2025 Volume 3, Issue 2
Educational Innovation Research
ISSN: 3029-1844(Print)
ISSN: 3029-1852(Online)

Difficulties and Relief: Innovative Research on the Integration of Digital Technology and Physical Education Teaching

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Abstract:

The deep integration of digital technology and physical education is not only an essential direction for contemporary classroom reform but also a key pathway for enhancing students' core competencies in physical education. Despite the vigorous promotion of digital tools in PE instruction, numerous challenges persist in actual teaching practice. On one hand, some PE teachers exhibit a limited understanding of digital pedagogy; while digital elements are incorporated into lessons, traditional instructional paradigms remain dominant, resulting in scenarios akin to "old wine in a new bottle." On the other hand, the intelligent features of digital teaching materials are often underutilized, leading to overly simplistic methods and superficial content delivery. In response to these issues, this study employs CiteSpace 6.3.1 to conduct a visualized analysis of the current state and evolving trends of digital-PE integration. The goal is to uncover its underlying value logic, identify research hotspots and critical issues, reveal practical barriers in the integration process, and propose feasible pathways for improvement, thereby offering theoretical and practical insights for the future development of digital physical education in China.

Keywords:

Digital technology
Physical education teaching
Core competencies

Online publication: *March 27, 2025*

1. Introduction

The deep integration of digital technology and physical education teaching is not only a natural expectation for classroom teaching reform, but also a key factor in promoting the development of students' core competencies. Since the 21st century, the birth of digital technology has brought unprecedented impact to education and provided unlimited prospects for the reform

of physical education teaching. To cope with this impact, schools have rapidly launched large-scale construction in digital technology and physical education teaching. The 2022 Work Points of the Ministry of Education propose the implementation of the digital education strategy, which requires leveraging the advantages of networking, digitization, and artificial intelligence to innovate education and learning methods. The so-called digitization refers to the technology of converting complex and ever-changing scenes and objects into measurable data information, and converting resources such as images, text, audio, and graphics into binary code recognizable by electronic computers for analysis, operation, storage, and transmission [1]. Therefore, integrating digital technology with physical education teaching not only provides guidance for promoting the mastery of sports knowledge and skills but also points out the direction for the implementation of students' core competencies.

Currently, although some countries have introduced multiple policies related to digital technology, they have repeatedly encountered difficulties in physical education teaching practice. For example, the conflict and rigidity of concepts between physical education teaching and digital technology, the weak practical ability of teachers to use digital technology, and the dilemma of content selection brought by fragmented knowledge to students are constantly emerging. On the one hand, it is due to the deviation of physical education teachers' understanding of digital concepts. Although some classroom teaching reflects the application of digital technology, due to the influence of traditional teaching concepts, such classroom teaching still stagnates in the traditional teaching mode, and the result is nothing more than "wearing new shoes and walking the old path" or "new bottles of old wine." On the other hand, physical education teachers tend to overlook the intelligent characteristics of digital textbooks, resulting in a single teaching method and superficial teaching content.

In view of this, this study will conduct a quantitative analysis of the literature on digital technology and physical education teaching based on CiteSpace visualization analysis software, and present the overall development dynamics and evolutionary trends of the research in the form of a knowledge graph to explore the value logic and practical difficulties of the integration of digital technology and physical education teaching [2]. The following relief paths will be proposed: firstly, adhere to the concept first, and use systematic thinking to lead the improvement of digital technology for physical education teachers; Secondly, we should attach importance to technological support and empower physical education classroom teaching through digital teaching reform and innovation; Thirdly, emphasize the systematic collection and integration of students' fragmented knowledge choices through digital resources.

