transparently and take responsibility for decisions.

3. Alignment with PE Learning Purposes

AI must be judged against PE learning goals, not technological novelty. SHAPE America's 2024 [7] standards emphasize developing motor skills, applying movement and fitness knowledge, social skills through movement and personal engagement in physical activity (SHAPE America, 2024) [7]. A tool that increases data collection but reduces active participation may be counterproductive. Automated

scores also cannot fully represent progress, effort, adaptation, cooperation and understanding.

4. Technology, Pedagogy and Content Knowledge

The technological pedagogical content knowledge perspective suggests that technology is educationally meaningful when integrated with subject matter and pedagogy rather than added as a separate layer (Mishra & Koehler, 2006) [6]. In PE, a teacher must know the movement concept, the instructional approach suited to the learners and the limits of the chosen AI tool. Video analysis may help a student reflect on a throwing sequence, but the teacher must decide which cue is age-appropriate and whether recording is necessary.

Essential Competencies for Future-Ready Physical Education Teachers

1. AI Literacy and Critical Evaluation

AI literacy includes understanding that different systems perform different tasks and that their outputs can be incomplete, biased, outdated or incorrect. Teachers should distinguish generative AI from computer vision, predictive analytics and wearable-device dashboards. They need not become software engineers, but should understand a tool's purpose, required data, likely failure points and the evidence needed to trust its output. An AI-generated warm-up plan should be checked against learner age, available space, equipment, weather, inclusion needs and lesson objectives. Critical evaluation includes recognizing when AI is not needed: direct observation and a simple checklist may meet the objective more safely and cheaply.

2. AI-Enhanced Pedagogical Design

AI can support lesson outlines, station activities, differentiated task variations, reflective questions and assessment rubrics. The teacher's competence lies in shaping prompts, checking output and adapting it to curriculum and class needs. A useful workflow begins with a clear learning outcome, specifies learner age and constraints, requests options and critically edits the suggestions. For a lesson on locomotor skills, AI might generate three levels of task difficulty; the teacher must test whether each is safe, inclusive and achievable. AI cannot assume responsibility for supervision, class management, equipment inspection or real-time decisions.

3. Fitness Assessment and Data Literacy

Digital tools can organize fitness-test results, attendance, activity records and progress over time. Data literacy means understanding what a measure represents, checking data quality, interpreting change cautiously and communicating results without stigmatizing students. Fitness data are influenced by growth, maturation, fatigue, illness, disability, motivation, measurement conditions and device error. A single reading should rarely be definitive. Teachers should prefer age-appropriate, curriculum-aligned measures, explain assessment purposes and avoid public ranking. Health concerns should be referred through school policy to qualified professionals.

4. Sports Skill Analysis and Performance Feedback

Computer vision and pose-estimation tools can estimate body landmarks and provide visual feedback about selected movements. Potential applications include analyzing a badminton serve, basketball shooting sequence, sprint posture or basic gymnastics movement. These tools may help learners compare attempts and notice movement patterns. However, camera angle, lighting, occlusion, clothing, movement speed, body diversity and training data can affect estimates. A system designed for one sport or population may not be reliable for another. Feedback should be a prompt for observation, not a final verdict; teacher demonstration, student reflection and direct observation remain essential.

5. Inclusive and Student-Centred Teaching

AI may help teachers prepare alternative explanations, visual supports, task progressions or adaptations for different skill levels. Inclusion is not achieved simply by generating different tasks: teachers must understand individual needs and ensure adaptations preserve dignity and meaningful participation. Automated systems may perform differently across body types, skin tones, movement styles, disabilities and environmental conditions. Students should not be reduced to scores, and participation should not depend on owning a device. Inclusive practice includes low-tech alternatives and equivalent learning opportunities.

6. Assessment, Evaluation and Reflective Practice

AI can assist in drafting rubrics, organizing observations and generating feedback prompts, but assessment must align with intended learning outcomes. PE assessment may include knowledge, skill development, effort, decision-making, cooperation and personal progress. A single algorithmic score may not capture these dimensions. Teachers should combine direct observation, student self-assessment, peer feedback, practical performance and reflective discussion. Reflective practice asks whether students understood the cue, whether the activity was safe, whether active participation increased and whether the tool advantaged some learners.

