

A Competence–Pedagogy Framework for Integrating Sustainable Development into Physical Education Teacher Education: A Literature-Based Synthesis

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ADMINISTRATIVE INFORMATION

Support - No support.

Review Stage at time of this submission - Completed but not published.

Conflicts of interest - The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 30 June 2026 and was last updated on 30 June 2026.

INTRODUCTION

Review question / Objective This study works toward a framework linking sustainability competences with pedagogical approaches in PETE, treating digital pedagogy and social equity as distinct dimensions. Presented in matrix form, the framework shows the degree of correspondence between competences and pedagogical approaches, with the aim of giving PE teacher trainers a structured reference for curriculum design. This study seeks to construct a framework linking sustainability competencies with pedagogical approaches within the context of physical education teacher training, integrating digital pedagogy and social equity as two distinct dimensions. Presented in matrix form, the framework illustrates the degree of correlation between competencies and pedagogical approaches, aiming to provide physical education teacher trainers with a systematic reference for curriculum design.

Condition being studied 1. Retrieval complete.
2. Independent peer reviewer.
3. Sustainability expert.

METHODS

Search strategy The search terms were divided into three groups and cross-referenced: the first group comprised terms related to physical education, including ‘physical education teacher education’, ‘PETE’ and ‘sport pedagogy’; the second group comprised terms related to education for sustainable development, including ‘education for sustainable development’ (ESD), ‘sustainability competences’ and ‘sustainability pedagogy’; the third group comprises keywords relating to the two innovative dimensions of this study, including ‘digital pedagogy’, ‘artificial intelligence in education’ and ‘inclusive education’.

Participant or population No.

Intervention No.

Comparator No.

Study designs to be included 1. Peer-reviewed journal articles 2. Research topics related to physical education 3. Directly related to ESD competencies or ESD pedagogy 4. Involving digital/ AI pedagogy and physical education teacher training 5. English.

Eligibility criteria 1. Relating solely to competitive sports training
2. Non-peer-reviewed conference abstracts
3. Conference papers, theses and books
4. Research on school physical education activities not directly related to ESD competencies or pedagogy.

Information sources Web of Science (WOS), Scopus and EBSCO.

Main outcome(s) The analytical material of this study is derived from a systematic literature search. The databases searched included Web of Science (WOS), Scopus and EBSCO, with the search period set to end on 25 March 2026 to ensure the timeliness of the literature. The search terms were divided into three groups and cross-referenced: the first group comprised terms related to physical education, including 'physical education teacher education', 'PETE' and 'sport pedagogy'; the second group comprised terms related to education for sustainable development, including 'education for sustainable development' (ESD), 'sustainability competences' and 'sustainability pedagogy'; the third group comprises keywords relating to the two innovative dimensions of this study, including 'digital pedagogy', 'artificial intelligence in education' and 'inclusive education'.

After preliminary screening, a total of 1,381 articles were identified from WOS (222), Scopus (851) and EBSCO (308).

Quality assessment / Risk of bias analysis In hermeneutic research, reliability is primarily influenced by the researcher's own stance and interpretative preferences (Folgueiras-Bertomeu & Sandín-Esteban, 2023). To address this limitation, this study adopted the following measures. Firstly, the research team comprised members from diverse disciplinary backgrounds; these multiple perspectives helped to mutually correct any biases that might arise from a single standpoint. Second, the definitions of each competency item and pedagogical category were discussed and revised within the team to ensure that the final definitions reflected a consensus rather than individual interpretations. Third, following the completion of

the framework, external experts from the fields of PETE and ESD were invited to conduct an independent review of the framework's content, in order to further test its applicability and validity. The limitations of this study's validity must be clearly stated. Firstly, the literature review for this study primarily covered English-language sources; academic work in other languages may not have been fully incorporated. Secondly, the proposed framework is based on literature analysis and the researchers' interpretation and has not yet been systematically tested through large-scale empirical research. Baena-Morales et al. (2023) also noted, when developing the PESD competency measurement tool, that subsequent empirical validation of the theoretical framework is an indispensable next step for this type of research. Consequently, the conclusions of this study are distinctly theoretical in nature and require further validation in the future through expert consultation, teacher questionnaires and classroom-based empirical studies. Furthermore, in the field of digital pedagogy, Wang and Wang (2024) note that research on the application of AI technology in physical education remains, on the whole, at an early stage, with a limited body of literature and varying levels of research depth. This implies that the literature base upon which this study relies when constructing the categories of digital pedagogy is relatively weak; consequently, the sections of the framework pertaining to digital pedagogy may require adjustment in future updates as research progresses.

Strategy of data synthesis After the literature had been collected and organized, the formal analysis phase commenced. The analytical process followed the four stages of grounded theory's constant comparison method, incorporating hermeneutic principles of interpretation at each stage to enable continuous comparison, categorization and reflection on the literature. The first stage involves the categorization of materials. The research team conducted a preliminary categorization of the collected literature along two main axes: the first being SD competencies within the context of physical education teacher education, and the second being pedagogical approaches applicable to physical education teacher education. During the categorization process, the researchers did not presuppose fixed categories, but rather allowed categories to emerge naturally from the content of the literature (Stough & Lee, 2021). Concurrently, the researchers also drew upon the framework of foundational competencies and pedagogical approaches proposed by Lozano et al. (2017) to determine which elements could be directly

transferred, which required reinterpretation, and which constituted unique contributions to physical education teacher education.

The second stage involved category consolidation. The research team held internal discussions on the preliminary classification results, focusing on two key aspects: the overlap and distinctions between competency items, and the potential associations between teaching methods and different competency dimensions. Discussions during this stage were conducted through iterative comparison; following each round of discussion, the boundaries and definitions of the categories were revised until team members reached a consensus on the main categories.

The third stage involved identifying relationships. Once the definitions of the competency items and pedagogical categories stabilized, the research team began a systematic assessment of the connections between them. Researchers evaluated each 'competency–pedagogy' pair to determine whether the pedagogy typically fosters that competency (strong association, marked with (●)), whether it might foster that competency (potential association, marked with (○)), or whether there was no clear association between the two (marked with a blank). Each judgement required supporting evidence from the literature and was confirmed through multiple rounds of internal discussion within the research team (this process involved a degree of subjectivity and represents solely the views of the research team).

The fourth stage involves the drafting of the framework. Upon completion of the three preceding stages, the research team will synthesize the findings into a structured framework text, resulting in the PESD connection matrix and its textual interpretation. The drafting of the framework adheres to hermeneutic principles of writing, striving to present the overall structure whilst providing clear explanations of the logical underpinnings of each component. Lohmann et al. (2021) point out that researchers in the field of PETE often lack systematic competency frameworks and pedagogical references when addressing ESD issues; this is precisely the gap that the framework developed in this study aims to fill.

Subgroup analysis No.

Sensitivity analysis No.

Country(ies) involved China; Spain.

Keywords sustainable development; competence framework; digital teaching; social equity; curriculum design.

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