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Innovation in University Tennis Teaching Models in the Context of Digitization: Approaches, Challenges, and Practical Strategies

Yichao Xu

College of Physical Education, Southwest University, Chongqing 400715, China

2405171859@qq.com

Abstract

Against the backdrop of digitalization and intelligent sports, tennis, as an important part of college physical education in China, faces many issues in traditional teaching while also encountering numerous opportunities. Integrating digital technology with traditional physical education is a key measure to promote innovation in school sports teaching models. This study mainly introduces the current situation of college tennis teaching and proposes the construction of a'learning-practice-assessment'three-dimensional interactive model. By empowering each teaching stage with digital technology, using online platforms, VR/AR technology, and smart devices such as intelligent rackets and motion capture systems, teaching resources, personalized training programs, and dynamic evaluation systems can be optimized. This aims to enhance teaching effectiveness, meet diverse student needs, and promote the modernization of college tennis education.

Keywords

Digitalization, College Tennis, Teaching Innovation.

1. Introduction

During the '14th Five-Year Plan' period of deep technological transformation, national strategic plans prioritize 'accelerating digital development and building digital China' alongside 'enhancing education quality and promoting holistic development.' The 'Action Plan for Education Informatization 2.0' focuses on constructing new forms of intelligent education and emphasizes the organic integration of information technology with educational practice. As a key component of talent cultivation, college physical education must proactively align with national strategic demands, driving higher education development through exploring intelligent teaching pathways and optimizing teaching effectiveness evaluation mechanisms. This transformation not only aligns with the requirements of modern education in the new era but also provides practical support for building an education system that fosters moral, intellectual, physical, aesthetic, and labor development.

As an important part of college physical education, tennis serves as a crucial means to cultivate students' core physical literacy. However, with the deepening of higher education reform in China, educational concepts in physical education are undergoing profound changes. Traditional college tennis teaching models increasingly reveal their limitations in the context of the new era and can no longer meet the diversified and personalized development needs of contemporary college students, necessitating systematic reform and innovation. Based on this, the study mainly explores how, in the context of digitalization and with continuous technological advancement, digital tools can empower college tennis teaching. By constructing a 'learning-practice-assessment' three-dimensional interactive model, the study aims to promote innovation in teaching methods and enhance the effectiveness of college tennis courses to meet the diverse needs of students in the new era.

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2. Current issues in tennis teaching in colleges and universities

2.1. The teaching content is monotonous and lacks interest

With the gradual popularization of tennis in college physical education, most domestic universities have incorporated it into their professional curriculum systems and public sports elective modules. However, the teaching methods and approaches for tennis are relatively limited. Specifically, tennis-specific courses have not yet formed a systematic teaching system, and are still in the exploratory stage in terms of curriculum design and teaching implementation. Traditional teaching models suffer from a lack of innovation, which is manifested in the frequent use of one-way technical demonstrations and mechanical repetitive training in teaching methods, resulting in little effect in stimulating students' subjective initiative and cultivating interest in sports. Due to the limited popularity of the sport and the conditions of facilities, students generally have weak technical foundations and insufficient movement standardization. This multidimensional teaching dilemma makes it difficult for current college tennis education to achieve the dual teaching goals of imparting sports skills and cultivating lifelong sports awareness.

2.2. The curriculum is standardized, lacking personalization

Currently, tennis courses in universities generally adopt a homogenized teaching model with zero starting point, which lacks attention to individual differences and fails to effectively implement dynamic training regulation strategies. In the basic skill acquisition stage, due to the lack of progressive decomposition training and adaptive load monitoring systems, some students with weaker motor-neuro-muscular coordination often encounter movement stereotype barriers, making it difficult for them to form correct technical movements. This situation not only affects their learning efficiency but may also hinder their technical development, subsequently affecting their interest and confidence in tennis. In the advanced ability cultivation stage, limited by fixed course content and closed training paths, students with excellent proprioceptive abilities face the dilemma of being unable to achieve substantial improvement in specialized skills. Since the curriculum is not adjusted according to the actual abilities of students, these students are unable to fully utilize their potential for higher-level skill training, ultimately affecting their competitive level and development opportunities.