2. The value logic of integrating digital technology with physical education teaching

The integration of digital technology and physical education teaching is to better promote students' growth and development. The integration of digital technology into physical education classroom teaching not only provides teachers with new technologies, new scenarios, and new elements, but also offers new concepts, new paradigms, and new environment [3]. In this study, based on the research literature from CNKI database from 2014 to 2024, CiteSpace software will be used to draw a knowledge graph. From the perspectives of research institutions (**Figure 1**), authors (**Figure 2**), co-occurrence of keywords (**Figure 3**), the development dynamics and research trends of the integration of digital technology and physical education teaching will be sorted out, and their inherent value logic will be explored; Extract hot issues and analyze them to identify the practical challenges of integrating digital technology into physical education teaching; Reveal the relief path for the integration dilemma of digital sports and physical education teaching, and clarify the future development trend of digital technology and physical education teaching.

2.1. Promote the comprehensive development of core competencies

The deep integration of digital technology and physical education teaching is not only a natural expectation for classroom teaching reform, but also a key factor in promoting the development of students' core competencies. Core literacy refers to a set of integrated knowledge, abilities, and attitudes that can successfully

Figure 1. Knowledge graph of research institutions.

Figure 2. Author knowledge graph.

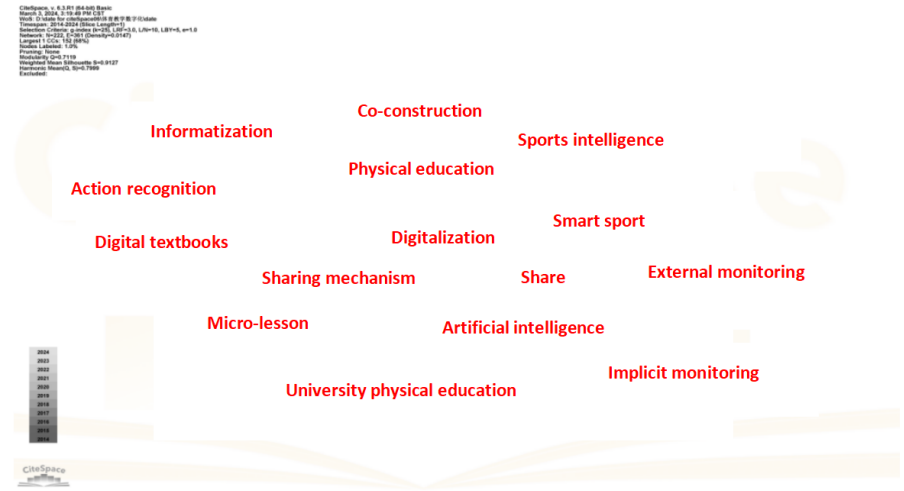

Figure 3. Keyword knowledge graph.

respond to personal and social needs [4]. It is gradually formed by students through long-term learning, based on knowledge internalization, behavior development, and moral cultivation. It is the result of students' experience, exploration, perception, and problem-solving in physical education and health courses. Physical education classroom teaching is the main battlefield for cultivating students' core competencies, and the integration of digital technology provides a basic guarantee for the comprehensive development of core competencies. For example, from keywords such as "action recognition", "internal monitoring", and "external monitoring" in **Figure 3**, it can be found that indicators such as athletic ability can be measured through visual, auditory, and tactile means, while indicators related to health behavior and sports ethics cannot rely solely on measurement methods with explicit features. At this point, digital technology can be deployed to the "battlefield." On the one hand, digital technology provides students with a comprehensive monitoring tool through advanced equipment. On the other hand, digital technology can bring new experiences of sports participation to students through new concepts, paradigms, environments, and so on. In this way, the integration of digital technology and physical education teaching not only guides and stimulates students' interest in sports, but also points out the direction for implementing students' core competencies.

2.2. Promote the diverse sharing of educational resources

Sharing educational resources is not only a necessary path for teaching reform [5], educational innovation, and social development, but also an important way to give birth to new forms of education, reform the relationship between teaching and learning, and promote changes in governance methods [6]. On the one hand, digital technology itself has functions such as collection, analysis, and visualization, which can effectively refine complex and disordered content and present it in a more convenient way. These organized contents are then presented to students at different stages through teachers' vivid language and actions, which is conducive to stimulating students' learning motivation. On the other hand, digital technology provides a platform for communication and interaction, which includes both teacher-student and student-student interaction, greatly enhancing students' sense of participation and experience. In addition, communication and interaction between different perspectives are also beneficial for students to open up cognitive boundaries and enhance their exploratory spirit. From the keywords such as "sharing," "sharing mechanism," and "sharing construction" in **Figure 3**, it can be found that high-quality physical education construction cannot be achieved without the diverse sharing of digital technology. Therefore, the integration of digital technology into physical education teaching is not only a requirement for social development, but also a necessary mission in the reform and innovation of physical education teaching [7]. It is also an effective path for students to enhance their core competencies through communication and interaction.

