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TITLE

Digital competencies of physical education teachers: a review of scientific evidence on their impact on pedagogical innovation and learning

Spanish title

Competencias digitales del docente de educación física: revisión de la evidencia científica sobre su impacto en la innovación pedagógica y el aprendizaje

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ABSTRACT

Digital teaching competencies have become an essential component in transforming contemporary teaching and learning processes. In Physical Education, the integration of digital technologies has promoted active teaching methodologies, innovative assessment strategies, and more engaging learning experiences for students. This review aimed to analyze the scientific evidence published between 2015 and 2026 regarding the impact of Physical Education teachers' digital competencies on pedagogical innovation and student learning, with particular attention to studies conducted in Latin America and Guatemala. A narrative literature review was conducted using Scopus, SciELO, Redalyc, Dialnet, and Google Scholar databases. The reviewed studies indicate that strengthening teachers' digital competencies facilitates the implementation of innovative methodologies such as blended learning, gamification, digital assessment, augmented reality, and mobile learning, positively influencing students' motivation, participation, and academic performance. Evidence from Guatemala also reveals gradual progress in digital transformation despite existing challenges related to technological infrastructure and continuous teacher training. The review concludes that strengthening digital competencies is a strategic factor for improving pedagogical innovation and educational quality in Physical Education.

Keywords: digital competencies; physical education; pedagogical innovation; learning; digital transformation; teacher training.

RESUMEN

Las competencias digitales docentes se han

consolidado como un componente esencial para la transformación de los procesos de enseñanza y aprendizaje en la educación contemporánea. En el ámbito de la educación física, la incorporación de tecnologías digitales ha favorecido el desarrollo de metodologías activas, estrategias de evaluación innovadoras y experiencias de aprendizaje más motivadoras para los estudiantes. El presente artículo tuvo como objetivo analizar la evidencia científica publicada entre 2015 y 2026 acerca del impacto de las competencias digitales del docente de educación física en la innovación pedagógica y en el aprendizaje, considerando especialmente los aportes provenientes del contexto latinoamericano y las investigaciones desarrolladas en Guatemala. Se realizó una revisión narrativa de la literatura mediante la consulta de bases de datos científicas reconocidas, incluyendo Scopus, SciELO, Redalyc, Dialnet y Google Académico, aplicando criterios de inclusión relacionados con actualidad, pertinencia temática e idioma español. Los estudios revisados evidenciaron que el fortalecimiento de las competencias digitales favorece la implementación de metodologías innovadoras como el aprendizaje híbrido, la gamificación, la evaluación digital, la realidad aumentada y el aprendizaje móvil, incrementando la motivación, la participación y el rendimiento académico del alumnado. Asimismo, se identificó que en Guatemala aún existen limitaciones asociadas con la infraestructura tecnológica y la formación permanente del profesorado, aunque las investigaciones recientes muestran avances significativos en los procesos de transformación digital educativa. Se concluye que el desarrollo sistemático de competencias digitales constituye un factor estratégico para impulsar la innovación pedagógica y mejorar la calidad de los procesos de enseñanza y aprendizaje en la educación física.

Palabras clave: competencias digitales; educación física; innovación pedagógica; aprendizaje; transformación digital; formación docente.

INTRODUCTION

Digital transformation has profoundly altered educational processes over the last decade, driving new forms of teaching, learning, and assessment at all levels of the education system. In this context, teachers' digital competencies have become an essential component for responding to the demands of a society characterized by constant access to information, connectivity, and the increasing use of emerging technologies. Beyond the instrumental mastery of digital tools, these competencies encompass teachers' ability to integrate technologies critically, ethically, and innovatively within pedagogical processes, fostering meaningful and student-centered learning experiences (Cabero-Almenara & Palacios-Rodríguez, 2021).

The United Nations Educational, Scientific and Cultural Organization (UNESCO, 2019) maintains that strengthening digital competencies is one of the fundamental pillars for achieving inclusive, equitable, and quality education. In addition, the European Framework for Digital Competence of Educators (DigCompEdu) states that teachers must develop skills related to lesson planning, the creation of digital resources, assessment using technology, student empowerment, and the development of students' digital competence (Redecker, 2020). These international frameworks have served as a reference for numerous Latin American education systems in the design of policies aimed at the digital transformation of education.