7. Ethical, Safe and Responsible AI Use

School PE can involve identifiable video, movement data, activity patterns and information about student ability. Teachers should minimize data collection, use approved platforms, follow institutional rules, obtain appropriate permissions and explain the purpose of recording or analysis. Identifiable images should not be uploaded to public tools without authorization. UNESCO guidance highlights data privacy, human-centred design and safeguards for learners (Miao & Holmes, 2023) [5]. Schools should specify approved tools, permitted data, retention and accountability. Safety-critical decisions should never be delegated to AI.

8. Professional Learning, Collaboration and Innovation

AI competence is not a one-time certification. Tools, school policies and evidence change, so teachers need ongoing learning through workshops, peer observation, mentoring, professional learning communities and reflective portfolios. Collaboration with ICT staff, school leaders, special educators and sports-science professionals can help evaluate tools. Teachers can document the learning need, tool selected, data used, student response, errors encountered and decision to continue, modify or discontinue the approach. Portfolios should assess professional reasoning and student benefit rather than the number of applications used.

Table 1: Competency Domains, Practical Indicators and Evidence of Competence

Competency Domain	Practical Indicators	Possible Evidence
AI Literacy	Explains Tool Purpose, Limitations and Likely Errors; Verifies Generated Content.	Tool Evaluation Note; Annotated Lesson Plan.
Pedagogical Design	Adapts Suggestions to Objectives, Age, Space, Equipment and Curriculum.	Revised Lesson Plan; Teaching Demonstration.
Fitness/Data Literacy	Interprets Data Cautiously and Avoids Unsupported Health Claims.	Assessment Plan; Anonymized Interpretation Task.
Sports Skill Analysis	Uses Video or Movement Estimates as Supplementary Feedback.	Observation Record; Student Reflection.
Inclusion	Offers Accessible Alternatives and Checks Unequal Access or Performance.	Adaptation Plan; Learner Feedback.
Assessment/Reflection	Combines Evidence Sources and Reviews Lesson Outcomes.	Rubric; Reflective Portfolio.
Ethics and Safety	Applies Consent, Data Minimization, Approved Tools and Human Oversight.	Risk Checklist; Data-Handling Plan.
Professional Learning	Uses Collaboration and Evaluates Impact Over Time.	Development Portfolio; Improvement Plan.

AI Applications in School Physical Education and Sports

1. Lesson Planning and Resource Creation

Generative AI can help draft lesson structures, activity variations, question prompts, game rules, station cards and rubrics. It can produce alternatives for different ability levels or make instructions more accessible. Teachers must check accuracy, curriculum alignment, developmental suitability and cultural relevance. Generated material should be edited and disclosed in line with institutional policies.

2. Movement Demonstration and Video Feedback

Short video clips may support reflection when paired with a clear question, such as where the racket face is at contact or how landing position changes between attempts. AI-based pose estimation may overlay landmarks or estimate movement patterns. The value comes from the task and discussion, not the visual sophistication of the software. Avoid unnecessary recording and provide non-recorded alternatives where appropriate.

3. Fitness Tracking and Progress Monitoring

Wearables, step counters and digital logs can illustrate activity patterns and personal progress. Data are most useful when interpreted alongside context and student reflection. They should not become a competition rewarding only high counts, since disability, access, health status and individual circumstances shape participation. Where devices are unavailable, teacher observation and paper-based logs remain meaningful alternatives.

4. Personalized Practice and Motivation

Digital systems may suggest practice sequences or adapt task difficulty. Personalization can support autonomy when students understand the purpose and retain meaningful choices. It can be counterproductive if learners are over-monitored, constantly compared or pushed toward narrow metrics. Teachers should check whether technology increases active learning time, feedback quality and enjoyment rather than screen time at the expense of movement.

5. Teacher Professional Development

AI can help generate reflective questions, compare lesson alternatives or organize non-sensitive notes. Teachers should not upload confidential student records or rely on generated references without checking them. Professional learning should include peer dialogue, practical trials and critical discussion of errors.

