

# The Basic Connotation, Cultivation Difficulties and Improvement Strategies of Digital Literacy for Physical Education Teachers in Primary and Secondary Schools

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**Abstract:** Through methods such as literature review and logical analysis, combined with the current educational digitalization policies and practical background, the connotation of digital literacy for primary and secondary school physical education teachers is deconstructed, and the cultivation predicaments and improvement strategies are systematically sorted out. Research suggests that the digital literacy of physical education teachers in primary and secondary schools is a fundamental connotative system that encompasses four dimensions: digital awareness and attitude, digital knowledge and skills, digital application and innovation, and digital social responsibility. At present, its cultivation is confronted with core predicaments such as cognitive biases in concepts, superficial integration of technology and teaching, structural shortage of teachers' digital capabilities, uneven resource support, and the absence of systematic training and evaluation mechanisms. To this end, it is necessary to build a multi-level and systematic improvement strategy system composed of teachers' proactive actions, school environment support, top-level policy design and social collaborative efforts. Enhancing the digital literacy of physical education teachers in primary and secondary schools is a systematic project. It is hoped that through digital empowerment, the all-round development of students can be better promoted, and ultimately the fundamental mission of cultivating people through physical education can be achieved.

**Keywords:** Digital Literacy Physical education teachers in primary and secondary schools Cultivate a predicament, Improvement strategy, Digitalization of education.

## 1. Introduction

With the fourth Industrial Revolution wave represented by artificial intelligence, big data and the Internet of Things sweeping across the world, digitalization of education has become the core driving force leading the world's education transformation and building a high-quality education system. The successive release of guiding documents such as the "Education Informatization 2.0 Action Plan" and the "Teacher Digital Literacy" education industry standard in our country has clearly placed enhancing the digital literacy of teachers and students at a strategic height in the development of national education, marking that the development of education has moved from technology empowerment to a new stage led by literacy. Against this macro backdrop, as an important front for implementing the fundamental task of fostering virtue and nurturing talent and developing quality-oriented education, the digital transformation of physical education in primary and secondary schools is imperative. The traditional teaching mode of combining commands with demonstrations is no longer able to meet the urgent needs of students in the new era for personalized, precise and interesting physical education learning. Digital technologies such as wearable devices, sports image analysis apps, and smart playgrounds have provided unprecedented possibilities for the visualization of motor skills acquisition, the precision of exercise load monitoring, and the objectivity of learning process evaluation in physical education teaching. Therefore, enhancing the digital literacy of physical education teachers in primary and secondary schools has become a key approach to deepening the reform of physical education teaching and fulfilling the mission of educating people through sports in the new era. However, compared with

subjects like Chinese, mathematics and English, the cultivation of digital literacy for physical education teachers in primary and secondary schools is currently facing a more severe predicament of being unable to adapt to the local conditions. On the one hand, there is a significant deviation in perception. The traditional mindset that emphasizes skills over technology has led some managers and teachers to believe that physical education teaching is inherently opposed to digital technology, and that the application of technology is regarded as a mere formality rather than a necessity [1]. On the other hand, there is a problem of deep integration in practice. The current application of technology mostly remains at the superficial level such as playing videos and recording grades, and has not effectively permeated into the core teaching links such as motion analysis, personalized guidance, and data-driven decision-making, resulting in a phenomenon of being disconnected [2]. In addition, the systematic support system is still not sound, which is manifested in uneven resource input, lack of targeted training, and imperfect incentive and evaluation mechanisms [3], etc. It can be seen from this that there is an urgent gap that needs to be bridged between the urgent requirements of the national education digitalization strategy and the practical sluggishness of the digital transformation of physical education teaching in primary and secondary schools. This article precisely explores the issue of digital literacy for primary and secondary school physical education teachers based on this core contradiction, aiming to systematically clarify the following questions: What is the basic connotation of digital literacy for primary and secondary school physical education teachers that meets the requirements of the new era? At present, what specific difficulties are physical education teachers facing in the process of cultivating this quality? Then, how can a set of effective and multi-level interactive

improvement strategies be constructed? The discussion and analysis of these issues are expected not only to enrich the theory of teachers' professional development, but also to provide practical guidance for educational administrative departments, schools and individual teachers.