In the field of physical education, the incorporation of digital technologies has generated a significant methodological evolution. Traditionally, this curricular area has been primarily associated with the development of motor skills and healthy habits through in-person activities. However, technological advancements have facilitated the integration of resources such as mobile applications, virtual platforms, wearable fitness monitoring devices, active video games (exergames), augmented reality, virtual reality, artificial intelligence, and digital systems for evaluating motor performance, considerably expanding the possibilities for teaching and

learning (Prat-Ambròs et al., 2022).

Several studies have demonstrated that the appropriate use of digital technologies increases student motivation, strengthens participation during classes, and improves formative feedback processes. Furthermore, it allows for the personalization of activities according to the individual characteristics of each student, facilitating the monitoring of physical and cognitive progress through digital tools for continuous assessment (Area-Moreira & Adell-Segura, 2021). Consequently, the role of the physical education teacher has evolved towards a professional profile that combines pedagogical, disciplinary and technological skills to respond to the educational needs of the 21st century.

La Recent scientific literature agrees that digital skills are a determining factor in promoting pedagogical innovation. This innovation should not be understood solely as the incorporation of technological devices into the classroom, but rather as a process of methodological transformation that modifies teaching strategies, fosters active methodologies, and generates more collaborative, inclusive, and contextualized learning experiences (Cabero-Almenara et al., 2022). In this sense, technologies such as gamification, project-based learning, the flipped classroom, mobile learning, and learning management platforms have demonstrated positive results in the development of motor, cognitive, and socio-emotional skills in physical education students.

In Latin America, several studies show significant progress in the incorporation of digital technologies into teacher training programs; however, significant differences persist between countries in terms of technological infrastructure, connectivity, access to digital resources, and ongoing professional development programs. These inequalities limit the effective implementation of innovative methodologies, especially in educational institutions located in rural areas or with limited technological resources (ECLAC & UNESCO, 2022).

The Guatemalan context reflects a similar situation. In recent years, the Guatemalan Ministry of Education has promoted various strategies to strengthen the

digitalization of the education system through teacher training programs, the incorporation of virtual platforms, and the development of digital educational resources. However, national research reports that limitations related to teachers' digital literacy, the availability of technological equipment, and unequal internet access still exist—factors that particularly affect the implementation of innovative proposals in practical areas such as physical education (Guatemalan Ministry of Education, 2023).

In Guatemalan teacher training institutions, there is also a growing interest in integrating digital competencies into initial and continuing training programs. Studies conducted by universities in the country highlight that teachers recognize the importance of technology in enriching teaching processes; However, they express training needs related to the design of digital resources, assessment using technological tools, and the pedagogical use of specific applications for physical education.

From a pedagogical perspective, teachers' digital competencies go beyond the simple technical mastery of platforms or applications. Various authors agree that they involve knowledge, skills, attitudes, and values that allow them to select, adapt, and evaluate technological resources according to specific educational objectives. This comprehensive view fosters the development of innovative, inclusive, and student-centered learning environments, while also promoting critical thinking, autonomy, and collaborative learning (INTEF, 2022).

In physical education, pedagogical innovation supported by digital technologies has diversified the methodological strategies used by teachers. The use of applications for biomechanical movement analysis, physical performance monitoring platforms, interactive audiovisual resources, QR codes, active video games, and artificial intelligence tools is currently a growing trend in numerous educational systems. These experiences have shown significant improvements in student motivation, adherence to physical activity, and the learning of motor skills (Pérez-Pueyo et al., 2021).

Despite these advances, scientific

evidence shows that the success of technological innovation depends primarily on teachers' level of digital competence. The mere availability of technological resources does not guarantee improvements in learning if teachers lack the necessary training to integrate them pedagogically. Therefore, international organizations emphasize the need to strengthen ongoing professional development programs for teachers specifically focused on the educational use of digital technologies (UNESCO, 2023).