2.3. Reform and innovation in optimizing teaching methods

Digital technology provides technical means and conditions to support for physical education teaching. Specifically manifested in two aspects. Firstly, the application of digital technology can assist physical education teachers in accurately analyzing students' learning status and knowledge mastery, helping them comprehensively analyze the learning characteristics of each student, pay attention to the learning differences of each student, and achieve targeted teaching [8]. Secondly, the multimedia technology covered by digitization can make teaching information diversified, structured, dynamic, and visual [9], making complex technical actions more intuitive and boring technical teaching processes contextualized, thereby helping students achieve deep participation and complete experience in sports. However, compared to traditional cramming classrooms where teachers master "teaching tools" and students are "bare handed," in the era of digital technology, students' full possession and effective use of learning platforms and tools can help improve their practical abilities such as information gathering, experimental exploration, analysis and criticism, and summarization [10]. In terms of physical education classroom teaching, the transformation of teaching methods is related to stimulating students' interests and improving efficiency. On the one hand,

digital technology, as a "new product" of physical education teaching, will inevitably generate students' interest. In this way, it is beneficial for physical education teachers to integrate it into the physical education classroom teaching. On the other hand, digital technology can visualize and analyze the more complex movement techniques in motor skill learning, making it easy for students to capture the formation patterns of motor skills. Through this process, students can also gain confidence and satisfaction, thus achieving comprehensive physical and mental development.

3. The practical dilemma of integrating digital technology with physical education teaching

The integration of digital technology into physical education teaching is undoubtedly a once-in-a-lifetime opportunity, but it also indicates that physical education teaching will face an unprecedented challenge [11]. The reason why it is a challenge is that in the current digital background, there are serious conflicts and rigid concepts in classroom teaching, weak practical abilities of teachers to use digital technology for teaching, and difficulties in content selection caused by fragmented knowledge, which urgently need to be solved one by one.

3.1. Conceptual conflicts and rigidity from classroom teaching

The innovation and optimization of classroom teaching concepts are important battlefields for promoting the integration of digital technology and physical education teaching. Digital classroom teaching is based on a "technology-based" standpoint, emphasizing the thinking tendency of "digital empowerment" and the "classroom revolution" driven by digital technology [12]. This differs significantly from traditional classroom teaching, which is led by the government, supervised by schools, taught by teachers, and listened to by students, in terms of concepts, values, and guidance. In terms of physical education classroom teaching, on the one hand, it is because some physical education teachers do not understand the concept of "human-machine integration" and may even have a skeptical attitude. Although digital technology is widely used in physical education teaching, many physical education teachers are still influenced by the traditional teaching philosophy of "technology first" and believe that "human-machine integration" is too idealistic. Any technology or equipment is just an auxiliary tool for teaching. In their view, only humans are the main body of teaching activities and can play a role in educating people. On the other hand, some physical education teachers only focus on "technology" and "light teaching", which easily ignores educational laws and turns technology driven physical education teaching into "technology following the trend", leading to the integration of digital and physical education teaching falling into the trap of "technologism" [13], thus creating a situation where digital technology is integrated into physical education teaching to cater to the trend of the new era.