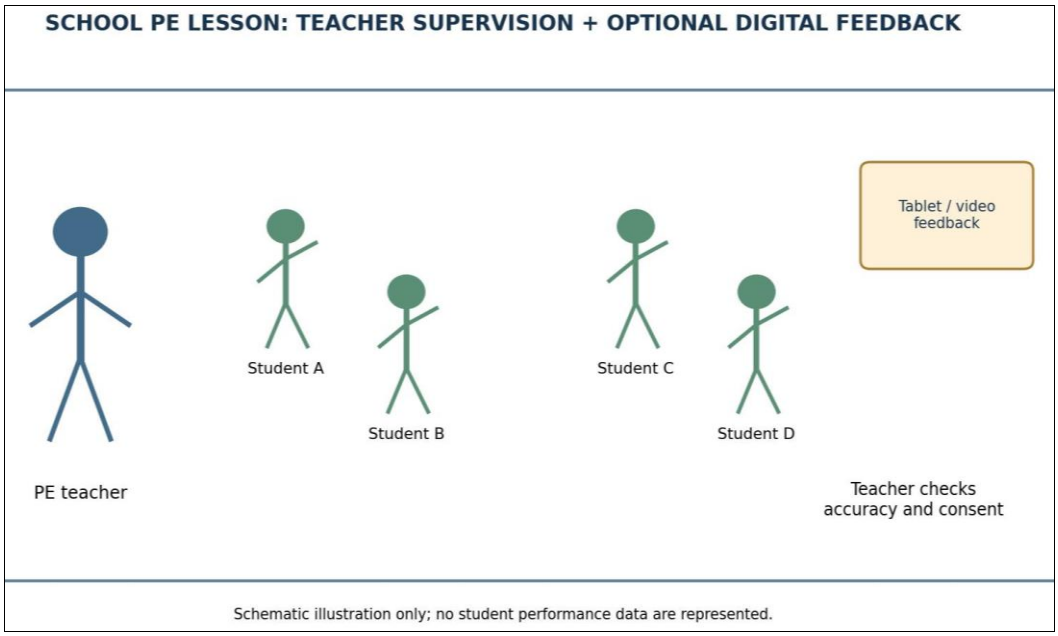


Fig 1: Illustrative school PE lesson showing teacher supervision and optional digital feedback. Schematic illustration created for this manuscript.

Table 2: Potential AI Applications, Educational Value and Cautions

Application	Potential Value	Teacher's Role	Key Caution
Lesson Planning	Generate Activity Options, Prompts and Rubrics.	Edit for Curriculum, Age and Needs.	Output May Be Inaccurate or Impractical.
Movement Analysis	Support Observation and Reflection.	Verify with Direct Observation.	Camera Conditions and Bias Affect Estimates.
Fitness Data	Organize Records and Show Trends.	Interpret Context and Protect Confidentiality.	Do Not Diagnose or Publicly Rank Students.
Personalized Practice	Suggest Task Progressions.	Ensure Safety, Fairness and Agency.	Over-Reliance on Narrow Metrics.
Assessment Support	Draft Rubrics and Feedback.	Use Multiple Evidence Sources.	AI Scores May Miss Learning Dimensions.
Professional Learning	Generate Reflection Prompts.	Check Claims and Discuss with Peers.	Never Enter Confidential Data into Unapproved Tools.

Ethical, Pedagogical and Implementation Challenges

1. Privacy, Consent and Data Minimization

PE teachers should collect only data needed for a defined educational purpose. Video, movement traces and fitness records can reveal more than a student's performance in one lesson. Schools should specify approved platforms, access controls, retention periods and deletion procedures. Consent and assent should be age-appropriate and consistent with law and institutional policy. Refusal to be recorded should not exclude a student from meaningful learning.

2. Bias, Reliability and Contextual Validity

AI outputs depend on data, design choices and conditions of use. A pose-estimation tool may perform poorly when limbs are occluded or the camera angle is unsuitable; a generated rubric may privilege one style of performance; a wearable may be inaccurate for certain movements. Teachers should ask what the tool measures, how it was tested, which learners it represents and whether it has been validated for the intended setting. If these questions cannot be answered, output should be treated as exploratory.

3. Digital Divide and Resource Constraints

Schools vary in device availability, connectivity, facilities, staffing and technical support. A framework that assumes every school has cameras, wearables or paid subscriptions will be inequitable. Teacher preparation should include low-cost and offline options, shared-device routines and non-digital alternatives. Procurement should consider cost, accessibility, data practices, support and whether the tool solves a genuine problem.

4. Overdependence and Reduced Movement Time

PE is intended to engage students physically and socially. If a lesson spends too much time filming, uploading, checking dashboards or waiting for feedback, technology may reduce active participation. Teachers should set time limits and use technology only when it improves learning. Direct instruction, demonstration, cooperation, play, practice and teacher-student relationships remain core elements of PE.