From a research perspective, literature reviews allow for the synthesis of existing scientific output, the identification of trends, the recognition of knowledge gaps, and the guidance of future research. In the specific case of physical education, review studies that systematically integrate evidence related to teachers' digital competencies and their impact on pedagogical innovation are still limited, particularly considering the educational context of Guatemala.

In light of the foregoing, this article aims to answer the following research question: What scientific evidence exists regarding the impact of physical education teachers' digital competencies on pedagogical innovation and learning processes, with an emphasis on studies conducted in Guatemala and Latin America?

This review is relevant because it will allow for the systematization of available scientific knowledge, the identification of key research trends, and the provision of analytical tools that contribute to strengthening teacher training policies and the digital transformation of education. Furthermore, its findings can serve as a reference for researchers, higher education institutions, policymakers, and teachers interested in promoting innovative pedagogical practices through the use of digital technologies.

Consequently, the overall objective of this research was to analyze the scientific evidence published between 2015 and 2026 on the digital skills of physical education teachers and their impact on pedagogical innovation and learning, especially considering the research developed in Guatemala and other Latin American countries.

The guiding assumption of the review

is that the development of digital skills in physical education teachers is a determining factor in strengthening pedagogical innovation, increasing student motivation and improving learning outcomes, although its implementation continues to be conditioned by factors related to professional training, technological infrastructure and educational policies in each national context.

Table 1: Main international frameworks on digital teaching competencies

Reference framework	Organization	Main dimensions	Application in Physical Education
UNESCO ICT Competency Framework for Teachers	UNESCO	Understanding ICT, curriculum, pedagogy, assessment, and professional development	It guides the pedagogical integration of technologies to promote active learning and digital skills.
DigCompEdu	European Commission	Professional engagement, digital resources, teaching and learning, assessment, student empowerment, and development of students' digital competence	It facilitates the design of innovative methodologies through digital platforms, formative assessment, and personalized learning.
Digital Competency Framework for Teachers	INTEF (Spain)	Information and digital literacy, communication, content creation, security, and problem-solving	It promotes the didactic use of digital resources, mobile applications, and innovative strategies in physical education.

Note. Own elaboration based on UNESCO (2019), Redecker (2020) and INTEF (2022).

MATERIALS AND METHODS

Study Design

This research was conducted through a systematic narrative literature review, following the recommendations of the 2020 PRISMA statement (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) for the identification, selection, and synthesis of scientific studies. This methodological design allowed for the integration and critical analysis of available evidence on the digital competencies of physical education teachers and their impact on pedagogical innovation and learning, identifying trends, contributions, and research gaps present in recent scientific literature.

The review employed a qualitative-documentary approach, as it was based on the

analysis and interpretation of previously published research, without manipulating variables or intervening on any population. The process consisted of searching for, selecting, critically appraising, and synthesizing academic publications related to the research topic..

Literature Search Strategy

The search for scientific information was conducted between January and March 2026 by consulting academic databases recognized for their quality and impact in the fields of education and physical education.

The following sources were consulted:

- Scopus
- SciELO
- Redalyc
- Dialnet
- ERIC
- Google Scholar

The search strategy combined Boolean operators (AND, OR) with Spanish descriptors related to the research topic.

The main terms used were:

- Digital teaching competencies
- Digital teaching competence
- Physical education
- Pedagogical innovation
- Digital transformation
- Learning
- Educational technologies
- Teacher training
- Guatemala
- Higher education

Combinations such as the following were used:

- ("competencias digitales" AND "educación física")
- ("docente" AND "innovación pedagógica")
- ("competencia digital docente" AND "aprendizaje")
- ("educación física" AND "Guatemala"

Table 2: Databases and search strategy used

Database	Main descriptors	Records identified	Included studies
Scopus	Competencias digitales AND Educación Física	68	18
SciELO	Competencia digital docente	54	16
Redalyc	Innovación pedagógica AND Educación Física	49	14
Dialnet	Formación docente digital	61	17
ERIC	Digital Competence AND Physical Education	43	10
Google Scholar	Additional search	132	19
Total	—	407	94

Note. Prepared by the author based on the bibliographic search process carried out for this review.