## 2. The Basic Connotation of Digital Literacy for Physical Education Teachers in Primary and Secondary Schools

Digital literacy of physical education teachers in primary and secondary schools refers to the sum of knowledge, ability and attitude that they should possess when making reasonable, effective and innovative use of digital technologies and resources in basic activities such as physical education teaching, research, management and professional development in primary and secondary schools to enhance teaching effectiveness and promote the all-round development of students [4]. It is an organic whole led by digital awareness, based on digital knowledge and skills, centered on digital application innovation, and guaranteed by digital social responsibility. The fundamental purpose of advocating digital literacy is not to pursue technology for the sake of technology, but to empower physical education through technology to make it more scientific, efficient, interesting and personalized, and ultimately better serve the fundamental goal of cultivating people through physical education. The digital literacy of physical education teachers in primary and secondary schools has transcended the simple ability to use computers and software, and has been elevated to a multi-dimensional comprehensive ability system deeply integrated with the physical education discipline. Its basic connotation can at least be summarized into the following four interrelated core dimensions.

1) Including digital awareness and attitude. Be able to proactively recognize the significant value and trends of digital technology in innovating physical education teaching, enhancing teaching effectiveness, and promoting the all-round development of students. This is the ideological foundation of literacy, which determines whether teachers are willing and dare to use digital technology. Digital awareness and attitude literacy encompass four aspects of meaning: In terms of identity, it is mainly reflected in the belief that digital technology is not a burden or the opposite of physical education classes, but a powerful enabler; In terms of sensitivity, it is reflected in the ability to keenly identify pain points in teaching (such as difficulty in demonstrating movements, difficulty in quantifying loads, and difficulty in objectivity in evaluation), and consider whether digital technology can be used to solve them. In terms of data thinking, it is reflected in having the awareness to speak with data, understanding the significance of data such as heart rate, speed, and frequency for scientific training and personalized guidance. In terms of safety awareness, it is reflected in paying attention to the protection of students' privacy and properly managing the collected health data, etc.

2) Including digital knowledge and skills. Be capable of mastering the basic knowledge and operational skills of hardware equipment, software platforms and data processing related to physical education teaching. This is the tool foundation of literacy and the hard power that teachers need to

carry out digital teaching. Digital knowledge and skills literacy include the following contents: In terms of hardware knowledge, it is reflected in understanding and being able to operate common smart sports equipment and devices, such as wearable devices (heart rate bracelets, smartwatches), sports image acquisition devices (action cameras, tablet computers), smart sports equipment (smart skipping ropes, smart footballs and smart basketballs), etc. In terms of software knowledge, it is reflected in the ability to be familiar with operating software tools used for motion analysis (such as video slow-motion, comparison drawing apps), data analysis (such as Excel, physical fitness test data management platforms), course management (such as online course platforms, class optimization masters), etc. In terms of information acquisition skills, it is reflected in the ability to efficiently search for, screen and obtain high-quality physical education teaching resources (such as teaching videos, lesson plans, and the latest training methods) from the Internet.

3) Including digital application and innovation. Be capable of effectively and innovatively applying digital technologies throughout the entire teaching process to optimize teaching, evaluation and professional development. This is the core ability of quality, the key to deeply integrating digital technology into physical education teaching practice, and also the highest-level requirement. Digital application and innovation literacy mainly include the following contents: In terms of teaching design, it is reflected in the ability to create diverse and interesting teaching scenarios by using technology (such as conducting simulation training with AR or VR, and designing orienteering tasks with apps); In terms of teaching implementation, it is reflected in the ability to precisely demonstrate, using slow-motion video playback and technical movement comparison analysis to help students clearly understand the key points of movements. At the same time, it can scientifically monitor, using heart rate monitoring devices to adjust the exercise load in real time, ensuring the safety and effectiveness of exercise, and achieving personalized teaching with individualized strategies for each student. In addition, it can also stimulate interest by using sports gamification apps, real-time feedback systems, etc. (such as the light and sound feedback of the device after a shot is made) to enhance students' participation. In terms of teaching evaluation, it is reflected in the ability to present process-oriented assessment, recording students' participation, progress curves, and skill acquisition processes through a data platform. Finally, it can further achieve precise summative evaluation, automatically collect, analyze and generate visual reports on physical fitness test and skills assessment data, making the evaluation more objective and accurate. Or it can promote professional development by using online teaching and research communities, virtual teaching and research rooms, open course resource platforms, etc. for learning, communication and reflection, and achieve self-improvement, etc.