5. Teacher Workload and Accountability

AI may reduce some preparation tasks but create new work: verifying outputs, managing devices, obtaining permissions, troubleshooting and documenting decisions. Institutions should provide time, training and clear policies rather than treating competence as an individual responsibility alone. Accountability should be allocated clearly among tool providers, school leadership and educators, while teachers remain responsible for professional decisions in class.

6. Evidence and Overclaiming

Promising examples do not establish that every AI application improves learning. Studies differ in duration, sample, setting, comparison condition and outcome measures. Improvements in motivation or task performance may not persist or generalize. Schools should pilot tools against defined outcomes, gather feedback and stop using them if benefits are unclear or harms emerge.

Table 3: Risks and Suggested Safeguards

Risk	Example In PE	Suggested Safeguard
Privacy	Student Movement Video Stored Externally.	Approved Tools, Minimal Identifiers, Retention Limits and Permission.
Bias/Validity	Tool Misclassifies Adapted Technique.	Check Suitability; Human Review; Contextual Interpretation.
Over-Monitoring	Students Judged by Step Counts or Scores.	Private Formative Feedback; Focus on Individual Progress.
Unequal Access	Only Device-Owning Students Get Feedback.	Shared-Device and Non-Digital Alternatives.
Inaccurate Content	Generated Activity Is Unsafe.	Verify with Trusted Sources and Teacher Expertise.
Reduced Active Time	Lesson Spent Managing Technology.	Set Purpose and Time Limit; Prioritize Movement.
Accountability Gaps	Staff Defer to Algorithm.	Document Human Decisions and School Responsibilities.

Proposed Competency Development Framework

The proposed framework in Figure 2 integrates eight competency domains around a common purpose: meaningful student learning, physical literacy, participation, well-being and fairness. It is informed by UNESCO's teacher AI competency dimensions and PE learning standards, but adapted conceptually to school PE. It is not a validated scale and should be tested with teacher educators, school PE teachers and learners before use in high-stakes decisions.

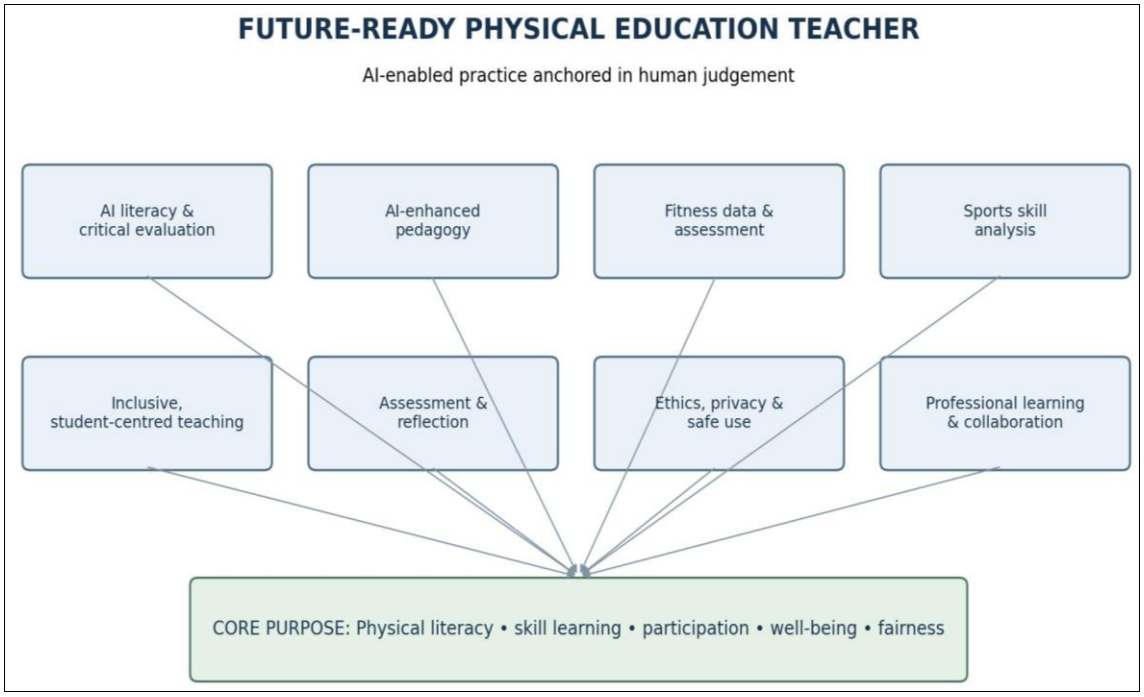


Fig 2: Proposed competency framework for future-ready Physical Education Teachers. Author-developed synthesis informed by UNESCO (Miao & Cukurova, 2024) and SHAPE America (2024) [4, 7].