Inclusion Criteria

Studies meeting the following criteria were included:

- Publications between 2015 and 2026.
- Peer-reviewed scientific articles.
- Systematic reviews.
- Quantitative, qualitative, or mixed-methods empirical studies.
- Research related to teachers' digital

competencies.

- Studies developed in physical education.
- Research on pedagogical innovation.
- Publications in Spanish.
- Studies conducted in Latin America and Spain, incorporating research from Guatemala when available.

Exclusion criteria

The following were excluded:

- Duplicate articles;
- non-peer-reviewed book chapters;
- institutional documents without academic review;
- conference abstracts;
- publications prior to 2015;
- research focused exclusively on students without considering teaching performance;
- documents without full-text access.

Table 3
Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
Publications 2015–2026	Publications prior to 2015
Peer-reviewed scientific articles	Conference abstracts
Spanish language	Documents without full text
Physical Education	Other unrelated disciplinary areas
Digital teaching skills	Technological studies only
Pedagogical innovation	Duplicate publications

Note. Original work.

Study Selection Process

The initial search identified 407 records. Subsequently, 96 duplicate documents were removed, resulting in a total of 311 publications for the preliminary review phase.

In a second stage, the titles and abstracts of each study were analyzed to determine their relevance to the research objective. During this process, 174 studies were excluded for not specifically addressing digital teaching competencies in physical education or for presenting insufficient information.

Finally, 137 articles were read in full, of which 94 studies met all the established methodological criteria and were included in the qualitative analysis of the review..

Variables Analyzed

To systematize the information obtained, the following categories of analysis were defined:

- Teachers' digital competencies;
- Pedagogical innovation;
- Active methodologies supported by digital technologies;
- Technological tools used in physical education;
- Impact on learning;
- Student motivation;
- Teacher professional development;
- Latin American context;
- Scientific evidence from Guatemala.

Each publication was reviewed using a document analysis matrix designed to record information related to authors, year of publication, country, methodology used, population studied, main findings, and contributions to physical education.

Table 4: Categories of analysis used in the review

Category	Aspects analyzed
Digital skills	Level of teacher development
Pedagogical innovation	Methodological strategies implemented
Digital technologies	Platforms, applications, and resources used
Learning	Student motivation, performance, and participation
Teacher training	Training and professional development
Educational context	Latin American and Guatemalan evidence

Note. Original work.

Data Analysis

The collected data was organized using comparative matrices and summary tables, allowing for the identification of convergences, divergences, and trends in scientific production. The analysis followed a thematic approach, grouping studies according to predefined categories. Subsequently, a comparison was made between the findings reported by international, Latin American, and Guatemalan research to establish the current state of knowledge regarding the digital competencies of physical education teachers and their influence on pedagogical innovation and learning.

To strengthen the validity of the review, priority was given to publications indexed in databases of recognized academic prestige, as well as recent research that provided empirical evidence on the phenomenon under study. This procedure allowed for the construction of a critical synthesis of the literature, identifying both the progress achieved and the remaining challenges for the effective integration of digital competencies in physical education teaching.

RESULTS AND DISCUSSION

The literature review revealed a growing scientific interest in the digital competencies of physical education teachers as a determining factor for pedagogical innovation and improved learning. The studies analyzed demonstrate that the effective integration of digital technologies fosters the development of active methodologies, increases

student motivation, and strengthens teachers' professional development. Furthermore, the reviewed literature shows that digital transformation in physical education depends not only on the availability of technological resources, but primarily on the level of teachers' digital competencies to plan, implement, and evaluate technology-supported learning experiences.

The thematic analysis allowed the results to be organized into four main categories: digital teaching skills, pedagogical innovation, impact on learning, and scientific evidence in Guatemala.

Digital Competencies of Physical Education Teachers

Most studies agree that digital competencies constitute an integrated set of knowledge, skills, attitudes, and values that enable teachers to use technology pedagogically to improve teaching and learning processes. In physical education, these competencies take on particular characteristics due to the practical nature of the subject, which requires combining body movement with digital tools geared toward motor assessment, immediate feedback, and monitoring of physical performance.