2.3. Inadequate evaluation system

The current teaching evaluation system suffers from a structural imbalance, with the core issue being an overemphasis on summative evaluation and an underestimation of formative assessment. This imbalance manifests primarily in the evaluation dimensions, where the end-of-term technical proficiency test serves as the sole quantitative criterion, failing to fully incorporate multidimensional development indicators such as learners' progress curves, technical transfer and application abilities, and theoretical levels of sports cognition. In terms of evaluation methods, standardized test templates are employed, lacking dynamic tracking and qualitative analysis of individualized growth trajectories. The absence of personalized guidance on action improvement paths prevents most students from accurately diagnosing their technical shortcomings, making it difficult for them to form a deep understanding of their own technical acquisition.

3. The connotation and requirements of "learning-training-evaluation"

The "learn-practice-evaluate" three-dimensional linkage refers to the integration of learning, practice, and evaluation processes in the teaching process, empowering each link through digital technology to achieve better teaching effectiveness and enhance student learning

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outcomes. In the digital context, the continuous development of artificial intelligence and digital science has provided new paths and opportunities for college physical education teaching.

3.1. The dimension of "learning"

In the digital era, the ways of acquiring knowledge have become more diversified, encompassing innovative platforms such as online education platforms, MOOC systems, short video tutorials, and social networking applications, all of which have established a multi-dimensional learning matrix for those seeking knowledge. This technology-enabled cognitive revolution not only restructures the spatial and temporal dimensions of traditional education but also enables learners to break through the constraints of time and space and acquire professional knowledge and practical skills on demand through a personalized recommendation mechanism supported by intelligent algorithms.

3.1.1. Online courses and teaching platforms provide learning resources and tools

Leveraging digital and intelligent technology, the online course platform brings together teaching videos from outstanding coaches around the world, providing learners with a rich and diverse array of learning resources. The course content spans from basic grip techniques and footwork training to advanced tactical strategies and psychological qualities. Learners can freely choose courses that suit their own levels and specific needs, achieving a personalized learning experience and engaging in in-depth learning anytime, anywhere.

Furthermore, the application of digital intelligence technology has brought significant innovations to tennis learning tools, making them more intelligent and precise. For instance, the introduction of virtual reality (VR) and augmented reality (AR) technologies has provided a new immersive training experience for tennis learning. Through VR technology, students can compete with opponents of different levels in a virtual environment, simulating various real-life match scenarios. This experience not only enhances the fun of training but also improves students' ability and adaptability to different match situations. AR technology provides more intuitive feedback for students' training process by overlaying virtual coach guidance and technical indicators in real-time on real-life scenes. During actual strokes, students can see instant technical analysis and guidance suggestions. This intuitive approach greatly enhances learning effectiveness, helping students quickly adjust and improve their technical skills during training.

3.2. The dimension of "practice"

Training plays a pivotal role in achieving the three-dimensional synergy of "learning, training, and evaluation". Once students have mastered the basic techniques and strategies of tennis, they can effectively enhance their practical application abilities and comprehensively improve their overall qualities through extensive targeted training.

3.2.1. Develop personalized training programs

Develop a tennis training management system for universities to achieve digital management of student training information. Coaches can view students' training plan execution status, training data statistics, and other information through the system, and provide timely guidance and evaluation. At the same time, students can also submit training logs and feedback through the system to communicate with coaches. By utilizing big data analysis and artificial intelligence algorithms, combined with students' physical function data, technical level, and learning progress, a customized training plan can be tailored for each student. At the same time, the system can adjust the plan in real-time based on students' training feedback to ensure the scientific and effectiveness of training.

Introduce devices such as smart tennis rackets and smart tennis balls. The smart tennis racket can record data such as the force, angle, and spin of the shot, while the smart tennis ball can track the flight trajectory and speed of the ball. Additionally, motion capture equipment can be

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installed on the tennis court to capture students' tennis movements in a comprehensive and high-precision manner. Students can view detailed data analysis through the accompanying mobile app to understand their technical strengths and weaknesses, and make targeted improvements.

3.3. Dimensions of "Evaluation"

Evaluation is a crucial link in achieving the organic cycle of "learning, practicing, and evaluating". After students have completed the study of theoretical knowledge and enhanced their practical abilities through training, a scientific and comprehensive evaluation system can effectively provide feedback on their learning outcomes, thereby promoting further development.