3.2. Weak practical ability of teachers to use digital technology in teaching

The practical participation of physical education teachers in digital technology greatly affects and even determines the degree of integration between digital technology and physical education teaching. However, the practical ability of physical education teachers to use digital technology for teaching is relatively weak, mainly reflected in two aspects. One reason is that physical education teachers only treat digital tools as "accessories" in the teaching process, and fail to deeply integrate digital technology with physical education teaching. This is reflected in the fact that students do not show a clear sense of participation and experience after a physical education class that integrates digital technology. The reason is that physical education teachers have not conducted an in-depth exploration of the educational function of digital technology, which leads to low interest and physical and mental detachment among students in the digital physical education classroom. Secondly, physical education teachers have not fully integrated digital technology into the context of physical education teaching. Context is a key element for students to gain deep participation and complete experience, and an important way for knowledge application to be reflected. Digital physical education teaching without context is like a body without a soul. Although it is intact, it has already lost its mind and is like the walking dead.

3.3. Fragmentation of knowledge poses a dilemma for students in content selection

Knowledge acquisition is not only a prerequisite for teachers' knowledge storage, transmission, sharing, and innovation, but also an important cornerstone for teachers' digital teaching content design and professional development [14]. In the current digital age, knowledge appears in various forms in people's vision. Although it has solved many problems, some people are easily trapped in the "fear" and "entanglement" of knowledge selection in the face of this sudden "knowledge explosion" environment. In terms of physical education teaching, the integration of digital technology has opened the door for students to acquire knowledge, but it has also created a dilemma for students in choosing learning content. This includes two reasons. Firstly, emerging technologies such as the internet and artificial intelligence are gradually entering the field of teaching. Students have expanded their understanding of the world through self-media. However, due to their limited accumulation of knowledge, they are unable to accurately judge the right or wrong of new things, resulting in a fruitless outcome. Secondly, although digital technology provides convenience for students to acquire knowledge, the knowledge that appears on the internet has not been systematically classified and is usually presented in a fragmented manner. The reason is that the audience of platforms such as the internet and self-media is all of humanity, and it does not adapt to local conditions or vary from person to person. Therefore, students have not yet formed a systematic retrieval of knowledge when facing the fragmented knowledge presented by the internet.

4. 3 Ways to relieve the integration of digital technology and physical education teaching

The integration of digital technology and physical education teaching is the process of school physical education adapting to the external digital era development environment and cultivating comprehensive development needs internally. In terms of physical education teaching, digital technology can innovate teaching methods, optimize teaching content, and improve teaching quality. Although there are many problems and challenges in integrating digital technology into physical education teaching, the development of the digital age will not stagnate. Therefore, based on the practical difficulties of integrating digital technology with physical education teaching, this study proposes the following relief paths.

4.1. Putting the concept first, enhancing teachers' awareness of the value and subjectivity of digital technology

The value recognition and subject consciousness of teachers towards digital technology are related to the development of digital technology in teaching. In the context of digitalization in education, if teachers lack ethical and moral principles, as well as a sense of subjectivity, regarding the application of digital technology in teaching, it will be difficult for them to smoothly mobilize interrelated elements such as data literacy, information literacy, and information technology application capabilities, and even more difficult to obtain high-level digital abilities [15]. To improve the effectiveness of integrating digital technology with physical education teaching, two aspects need to be grasped. Firstly, the value awareness of physical education teachers should be enhanced. Influenced by traditional teaching concepts, physical education teachers tend to view digital technology more as an auxiliary tool for teaching, and fail to fully utilize the functions and value of digital technology. However, teachers should be aware that digital technology is no longer just a teaching aid, but rather a mindset that reshapes teaching models through innovative teaching methods [16], constantly driving teaching towards high-quality development. The digital thinking of physical education teachers can also be strengthened through organizing education and training on digital technology. For example, different physical education teachers can be gathered to discuss and exchange their views on the integration of digital technology and physical education teaching, thereby deepening their understanding of the integration of digital technology into physical education teaching. Secondly, the subject awareness of physical education teachers should be enhanced. In the digital age, physical education teachers should change their previous roles as technology observers and implementers, fully exert their subjective initiative, and become creators and designers of

technology. They should creatively use digital technology methods according to the actual teaching situation, so as to truly integrate them with teaching activities [17]. Not only that, but also more autonomy should be given to teachers in physical education teaching practice, so that they can freely choose the content and teaching mode of physical education classroom teaching, in order to promote the improvement of physical education teachers' subjectivity.