4) Including digital social responsibility and ethics. Be able to abide by relevant laws and regulations, fulfill moral responsibilities, and promote the physical and mental health development of students in a digital teaching environment. This is a safety barrier for literacy, ensuring that digital teaching operates on a compliant, ethical and healthy track. Digital social responsibility and ethical literacy should

include the following aspects: In terms of privacy protection, it is reflected in the ability to strictly manage and protect students' personal health data, sports performance and other sensitive information, without leakage or abuse. In terms of technical ethics, it is reflected in guiding students to view data correctly, avoiding excessive reliance on devices or data anxiety, and maintaining the humanistic spirit and team values in sports. In terms of healthy usage, it is reflected in being able to guide students to reasonably control screen time, balance the relationship between digital learning and physical practice, and prevent Internet addiction, etc.

### **3. The Predicament of Cultivating Digital Literacy Among Physical Education Teachers in Primary and Secondary Schools**

The predicament of cultivating digital literacy among physical education teachers in primary and secondary schools is a multi-level and systematic issue. It is a complex system composed of multiple factors, including internal factors such as concepts and abilities, as well as external factors such as resources and systems. The formation of this system began with conceptual conflicts, was trapped by insufficient capabilities, restricted by scarce resources, and ultimately solidified by institutional deficiencies [5]. Specifically, the predicament in cultivating digital literacy among physical education teachers in primary and secondary schools mainly includes the following four major aspects.

1) There exists a mindset at the conceptual and cognitive levels that emphasizes skills over technology. The mindset of valuing skills over technology at the conceptual and cognitive levels is mainly manifested in the following three aspects. Firstly, it conflicts with the established concepts. Traditional physical education teaching emphasizes the role of physical presence and personal demonstration. Many physical education teachers and administrators in primary and secondary schools believe that the core of physical education classes is to sweat and exercise the body. Digital technology is just a show. Even some teachers think that using devices such as wristbands and tablets will distract students' attention and interfere with normal sports training and physical exercise. This original view of physical activity is in natural opposition to the transformation of digital technology, and this concept is the biggest obstacle to the cultivation of digital literacy among primary and secondary school physical education teachers. Secondly, there is insufficient recognition of the value of digital literacy. Some teachers have failed to recognize the huge potential of digital technology in addressing practical teaching pain points, such as personalized guidance, quantification of exercise load, and movement analysis. They believe that the input-output ratio is low and it adds burden rather than improves efficiency. They have not truly recognized the huge potential of digitalization in empowering physical education teaching in primary and secondary schools. Thirdly, there exists technical anxiety and fear of difficulties. Under the great wave of digitalization, a large number of novel digital devices and instruments will emerge in physical education teaching. It takes teachers a certain amount of time to learn and train to recognize and use them. This makes many teachers feel anxious and afraid of difficulties. Especially for older teachers, they are prone to feel strange and scared when facing new technologies, worrying that they won't be able to

learn or use them well, and are afraid of making mistakes in operation in class and making a fool of themselves. Thus, they choose to avoid using these digital devices and instruments.