The reviewed research shows that teachers with higher levels of digital competence are more willing to incorporate innovative methodologies, adapt curricular content through virtual platforms, and use specialized applications for human movement analysis. They also develop more dynamic assessment strategies, fostering personalized and student-centered learning processes..

Another recurring finding is the influence of continuing professional development on the development of these skills. Studies show that ongoing training increases teachers' confidence in integrating digital technologies into their teaching practices, reducing resistance to change and fostering a positive attitude toward educational innovation..

Table 5: Summary of research on digital skills of physical education teachers

Author	Country	Study design	Main findings
Cabero-Almenara y Palacios-Rodríguez (2021)	Spain	Systematic review	Digital skills foster methodological innovation and active learning.
Area-Moreira y Adell-Segura (2021)	Spain	Document review	Digital competence goes beyond the instrumental use of technologies.
Pérez-Pueyo et al. (2021)	Spain	Descriptive study	The use of digital tools increased student motivation in physical education.
Silva et al. (2022)	Chile	Quantitative study	Teacher training significantly improves technological integration.
López-Belmonte et al. (2023)	Spain	Meta-analysis	There is a positive relationship between digital competence and pedagogical innovation.

Note. Prepared by the author based on the reviewed scientific literature.

Digital Competencies and Pedagogical Innovation

The second category analyzed revealed that pedagogical innovation is the primary outcome of strengthening teachers' digital skills. Studies show that teachers with greater technological proficiency more frequently incorporate active learning methodologies that transform the traditional role of the student, promoting more autonomous, collaborative, and reflective participation.

Among the most frequently used methodological strategies are project-based learning, the flipped classroom, gamification, mobile learning, digital assessment, virtual learning environments, and the use of interactive audiovisual resources. These methodologies encourage student participation during practical sessions and allow learning to extend beyond the physical space of the educational institution.

Furthermore, several studies highlight the incorporation of emerging

technologies such as augmented reality, virtual reality, artificial intelligence, and wearable devices for monitoring physical activity. These tools allow for recording motor performance in real time, providing immediate feedback, and adapting activities to the individual needs of students.

Table 6: Digital technologies used in the pedagogical innovation of physical education

Technology	Pedagogical application	Identified benefits
LMS Platforms	Content organization and assessment	Improved learning monitoring.
Mobile Applications	Physical activity tracking	Increased student participation.
Gamification	Motivation through challenges and rewards	Greater engagement during classes.
Augmented Reality	Motor skills learning	Interactive visualization of movement.
Artificial Intelligence	Personalized feedback	Improved assessment process.
Video Analytics	Technical movement correction	Development of independent learning.

Note. Prepared by the author based on a review of the literature.

Impact of Digital Skills on Learning

The reviewed studies agree that teachers' digital skills have a positive impact on multiple dimensions of learning. Among the most frequently reported benefits are increased motivation, improved academic performance, strengthened student autonomy, and the development of collaborative skills.

Research shows that incorporating digital resources fosters more dynamic assessment processes, allowing for immediate feedback and monitoring of individual student progress. Furthermore, virtual platforms facilitate continuity of learning outside the classroom, promoting self-assessment and independent learning.

From a physical education perspective, the use of mobile applications, body sensors, and digital platforms allows for the recording of indicators related to physical fitness, motor performance, and student participation, providing objective information for pedagogical decision-making.

Studies also highlight that digital methodologies increase students' intrinsic motivation, especially when they incorporate elements of gamification, collaborative challenges, and project-based learning. These strategies foster greater engagement during physical activities and contribute to the development of healthy habits..

Table 7: Impact of digital skills on learning

Dimension	Evidence found
Motivation	Sustained increase in interest in participating in activities.
Academic performance	Improvement in the achievement of motor and cognitive skills.
Participation	Greater engagement during in-person and virtual classes.
Evaluation	Immediate feedback and personalized follow-up.
Independent learning	Development of self-assessment and self-regulation skills.
Collaborative work	Increase in cooperative activities facilitated by digital technologies.

Note. Original work.

Scientific evidence in Guatemala

The review identified that specific scientific production on the digital competencies of physical education teachers in Guatemala is still limited compared to other Latin American countries. However, in recent years there has been a progressive increase in research related to the digital transformation of the education system and teacher training.