3.3.1. Constructing multi-dimensional data evaluation

Multi-dimensional data evaluation is an important component of this evaluation system. By integrating various information such as data collected by smart devices, motion analysis results, and competition results, we are able to conduct a comprehensive and objective evaluation of students' training effectiveness. This evaluation is not limited to technical aspects, but also includes multi-dimensional factors such as students' psychological quality, team collaboration ability, and tactical awareness. In this way, teachers can provide students with more comprehensive and personalized development suggestions, helping them improve in all aspects.

3.3.2. Utilization of real-time feedback and dynamic adjustment

Real-time feedback and dynamic adjustment are crucial strategies for ensuring continuous optimization of training effectiveness. The evaluation of training effectiveness should not merely be a periodic summary, but rather viewed as a continuous process of feedback and dynamic adjustment. By continuously monitoring students' training data and performance, teachers can promptly identify issues and adjust training plans, ensuring that students steadily progress towards the established goals. This flexibility enables teaching to better align with students' actual needs, thereby enhancing their learning efficiency and effectiveness.

4. Realistic challenges of tennis teaching innovation in colleges and universities under the digitalization background

4.1. Infrastructure is not perfect

The in-depth application of digital technology in physical education, particularly in sports like tennis, relies on high-performance hardware facilities and a stable and reliable network environment. However, many universities currently face issues such as limited budgets or suboptimal venue conditions, which prevent them from purchasing advanced digital teaching equipment such as smart racket sensors, virtual reality (VR), or augmented reality (AR) training devices. These devices provide real-time data analysis and technical feedback, which are crucial for enhancing students' skill levels. Nevertheless, on the tennis courts of some universities, there is a lack of systems such as smart ball launchers or video analysis, preventing students from obtaining immediate data support to correct their technical movements during training. This absence not only diminishes the effectiveness of digital teaching but also hinders students from promptly identifying and correcting errors during the learning process, thereby delaying skill improvement.

4.2. Insufficient digital competency of teachers

The effective implementation of digital teaching requires teachers not only to master solid physical education skills but also to possess the ability to proficiently operate technical tools, interpret sports data, and design information-based teaching plans. However, many tennis

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teachers in universities currently exhibit significant deficiencies in this regard. They often lack systematic digital training, resulting in relative unfamiliarity with the use of sports data analysis software or wearable devices. This lack of technical proficiency makes some teachers fearful of new technologies, preferring to rely on traditional experiential teaching models. Consequently, digital tools fail to play their due role and become mere "ornaments". Although many teachers are able to use basic video recording functions, they are inadequate when it comes to optimizing students' technical movements in conjunction with biomechanical analysis software. This prevents them from analyzing students' performance at a deeper level and making effective teaching adjustments based on data feedback, thereby failing to enhance students' skill levels. In this situation, the potential value of digital technology has not been fully unleashed, failing to bring substantial improvements to teaching.

4.3. Inertial resistance of traditional teaching mode

Tennis teaching in universities has long followed a linear model of "demonstration-imitation-practice", which has led to fixed habits and ways of thinking among teachers and students during the teaching process. However, the introduction of digital technology requires teachers to first change their mindset, while also requiring students to adapt to training methods based on autonomous learning and data-driven approaches. Some teachers have doubts about the potential impact of technology application, fearing that it will weaken their control in the classroom. Students, on the other hand, may resist due to the complexity of technology, leading them to be unwilling to actively participate in the new learning model. For example, in traditional group practice, teachers often prefer to correct students' technical movements through visual observation rather than using smart devices to retrieve students' stroke trajectory data for more precise and targeted guidance. This reliance on subjective judgment not only limits teaching efficiency but also hinders the application of technology. Without data support, students find it difficult to fully understand their own performance and technical deficiencies, which affects their learning motivation and progress rate.

4.4. Disconnection between technology application and teaching objectives

Although some universities have introduced digital devices, the application of these devices often lacks deep integration with curriculum objectives, resulting in the use of technology remaining at the level of "using for the sake of using" and failing to effectively address practical problems in teaching. For example, in the process of gait optimization, teachers may simply use a certain device without designing targeted supporting plans to deeply observe and analyze the specific problems existing in students' gait. This lack of systematic application prevents the full potential of technology from being realized. At the same time, the standardized solutions provided by many technology suppliers often fail to truly match the actual needs of universities. This situation leads to low utilization of equipment and fails to produce the expected effects in teaching. When teachers and students in universities use these standardized tools, they may find that they do not match the actual teaching scenarios, resulting in reduced dependence on technology and even resistance. This phenomenon of "emphasizing hardware and neglecting design" severely restricts the effective application of digital technology in teaching, making it impossible to truly enhance teaching effectiveness.