2) At the level of ability and practice, there is a disconnect between technology and teaching. Some physical education teachers in primary and secondary schools are slightly lacking in digital teaching capabilities and practices, with a disconnect between technology and teaching. This mainly includes three aspects. First, simplify the application of technology. At present, the application of digital technology in physical education in primary and secondary schools mostly remains at the level of players and recorders (such as playing teaching videos and recording grades with Excel), and has not delved into core teaching links such as the acquisition of motor skills, real-time feedback, and personalized training. There are few cases of the deep integration of technology and teaching. Secondly, there is a structural shortage of teachers' digital teaching capabilities. Many teachers are reluctant to learn and train in digital teaching skills, resulting in skill deficiencies. Eventually, many teachers lack necessary digital teaching skills such as operating smart devices, analyzing motion data, and using professional apps. Moreover, a large number of teachers have insufficient digital teaching integration capabilities and generally lack the teaching design ability to transform digital technologies into effective teaching behaviors. For instance, when conducting digital teaching, one doesn't know how to utilize heart rate data to adjust the training intensity, nor does they know how to use video analysis to reconstruct their teaching steps. In addition, the threshold for innovative applications is high. The threshold for digital innovation applications is relatively high and cannot be used at will. To develop a mature digital teaching plan that integrates with school-based courses, teachers need to invest a lot of time and energy in research and design. Under the circumstances of heavy teaching tasks themselves, many teachers find it difficult to sustain.

3) There is a lack of software and hardware support and sharing mechanisms at the resource and environmental levels. At present, many primary and secondary schools, especially rural ones, have shortcomings in both software and hardware in terms of digital resources and environment, and lack a sharing mechanism, which seriously affects the cultivation of teachers' digital literacy. This is specifically manifested in the following three aspects. First, hardware resources are scarce and uneven. On the one hand, the investment in digital teaching equipment is huge. Smart bracelets, action cameras, smart playgrounds and other devices are expensive. Generally, schools have very limited funds for physical education and will give priority to ensuring regular equipment, which results in very limited funds for digital teaching equipment. On the other hand, the digital divide is obvious. The digital development of schools of different natures and with different focuses in different regions is highly uneven. There is a huge gap in the allocation of digital equipment between urban and rural areas, between public and private schools, and between key and weak schools. This uneven distribution of hardware resources has affected the cultivation of digital literacy among many teachers. Second, the construction of software and resource libraries lags behind. At present, many primary and secondary schools lag behind in the construction of software and resource libraries, lacking high-quality and systematic

resources. Many schools do not have a dedicated digital teaching resource platform for physical education subjects. Teachers have to search for teaching videos, lesson plans, etc. by themselves like looking for a needle in a haystack, resulting in uneven teaching quality. Even if a few schools or teachers have developed high-quality resources, there is also a lack of an effective regional sharing mechanism, which makes it impossible to form a synergy and easily leads to the phenomenon of resource silos. Third, the digital ecosystem of schools is not yet mature. The main manifestation is that the leaders do not attach sufficient importance to digital physical education teaching. Once the school leaders do not pay attention, the digital attempts of physical education teachers will be difficult to obtain necessary support. The ultimate result is various problems such as weak maintenance and support for digital teaching technology. For example, when digital equipment malfunctions, there will be a lack of professional personnel to maintain and repair it in a timely manner. It will also make teachers more reluctant to boldly use digital teaching.

4) There is a lack of systematic training and incentive evaluation mechanisms at the institutional and guarantee levels. At present, many schools are lacking systematic training and incentive evaluation mechanisms for digital teaching, which seriously affects the cultivation of teachers' digital literacy. This is mainly manifested in two aspects. First, the training system does not match. At present, many schools have also begun to provide digital teaching training for teachers, but there are still improper training issues. Systematic training is insufficient. On the one hand, this is manifested in the generalization of content. The existing information technology training for teachers is mostly targeted at all teachers, with generalized content, lacking precise and targeted training tailored to the characteristics of physical education teaching. On the other hand, it is manifested in the emptiness of training methods. The training mainly focuses on theoretical lectures, lacking practical exercises and follow-up guidance in real sports teaching scenarios, ultimately leading to a disconnection between learning and application. Second, there is a lack of evaluation and incentive mechanisms. At present, many schools do not conduct scientific evaluations of teachers' digital teaching and lack incentive mechanisms. The main manifestation is that it is not linked to the assessment of teachers. For instance, in key evaluation systems such as professional title assessment and commendation, teachers' digital literacy and digital teaching innovation are rarely taken as assessment indicators. This makes teachers' exploration lack external motivation. It makes no difference whether they do well or poorly. Then why should they still strive to do so? Another manifestation lies in the low recognition of the achievements. The efforts and achievements made by teachers in digital teaching often fail to gain immediate and explicit recognition like leading a sports team to win a championship, resulting in insufficient internal motivation and other issues [6].