The reviewed publications show that higher education institutions and the Guatemalan Ministry of Education have promoted initiatives aimed at strengthening digital competencies through training programs, the incorporation of virtual platforms, and the development of digital educational resources. Nevertheless, challenges persist related to connectivity, the availability of technological infrastructure, and opportunities for professional development for teachers.

In the field of physical education, the available studies indicate that the use of digital tools has allowed for the diversification of methodological strategies, especially through mobile applications for monitoring physical activity, virtual platforms for learning management, and audiovisual resources for teaching motor skills.

Despite these advances, the literature agrees on the need to expand scientific research on the impact of digital skills in physical education teaching within the Guatemalan context, promoting empirical studies that allow for the evaluation of the effectiveness of different technological strategies and guide the design of public policies for teacher training.

Table 8: Main contributions of the reviewed literature to the Guatemalan context

Aspect analyzed	Evidence identified
Teacher training	Increased digital skills training programs.
Pedagogical innovation	Growing use of virtual platforms and digital resources.
Physical education	Initial integration of mobile applications and digital assessment.
Limitations	Insufficient technological infrastructure and unequal internet access.
Opportunities	Strengthening of public policies and ongoing professional development.

Note. Own elaboration based on the reviewed literature.

Summary of Results

The analysis of the 94 selected studies reveals a consensus regarding the importance of digital skills as a key element for pedagogical innovation in physical education. Scientific evidence demonstrates that teachers with greater development of these skills implement more active methodologies, use technological resources strategically, and foster more motivating and meaningful learning experiences.

Furthermore, the review identifies continuing professional development as the main factor associated with strengthening digital skills, while limitations in technological infrastructure and unequal access to digital resources continue to represent the main challenges, especially in educational contexts such as Guatemala's..

DISCUSSION

This review demonstrates that the digital competencies of physical education teachers constitute a strategic factor for promoting pedagogical innovation and improving learning outcomes. The findings show broad agreement with research conducted in recent years, which recognizes that the pedagogical use of digital technologies transcends the mere incorporation of technological tools and is geared towards transforming teaching practices through active, collaborative, and

student-centered methodologies (Cabero-Almenara & Palacios-Rodríguez, 2021; Area-Moreira & Adell-Segura, 2021).

One of the main contributions identified in the reviewed literature is the positive relationship between teachers' level of digital competence and their ability to implement innovative strategies in physical education. In this sense, the results align with the DigCompEdu model, which maintains that digital competencies should be integrated across all aspects of planning, curriculum development, assessment, and learning support (Redecker, 2020). This approach moves beyond a purely instrumental view of technology and promotes reflective teaching practices based on the development of professional competencies.

Furthermore, the review highlights that digital technologies facilitate the design of more dynamic and contextualized learning experiences. Tools such as virtual platforms, mobile applications, video analytics, augmented reality, artificial intelligence, and physical monitoring devices have been shown to contribute significantly to increased student motivation, participation, and the development of motor skills. These results are consistent with recent research conducted in Spain, Chile, and Colombia, which reports significant improvements in student engagement when technologies are integrated through active methodologies with clearly defined pedagogical objectives.

However, the literature also cautions that the availability of technological resources, in itself, does not guarantee effective educational innovation processes. Several studies agree that the most influential variable continues to be teacher training. Teachers who regularly participate in professional development programs demonstrate greater confidence in

selecting digital tools, adapting methodological strategies, and evaluating learning using technological resources. Consequently, ongoing training is an essential element for consolidating the digital transformation of physical education..

In the Latin American context, significant progress has been identified, although marked differences exist between countries. While some institutions have incorporated well-established models of digital teacher training, others still face limitations related to technological infrastructure, connectivity, and access to specialized resources. These differences directly impact opportunities for pedagogical innovation and explain the heterogeneity observed in the results of the analyzed research.

Regarding the case of Guatemala, the review revealed that specific scientific production on digital competencies in physical education is still in its early stages. Most national research focuses on educational digitization in general, with a limited number of studies focused exclusively on physical education teaching. This situation presents an opportunity to strengthen future lines of research aimed at analyzing the impact of digital technologies on the development of motor skills, healthy habits, and the evaluation of physical performance within the Guatemalan education system.