5. Practical Strategies for Innovation in College Tennis Teaching in the Digital Context

5.1. Strengthen the construction of digital hardware facilities and optimize the digital teaching platform

By introducing intelligent training equipment, including smart ball launchers with adaptive adjustment capabilities, wearable biomechanical sensors, and motion capture systems based

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on computer vision, a digital monitoring network for the stadium is established. This system can collect key data such as athletes' hitting speed, racket swing trajectory, and body posture in real time, and generate personalized training suggestions through machine learning algorithms, forming a closed-loop feedback mechanism to enhance the scientific level of training.

Build an integrated smart tennis teaching space equipped with high-performance video analysis software, combining virtual reality (VR) and augmented reality (AR) technologies to achieve 3D modeling of technical movements and interactive simulation of tactical scenarios. Through VR equipment, real game scenarios are restored to assist students in decision-making training; AR is used to overlay virtual hitting paths to optimize movement standardization. At the same time, a customized tennis teaching management platform for universities is developed, integrating course resource libraries, student training profiles, intelligent scheduling systems, and training load monitoring functions. It supports blended teaching modes and realizes digital management of the teaching process.

5.2. Conduct digital teaching capability training and establish a digital learning community for teachers

To effectively enhance teachers' professional proficiency in digital teaching, it is recommended to organize specialized training sessions targeting specific digital teaching tools, including video analysis software and sports biomechanics analysis tools, to strengthen teachers' technical operation abilities. Simultaneously, teachers are encouraged to collaborate closely with information technology professionals to jointly design and develop innovative digital tennis courses, thereby achieving interdisciplinary knowledge integration and application. Furthermore, successful experiences in digital teaching can be shared and disseminated through holding on-campus lectures, promoting inter-school exchange activities, or utilizing online learning platforms such as MOOCs and professional discussion forums, thereby establishing a good mechanism for mutual learning. Lastly, incorporating digital teaching capabilities into teachers' assessment systems can not only motivate teachers to actively learn new technologies but also provide a clearer direction for their professional development, driving the digital transformation of the entire teaching team.

5.3. Promote "student-centered" blended teaching and innovate teaching evaluation methods

By combining online theoretical learning with offline practical training, we can effectively enhance teaching effectiveness. Specifically, the online part can include tactical analysis, rule explanations, etc. Through digital tools, such as specially developed apps and mini-programs, personalized homework can be assigned to students to ensure that each student's learning needs are met. In terms of teaching mode, the concept of flipped classroom is adopted, where students can learn relevant technical movements through watching videos before class, so that they can focus more on error correction and practical drills in the classroom. This approach not only improves the utilization efficiency of the classroom but also enables students to better master skills in practice.

The traditional single-outcome evaluation method has become inadequate in comprehensively reflecting students' progress. Therefore, we have introduced digital dynamic evaluation tools, such as sports data tracking and artificial intelligence motion scoring, to monitor and assess students' performance in real-time through sports equipment. This evaluation approach emphasizes the process of student progress and encourages them to continuously challenge themselves during training. Through big data analysis of students' training performance, we are able to generate personalized feedback reports, providing targeted suggestions and guidance. This data-driven teaching method not only enhances the relevance of teaching but

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also helps students gain a clearer understanding of their strengths and weaknesses, enabling them to have a clear goal in training and achieve higher levels of progress and development.

5.4. Clarify the core objectives of digital teaching and establish a demand-driven diagnostic system

Universities should actively conduct in-depth research on teaching needs, systematically analyze and identify specific problems and goals that need to be addressed in the application of various technologies. This process not only involves evaluating existing teaching methods but also considers students' learning habits and psychological needs, to ensure that the application of technology can truly enhance the classroom experience. On this basis, universities should establish close partnerships with technology suppliers to jointly promote the development of customized solutions, ensuring that the equipment and software provided can accurately match the actual needs of teaching.