4.2. Technical support, empowering physical education classroom teaching through digital teaching reform and innovation

Innovation guarantee mechanism is a key link in comprehensively promoting the integration of digital technology and physical education teaching. In terms of physical education teaching, the guarantee mechanism for empowering physical education classroom teaching through digital teaching reform and innovation includes the following two aspects. One is to promote the deep integration of digital thinking, teaching methods, and teaching evaluation, and achieve the comprehensive and all-round evaluation of education [18]. In traditional physical education classroom teaching, the selection of teaching methods is mainly based on appropriateness, while physical education classroom teaching based on digital technology should focus more on experiential and exploratory learning. The integration of digital technology will also force the transformation of teaching methods, and accordingly, traditional teaching methods and tools will not be able to meet the needs of digital development. Therefore, it is necessary to establish a mechanism with teacher-student interaction and participation, and equal and open teacher-student relationships, which can optimize the evaluation of education quality and students' comprehensive quality, and provide direction for the evaluation reform of physical education teachers. The second is to promote human-machine integration and accelerate the interactive sharing of physical education classroom teaching. Faced with the rapid development of digital technology, physical education teaching can use its interactive functions to improve the interaction effect between teachers and students. Among them, teaching and learning a very personalized processes of teacher-student interaction and student-student interaction. To further achieve the sharing of sports resources, the original simple application of digital technology resources in physical education teaching should be transformed into the integration of the common needs of teachers and students with digital technology, thus developing high-quality digital physical education resources with new forms, and promoting the interaction between digital technology and physical education teaching. From this, it can be seen that forming an open, interactive, and shared digital sports centered on people is the focus and foothold to ensure the high-quality development of sports.

4.3. System collection, integrating digital resources to choose fragmented knowledge for students

The integration of fragmented knowledge is an important way to comprehensively promote the integration of digital technology and physical education teaching. The prominent manifestation of utilizing digital resources to promote the process of fragmented knowledge towards structuring lies in two aspects. Firstly, adapt to local conditions and comprehensively promote the integration of digital technology and physical education teaching. In physical education teaching, digital technology provides information technology environment, platform, tools and other resources, which is not only the development advantage of digitalization, but also the development opportunity of physical education teaching. What is needed is for physical education teachers to conduct targeted classroom teaching through a combination of online and offline methods, providing different learning content and developing different learning methods for students with different learning situations, achieving differentiated teaching and personalized learning for students [19]. In this way, although students face a "cold" screen, there is analysis of learning content from physical education teachers through the screen, providing support for personalized and diversified high-quality physical education classroom teaching in the digital background. Second, improve the quality of digital media platforms such as the Internet and provide students with high-quality content that conforms to curriculum standards and cognitive laws. The curriculum standards emphasize the structuring of learning content and the contextualization of learning knowledge. In this environment, students

can grasp the integrity of the learned content, which is undoubtedly a powerful "weapon" to break down fragmented knowledge. Therefore, although digital technology can be used as an "imported product" in physical education teaching, which can better innovate teaching methods, if it deviates from the knowledge system construction dominated by curriculum standards, it will inevitably deviate from the essence of students' physical education learning. Constructing a digital physical education knowledge system guided by curriculum standards is not only beneficial for students to grasp the essence of learning, but also provides guidance for the integration of digital technology into physical education teaching.

5. Conclusion

The integration of digital technology and physical education teaching is driving school physical education into a new stage of digital development. This study analyzes the value logic of the integration of digital technology and physical education teaching, explores the practical difficulties of the integration of digital technology and physical education teaching, and uses this as a starting point to construct a practical path for the integration of digital technology and physical education teaching. Perhaps the comprehensive popularization of digital technology in physical education teaching will be in the future, but the pace of the world will never stop. Time waits for no one, putting people first, exploring warm digital technology in development, and opening up a broad path for building higher quality physical education teaching.

Disclosure statement

The author declares no conflict of interest.

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