1. Stage 1: Understand and Evaluate

Pre-service teachers learn AI terminology, capabilities and limitations, responsible-use principles and basic evaluation questions. Activities may include comparing an AI-generated lesson plan with curriculum expectations, identifying inaccurate sport information and discussing recording implications. Evidence should include explanation and critique, not only a quiz about tool names.

2. Stage 2: Practice with Guidance

Teacher candidates' use approved tools for bounded tasks, such as drafting an activity progression, creating a rubric or reviewing a non-identifiable movement clip. Mentors help them check age appropriateness, accessibility, safety and alignment. Candidates document how they modified AI output and why.

3. Stage 3: Apply in School Contexts

During supervised practice, candidates identify a genuine instructional need, select a proportionate tool, explain its use, protect student data and evaluate the result. The focus is on judgement and student benefit rather than novelty. Candidates should demonstrate low-tech alternatives where technology is unavailable.

4. Stage 4: Reflect, Improve and Collaborate

Teachers use portfolios, peer discussion and learner feedback to decide whether a tool should be retained, modified or discontinued. They consider active learning time, inclusion, reliability, workload and unintended consequences. Professional development should revisit competencies as tools and policies change.

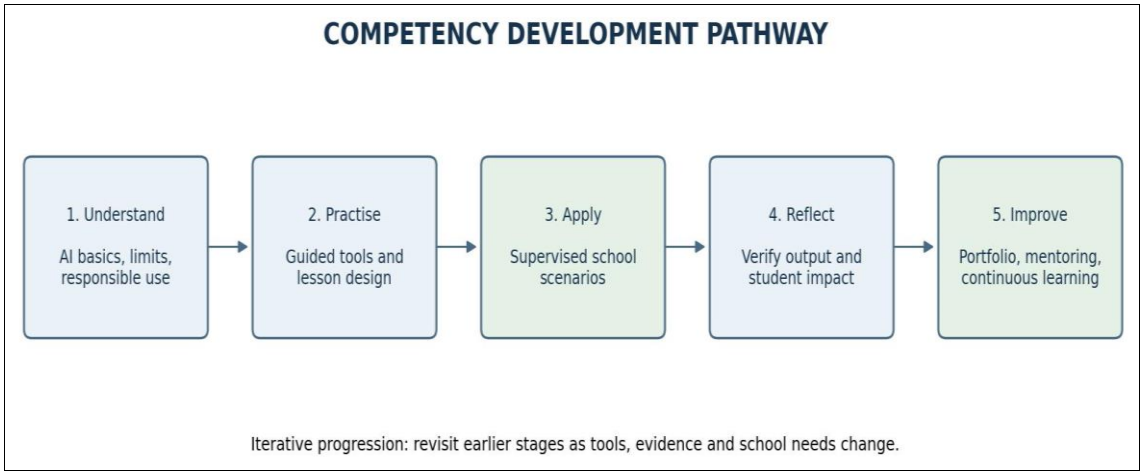


Fig 3: Staged pathway for developing AI-related competencies in PE teacher education. Author-developed framework.