#### **4. Strategies for Enhancing Digital Literacy of Physical Education Teachers in Primary and Secondary Schools**

Based on the above analysis of the predicament, the improvement of digital literacy for physical education

teachers in primary and secondary schools requires a multi-dimensional and systematic strategic support. The following are specific improvement strategies proposed from four aspects: teachers themselves, school management, regional policies, and ecological construction.

1) At the teacher level: Change your mindset, take the initiative, and become a digital athlete. First of all, awareness comes first, and character cognition is reshaped. Teachers should take the initiative to recognize that digital literacy is not an additional skill but a core quality for modern physical education teachers. Transform oneself from a traditional command taker and demonstrator to an analyst of sports data, a designer of digital learning environments, and a guide for students' personalized exercise [7]. Secondly, learn precisely to achieve rapid progress in small steps. On the one hand, one can start from the pain points. In response to specific issues in teaching (how to correct students' improper movements?) How to monitor the intensity of long-distance running? Look for corresponding digital tools (such as video analysis apps, heart rate monitoring wristbands), learn in practice and accumulate successful experience. On the other hand, one can participate in building an online learning community. Actively join wechat groups, QQ groups and professional forums related to physical education teachers (such as China School Physical Education Blog, etc.), observe others' digital teaching cases, share your own confusions and insights, and grow in the collective wisdom.

2) School level: Create an environment and build a supportive digital soil. First of all, carry out precise and school-based training. Training can be carried out based on demand orientation, changing the general training style of flooding the market. Through research, the real needs and confusions of physical education teachers in our school can be understood, and special workshops such as how to design an orienteering class using sports apps and how to interpret heart rate data to optimize training plans can be held. Training can also be carried out in a practice-oriented manner. The training should focus on learning through doing, allowing teachers to operate various digital devices by themselves, analyze data, design teaching plans, and arrange subsequent classroom practice and reflection sessions well. It is also possible to promote the pairing of young and experienced teachers for learning, pairing young teachers who are proficient in technology with experienced backbone teachers to complement each other's strengths and jointly overcome the difficulties in the application of technology [8]. Secondly, establish an effective incentive and evaluation mechanism. On the one hand, digital literacy can be incorporated into the assessment. In the evaluation of teachers' professional titles, performance-based pay, and commendation and awarding, the weight of digital teaching application and innovation should be added, and it should be examined as an important professional ability. On the other hand, a display platform can be built. Regularly hold school-level basic skills competitions for digital physical education teaching, exhibitions of outstanding teaching cases, and exchange meetings on digital teaching achievements. Commend and reward teachers with outstanding performance, set benchmarks, and create an atmosphere of learning from each other and striving for excellence. Third, increase investment and optimize resource allocation and management. Procurement can be rationally planned. Schools should

coordinate funds and introduce essential digital sports equipment in batches, such as tablet computers, action cameras, heart rate bands, etc. They can also set up shared corners for digital sports equipment to improve their utilization efficiency. At the same time, technical support should be provided as much as possible. Clear technical support personnel or procedures within the school should be established to ensure that the equipment can be repaired in a timely manner when it malfunctions, eliminating teachers' concerns about not daring to use it.