Available studies in Guatemala highlight that initiatives promoted by the Ministry of Education and universities have fostered progress in teachers' digital literacy; however, challenges persist related to the coverage of training programs, connectivity in rural areas, and the availability of technological equipment in schools. These limitations coincide with those identified by international organizations for other Latin American

countries, demonstrating the need to strengthen public policies that guarantee equitable conditions for digital transformation in education.

Another relevant aspect identified in this review is the potential of emerging technologies to enrich physical education teaching. The incorporation of artificial intelligence, learning analytics, virtual reality, and augmented reality is beginning to solidify as an international trend that allows for personalized instruction, monitoring of student progress, and immediate feedback on motor skills. However, its implementation requires teachers with advanced digital skills and ongoing professional development.

From a pedagogical perspective, the reviewed evidence supports the need to promote teacher training models that simultaneously integrate technological, pedagogical, and subject-matter competencies. In this regard, the TPACK (Technological Pedagogical Content Knowledge) model is a relevant framework for understanding that educational innovation depends not only on technological knowledge, but also on the interaction between subject matter expertise, teaching strategies, and the pedagogical use of digital technologies. The balanced integration of these components fosters more effective educational practices that are better adapted to students' current needs.

The review also identified some gaps in the scientific literature. Although there is abundant evidence on teachers' digital competencies in general, longitudinal studies analyzing their sustained effects on academic performance and the development of motor skills in physical education are still scarce. Similarly, there is limited scientific output in Central American countries, particularly Guatemala, which hinders the development of contextualized evidence to guide specific educational policies.

Among the main limitations of this study is the exclusive inclusion of publications in Spanish, which may have restricted access to relevant research published in other languages. Furthermore, as this is a narrative review, the results depend on the methodological quality of the selected studies and do not allow for the establishment of causal relationships. However, the breadth of the databases consulted and the application of systematic selection criteria strengthen the reliability of the presented synthesis.

Finally, the results obtained allow us to affirm that digital competencies represent an essential component for strengthening pedagogical innovation in physical education. Their development not only improves teachers' professional skills but also contributes to generating more motivating, inclusive, and meaningful learning experiences, in line with the demands of 21st-century education. Consequently, it is a priority for higher education institutions, government agencies, and continuing education programs to promote comprehensive strategies that foster the ongoing development of teachers' digital competencies, especially in contexts where technological gaps and inequalities in access to digital resources persist.

CONCLUSIONS

Based on the analysis of the reviewed scientific evidence, it is concluded that the digital competencies of physical education teachers are a determining factor in transforming teaching and learning processes. The studies analyzed demonstrate that the development of these competencies fosters the implementation of active methodologies, the pedagogical use of digital technologies, and the creation of more dynamic, collaborative, and student-centered learning environments.

The review identified that pedagogical innovation depends more on the level of teacher preparation than on the mere availability of technological resources. Consequently, ongoing professional development emerges as the primary factor for strengthening the effective integration of digital tools in physical education, promoting educational practices geared toward the development of motor, cognitive, and socio-emotional competencies.

Furthermore, scientific evidence shows that the use of virtual platforms, mobile applications, augmented reality resources, artificial intelligence, and digital assessment systems significantly contributes to increased student motivation, participation, and learning, provided that these technologies are incorporated through planned teaching strategies that are consistent with curricular objectives.

Regarding the Guatemalan context, progressive advancements in educational digital transformation processes were observed; however, challenges related to technological infrastructure, connectivity, and teacher training opportunities persist, especially in institutions located in rural areas. These conditions highlight

the need to strengthen public policies that promote equitable access to digital resources and consolidate ongoing professional development programs.

Finally, this review identifies a limited body of specific scientific research on the digital competencies of physical education teachers in Guatemala, which opens new opportunities for the development of empirical research that evaluates the impact of emerging technologies on learning, motor performance, and pedagogical innovation. In this sense, future research can contribute to generating contextualized evidence that strengthens decision-making in teacher training and digital transformation of the education system.

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