Furthermore, establishing an effective feedback mechanism is crucial. Universities need to regularly collect feedback from teachers and students regarding their experience with digital teaching tools, effectiveness evaluations, and suggestions for improvement. This can be done through various forms such as questionnaires, interviews, and discussion sessions to fully understand the needs and feelings of different users. Based on this feedback, universities should promptly adjust and optimize technical solutions to continuously improve equipment utilization and teaching effectiveness. At the same time, it is recommended that universities establish a dedicated technical support team responsible for tracking the implementation effects of technology and helping teachers solve problems encountered during use. This continuous technical support can not only enhance teachers' confidence but also promote their active integration into the digital teaching environment. Through such comprehensive measures, universities can achieve effective integration of digital tools, making them a significant contributor to improving teaching quality.

6. Conclusion

6.1. The necessity of innovating tennis teaching models in colleges and universities under the digital background

In the context of digitalization, college tennis teaching faces numerous challenges, such as the monotonous content of traditional teaching models, the lack of flexibility in courses, and the imperfect evaluation system. These issues urgently require innovation through a three-dimensional linkage model of "learning-training-evaluation" to adapt to the needs and development of students in the new era. Regarding the "learning" dimension, digital tools such as online learning platforms, virtual reality (VR), and augmented reality (AR) can be fully utilized to enrich teaching content and forms. Through these technologies, students can learn and simulate tennis techniques in a virtual environment, increasing the fun and engagement of learning, thereby stimulating their interest in learning. In the "training" phase, smart devices and applications can be used to tailor personalized training programs for each student. These smart devices can monitor students' training data in real time, helping them to improve technically in a targeted manner, thus optimizing training effects. This personalized training approach not only enhances students' skill levels but also boosts their self-confidence and sense of achievement. In terms of the "evaluation" system, a more comprehensive and scientific evaluation system can be established by combining multi-dimensional data evaluation and feedback mechanisms. Through detailed analysis of students' performance in the learning and training process, teachers can adjust teaching strategies in a timely manner to ensure that students continue to progress on their own suitable tracks.

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However, numerous challenges still persist in practice. Firstly, the inadequacy of infrastructure restricts the effective application of digital tools; secondly, the digital competencies of many teachers still require enhancement to adapt to the new teaching model. Furthermore, the inertia resistance of traditional teaching models and the disconnection between technology and teaching objectives also make the transformation process fraught with difficulties. To address these issues, universities need to adopt a series of measures. Firstly, strengthen hardware construction to ensure that the teaching environment can support the effective use of digital tools; secondly, conduct systematic teacher training to enhance teachers' digital teaching capabilities, enabling them to flexibly apply new technologies; thirdly, promote the implementation of blended teaching models, combining traditional teaching with digital teaching; finally, construct a demand-driven diagnostic system to promptly identify and solve problems in the teaching process.

6.2. Outlook on digitalization empowering college tennis teaching

In the context of digitalization, tennis teaching in universities faces numerous challenges, such as the monotonous content of traditional teaching models, the lack of flexibility in courses, and the imperfect evaluation system. These issues urgently require innovation through a three-dimensional linkage model of "learning-training-evaluation" to adapt to the needs and development of students in the new era. Regarding the "learning" dimension, digital tools such as online learning platforms, virtual reality (VR), and augmented reality (AR) can be fully utilized to enrich teaching content and forms. Through these technologies, students can learn and simulate tennis techniques in a virtual environment, increasing the fun and engagement of learning, thereby stimulating their interest in learning. In the "training" phase, smart devices and applications can be utilized to tailor personalized training programs for each student. These smart devices can monitor students' training data in real time, helping them to make targeted improvements in technique and thus optimizing training effects. This personalized training approach not only enhances students' skill levels but also boosts their self-confidence and sense of achievement. In terms of the "evaluation" system, a more comprehensive and scientific evaluation system can be established by combining multi-dimensional data evaluation and feedback mechanisms. Through detailed analysis of students' performance in the learning and training process, teachers can adjust teaching strategies in a timely manner to ensure that students continue to progress on their own suitable track.

Overall, this study not only provides practical construction strategies and implementation steps for the digital transformation of tennis teaching in universities, but also delves into various challenges and opportunities that may be encountered during this transformation process. With the rapid development of technology and the evolving educational needs, we firmly believe that digital teaching resources will play an increasingly important role in university physical education courses, especially in tennis teaching. Looking ahead, continuous research and resource development will be key to enhancing the quality of education. We need to continuously explore and improve the application of digital tools to ensure that they can truly serve teaching goals and enhance students' learning experience. In this way, we believe that the in-depth application of digitalization will have a profound impact on tennis teaching in universities, promoting the comprehensive development of students and laying a more solid foundation for their future.

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