3) Regional and policy level: Top-level design, building a digital ecosystem. First of all, develop standards and guidelines to provide direction guidance. The education authorities may organize experts to develop the "Digital Literacy Development Framework for Physical Education Teachers in Primary and Secondary Schools" or the "Guidelines", clearly defining the digital knowledge, abilities and attitudes that teachers at different development stages should possess, and providing a clear basis for training, evaluation and teachers' self-development. Secondly, build a regional resource sharing platform to break down information silos. Establish a regional digital teaching resource library for physical education, gathering high-quality teaching plans, video lesson cases, data tools, application software lists, etc., and make it open to all teachers. Encourage teachers to upload and share their outstanding achievements, and offer them certification and incentives [9]. Third, implement demonstration and leading projects and set up learning models. Carry out the selection and cultivation work of smart sports demonstration schools or digital studios of sports masters. The following plays a leading and exemplary role. Provide certain policy and financial support to these pilot units and leaders, allowing them to take the lead in trials, summarize experiences, and form replicable and scalable models. Through observation and learning, they can radiate and drive the development of the entire district and the whole city.

4) Promote collaboration among the government, enterprises and schools, and introduce professional forces. Encourage universities, educational research institutions and technology enterprises to cooperate in jointly developing digital products and course solutions that are more suitable for physical education teaching in primary and secondary schools and have lower costs. Provide more professional and cutting-edge technical support and training services for schools. In conclusion, enhancing the digital literacy of physical education teachers in primary and secondary schools is a systematic project that progresses from the application at the tool level to the transformation at the thinking level and then to the reconstruction at the ecological level. The fundamental goal is not to pursue the coolness of technology, but to make technology better serve the purpose of physical education and talent cultivation. Through more scientific, more personalized and more interesting physical education teaching, it ultimately promotes the healthy growth and all-round development of every student [10].

## 5. Conclusion

This article focuses on the core topic of digital literacy for physical education teachers in primary and secondary schools, systematically analyzing its basic connotation, cultivation

difficulties and improvement strategies. Through research, we have reached the following core conclusions: Firstly, the digital literacy of physical education teachers in primary and secondary schools is a comprehensive concept that is multi-level and multi-dimensional. It is by no means merely the ability to operate equipment, but rather a professional quality that integrates digital awareness and attitude, digital knowledge and skills, digital application and innovation, as well as digital social responsibility. This positioning determines the complexity and systematicness of its cultivation. Secondly, the cultivation of digital literacy among current physical education teachers is currently facing multiple structural predicaments. These predicaments stem not only from the conceptual barrier of valuing skills over technology, but also from the practical gap between technology and teaching, and are further constrained by the systemic ecosystem such as uneven resource distribution, ineffective training mechanisms, and the absence of incentive policies. These factors are intertwined, posing a severe challenge on the path of digital transformation in physical education and seriously restricting the cultivation of teachers' digital literacy. For this reason, this article proposes that breaking through the predicament must rely on a systematic project that involves the joint efforts and coordinated advancement of multiple parties. It requires teachers themselves to achieve a role transformation from passive adaptation to active change. It is necessary for schools to create a continuously supportive environment, provide precise school-based training and effective incentive mechanisms. It is even more necessary to carry out top-level design at the regional and even national levels, build a platform for resource co-construction and sharing, and set up demonstration benchmarks for digital physical education teaching. Looking ahead, the ultimate value of enhancing the digital literacy of physical education teachers in primary and secondary schools does not lie in the pursuit of piling up and showing off technologies, but in returning to the fundamental purpose of cultivating people through sports. It is expected that through continuous improvement and efforts, digital technology will truly become a smart assistant for physical education teachers in primary and secondary schools, helping them create more scientific, efficient, personalized and interesting physical education classes. Let every movement analysis bring students an enlightening understanding, let every set of physiological data provide a solid guarantee for sports safety, and let every interactive game inspire students' inner enthusiasm for sports. Ultimately, when technology and education achieve a deep and warm integration, physical education will be able to better fulfill its mission of The Times. It will not only demonstrate its value in strengthening the physical fitness of teenagers, but also showcase its power in cultivating their sound personality, team spirit and innovative thinking, laying a solid foundation for nurturing all-round developed talents of the new era.

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