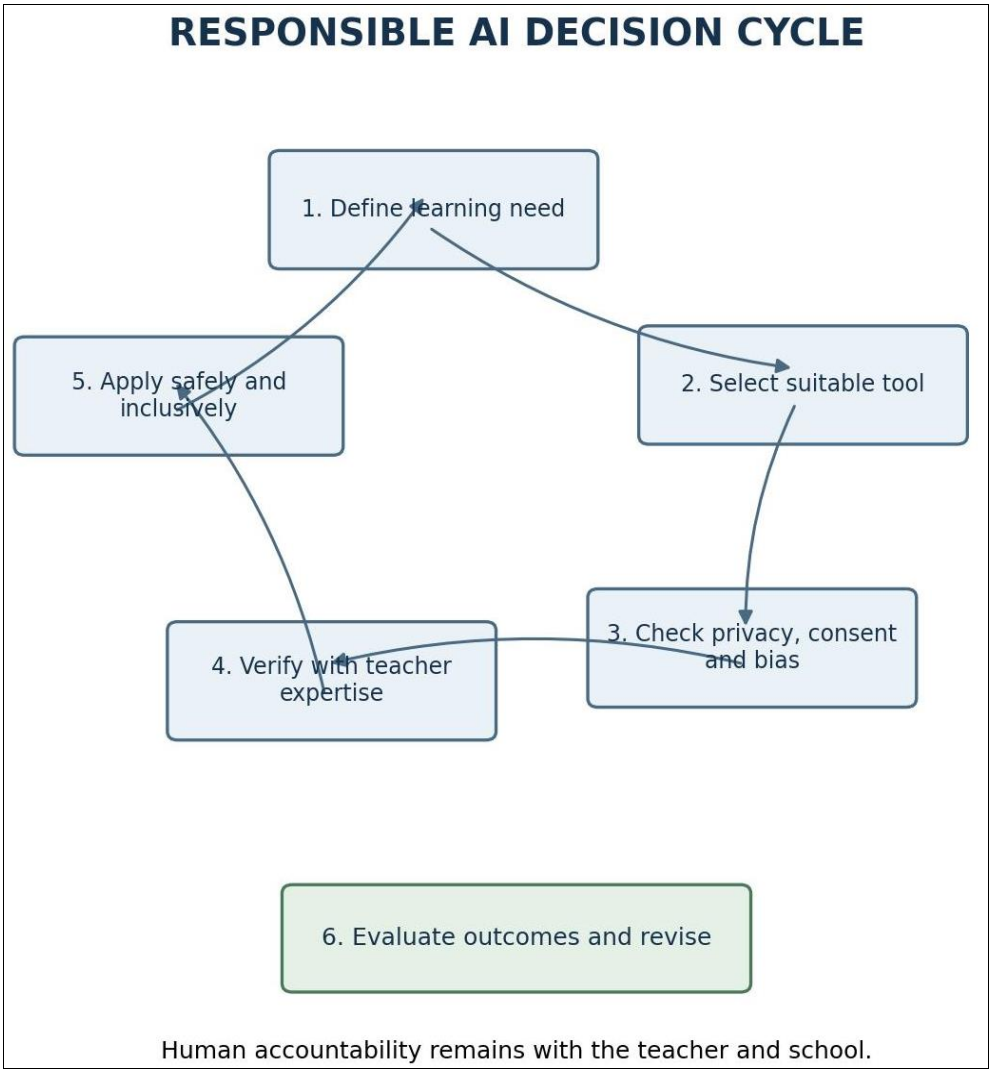


Fig 4: Responsible AI decision cycle for school PE. Author-developed framework.

Table 4: Roadmap for Teacher Education and School Implementation

Stage	Learning Activity	Assessment Evidence	Institutional Support
Foundation	AI Literacy, Ethics, PE Case Discussions.	Tool Critique; Knowledge Check.	Approved-Tool List and Introductory Module.
Guided Practice	Lesson Adaptation; Rubric Drafting; Video Critique.	Annotated Plan and Risk Checklist.	Mentor Support and Safe Practice Environment.
School Practicum	Supervised Application Tied to A Learning Objective.	Observation, Learner Feedback, Reflection.	School Approval, Consent and Device Access.
Professional Learning	Peer Inquiry and Case-Sharing.	Portfolio and Improvement Plan.	Protected Time and Peer Network.
Governance Review	Annual Evaluation of Tools and Policy.	Tool Review and Incident Review.	Leadership Oversight and Privacy Policy.

Discussion

The synthesis suggests that future-ready PE teaching requires professional knowledge and critical technological judgement. AI literacy matters, but its educational value depends on pedagogical integration. A teacher who can generate a lesson plan but cannot evaluate safety, curriculum fit or inclusion has not developed the full competence required. Conversely, a teacher who understands learning goals, student needs and the limits of AI may use only a few tools and still make well-informed decisions.

PE teacher education should move beyond demonstration-based training. Tool tutorials introduce functionality, but competence is better developed through realistic scenarios, lesson design, supervised practice, error detection and reflection. Candidates should practice identifying inaccurate sport rules, unsafe activities, misleading performance estimates and inappropriate data requests. They should also learn to explain why a tool is being used and how its output will—and will not—affect assessment.

AI should not displace the embodied nature of PE. Physical learning depends on movement, interaction, play, feedback and the teacher's ability to read the class. Technology is useful when it supports these purposes. A brief video may help a student reflect on a skill, but prolonged recording can reduce practice time or create discomfort. A dashboard may organize fitness data, but cannot fully explain the circumstances behind performance.

Equity must be a design principle. Future-ready teachers should provide equivalent opportunities when devices are unavailable, avoid public comparisons that stigmatize students and question whether a model generalizes across diverse learners. Implementation should be shaped by local curriculum, resources, privacy rules and student and family perspectives.

The framework is a proposal for development and evaluation. It draws together established AI-competency principles and PE-specific applications, but its domains and progression stages require empirical testing. Future studies should examine whether targeted professional development improves evaluation of AI output, instructional quality, engagement, inclusion and safe data practices.

Implications and Recommendations

1. For Pre-Service Teacher Education

- Integrate AI literacy and responsible-use principles into PE methods courses rather than treating them as a technical add-on.
- Use cases involving lesson planning, movement analysis, fitness data, accessibility and privacy.
- Assess candidates through annotated lesson plans, tool critiques, supervised teaching and reflective portfolios.
- Ensure candidates can explain when not to use AI and how to teach the same outcome without it.

2. For In-Service Professional Development

- Offer task-specific workshops followed by mentoring and classroom reflection.
- Develop peer-learning groups to share verified examples, errors and lessons learned.
- Provide protected time and technical support for evaluating tools.
- Update training as tools, policies and evidence evolve.

3. For School Leaders and Policymakers

- Adopt policies on approved tools, student data, video recording, consent, retention and accountability.
- Evaluate tools against purpose, validity, accessibility, privacy, cost and workload—not novelty alone.
- Ensure technology is not a condition for participation or a substitute for active learning.
- Support teacher agency and require human review for consequential decisions.

4. For Researchers

- Develop and validate PE-specific AI competency measures.
- Conduct longitudinal studies across sports, ages and resource settings.
- Report tool versions, data conditions, sample characteristics and adverse effects transparently.
- Examine outcomes beyond short-term engagement, including motor learning, inclusion, activity time and workload.

Limitations and Future Research Directions

This review is concept-led and integrative; it does not provide a systematic inventory of every study. Technologies vary in maturity, and findings from university PE, specialist coaching or laboratory settings may not transfer directly to ordinary school lessons. The proposed domains reflect a synthesis of literature and professional reasoning rather than Delphi consensus or psychometric validation.

Future research should consult school PE teachers, teacher educators, students and school leaders to test whether the eight domains are complete, understandable and feasible. A Delphi study could refine domains and indicators. Subsequent studies could develop performance-based assessments and evaluate whether professional development improves teachers' ability to critique AI outputs, design inclusive lessons and protect data. Multi-site research should include rural and low-resource schools, different sports and learners with disabilities.

A further priority is evidence standards for AI tools used in PE. Studies should report the setting in which a tool was tested, the comparison condition, outcome measures and whether findings were replicated. Without transparent reporting, schools may confuse a promising demonstration with reliable evidence of educational effectiveness.

Conclusion

AI is creating new possibilities for school PE, from lesson preparation and differentiated tasks to movement feedback, fitness-data organization and teacher professional learning. Yet future-ready teaching cannot be defined by the number of tools a teacher uses. It depends on connecting technology with PE knowledge, learning objectives, student diversity, safety and professional judgement.

This review proposes eight competency domains: AI literacy and critical evaluation; AI-enhanced pedagogical design; fitness assessment and data literacy; sports skill analysis; inclusive and student-centred teaching; assessment and reflective practice; ethical and safe use; and professional learning and collaboration. It also presents a staged development pathway and responsible-AI decision cycle.

The central principle is that AI should augment the teacher's capacity to support movement learning, not replace the teacher's responsibility or the embodied and social purposes of PE. Effective implementation requires evidence, appropriate training, privacy safeguards, accessible alternatives, institutional support and continuing evaluation. The framework offers a starting point for curriculum design and empirical validation.

Declarations

Funding: Authors should amend this statement to reflect the actual funding status.

Conflict of Interest: Authors should disclose actual financial or non-financial conflicts in accordance with the target journal's policy.

Ethics Approval: Not applicable to this literature-based review; no new human-participant data were collected.

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