

Research on the Application of Smart Wearable Devices in Physical Education Teaching at Higher Vocational Institutions

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Abstract: Against the background of the digital transformation of vocational education, traditional physical education teaching in higher vocational colleges is confronted with practical dilemmas including subjective evaluation, homogenized teaching and delayed safety supervision. Smart wearable devices are capable of real-time data collection, quantitative analysis and timely feedback, which carry great value for the reform of physical education teaching in higher vocational colleges. Based on actual physical teaching scenarios in higher vocational colleges, this paper elaborates the application value of smart wearable devices, analyzes practical difficulties of traditional physical education, and focuses on discussing their specific applications in five links: physiological load monitoring, technical movement diagnosis, personalized stratified teaching, process evaluation, as well as the cultivation of students' sports interest and self-management ability. It is expected to provide useful references for higher vocational colleges to implement smart physical education.

Keywords: Smart wearable devices; Physical education in higher vocational colleges; Data-driven teaching; Personalized teaching; Teaching evaluation

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1. Introduction

The digital transformation of vocational education has become an inevitable trend. The Implementation Plan for the Digital Strategy of Education and the Implementation Plan for the Digital Strategy of Vocational Education issued by the Ministry of Education clearly propose implementing AI empowerment initiatives and promoting the integration of intelligent technologies with education and teaching. Physical education constitutes an important part of talent cultivation in higher vocational colleges, which also needs information technology to improve teaching quality. Restricted by empirical teaching modes, traditional higher vocational physical education has deficiencies in evaluation, personalized teaching and safety management, failing to meet the educational requirements of the new era. Relying on technical advantages such as real-time data collection and quantitative analysis, smart wearable devices offer new approaches to the reform of physical

education teaching in higher vocational colleges. Combined with the actual physical teaching in higher vocational colleges, this paper analyzes the application value, practical difficulties and implementation methods of smart wearable devices, so as to facilitate the construction of smart physical education classrooms in higher vocational colleges.

2. Necessity of applying smart wearable devices in higher vocational physical education teaching

2.1. Realize objective and quantified teaching evaluation and strengthen process evaluation

Physical education evaluation in higher vocational colleges has long relied on teachers' subjective judgment and final examinations, which cannot reflect students' whole learning process. Smart wearable devices can collect sports data generated by students during learning, incorporating exercise duration, load intensity and other indicators into the evaluation system to cover students' complete learning process. This innovation optimizes the previous evaluation methods and reinforces process evaluation, making evaluation results fairer and more instructive, and giving better play to the motivating function of assessment on learning.

2.2. Support the implementation of stratified teaching and practice the concept of teaching students in accordance with their aptitudes

Higher vocational students differ greatly in sports foundation and physical fitness. Uniform teaching contents and training intensities are not suitable for all students. The application of smart wearable devices can continuously accumulate students' sports data, and the teaching platform can build exclusive sports ability portraits for every student by analyzing their strengths and weaknesses, assisting teachers in designing stratified teaching contents and assigning training tasks of varying intensities for students with different foundations ^[1]. In this way, all students can make progress under suitable learning plans, truly realizing the teaching philosophy of teaching students in accordance with their aptitudes.

2.3. Move safety protection forward and consolidate classroom safety barriers

In traditional physical education classes, teachers can hardly keep track of every student's physical condition at all times. Physical abnormalities can only be detected when students show obvious symptoms such as dizziness and fatigue, leading to delayed emergency responses. Smart wearable devices can monitor physiological indicators such as heart rate and body temperature in real time, and automatically send early warnings once indicators exceed safety thresholds ^[2]. This function helps teachers grasp the physical state of the whole class in real time and prevent risks such as heatstroke and over-fatigue.

2.4. Stimulate students' sports interest and foster lifelong sports awareness

Traditional physical classes mainly consist of sports activities and physical fitness tests with monotonous forms, failing to cultivate students' long-term interest in sports. Smart wearable devices can visualize sports data and show students their own progress, bringing a sense of achievement. Combined with gamified classroom design and data-based challenge tasks, students' participation enthusiasm can be further aroused. While improving physical fitness, students gradually form regular exercise habits and lay a foundation for lifelong physical education ^[3].

3. Practical dilemmas of traditional physical education in higher vocational colleges

3.1. Academic evaluation focuses on results rather than processes with insufficient incentive effect

The performance composition of general physical education courses in higher vocational colleges is mostly based on physical fitness tests plus a small proportion of usual grades. Students' classroom participation and training efforts can hardly be reflected in their scores ^[4]. Such an evaluation model cannot reflect students' learning processes and progress, failing to demonstrate real learning effects fairly. Many students only take crash training a few days before exams and stop exercising after tests, which limits the educational value of physical education courses.

3.2. Extensive sports load control with poor individual adaptability and hidden safety risks

General physical education classes in higher vocational colleges have a large number of students, making it difficult for teachers to track every trainee. Students of different majors have varied basic physical fitness as well as physical demands corresponding to their vocational posts ^[5]. For example, students majoring in mechanical and architectural engineering take plenty of practical training and have more daily physical activity with relatively strong upper limb strength and core stability, while students of accounting and secretarial majors study at desks for long hours with weak cardiopulmonary endurance. Uniform training contents and intensities in class cannot fit everyone, especially in summer outdoor endurance running and physical fitness tests. Some students struggle to keep up with the overall rhythm, increasing risks such as muscle strain, heatstroke and even temporary syncope.

3.3. Technical movement correction relies on empirical judgment, restricting teaching precision and efficiency

In technical events such as volleyball, basketball and track and field, teachers mainly deliver demonstrations and lectures, then observe and correct students' movements. Limited by class hours, teachers can only give targeted corrections to a small number of students. Details such as joint angles, force sequences and center of gravity shifts are easily overlooked, leading to wrong movement habits formed through long-term training ^[6].

4. Specific applications of smart wearable devices in higher vocational physical education teaching

4.1. Real-time physiological load monitoring and sports safety early warning

Monitoring physiological data is the most fundamental and mature function of smart wearable devices. Smart bands and heart rate armbands are widely adopted in classes. Equipped with photoelectric heart rate and temperature sensors, they collect real-time data such as heart rate and body surface temperature after students wear them, and synchronize data to teachers' terminals via wireless networks for teachers to view the whole class's real-time physical conditions ^[7]. Taking middle-distance running and aerobic exercise teaching as an example, teachers can set target heart rate ranges in the system. Students wear heart rate armbands throughout the class. If heart rates stay beyond safe limits, reminders will be sent to both students and teachers, allowing teachers to arrange deceleration or rest in time to avoid overtraining. Multiple safety thresholds can be set in the system with corresponding warning levels for excessive heart rate, low blood oxygen and abnormal body temperature, enabling teachers to detect abnormalities and handle incidents promptly to prevent safety

accidents effectively.

4.2. Quantitative diagnosis and guidance of sports technical movements

Smart wearable devices equipped with multi-node inertial sensors can quantitatively analyze technical movements for ball games, track and field and other technical events. Such devices capture detailed data including joint angles, force sequences and body center of gravity, and automatically generate movement assessment results after comparison with standard movement models^[8]. Take basketball shooting teaching as an example: after students wear wrist sensors, the device records professional indicators such as release angle and wrist flexion amplitude. The system automatically compares data with standard models and informs students of specific problems such as low release angle and insufficient wrist force. In volleyball digging training, the device feeds back arm angles, hitting force and center of gravity positions in real time for instant adjustments. In traditional teaching, teachers can only roughly observe movement forms and hardly capture details such as joint angles and force sequences. Smart wearable devices quantify movement standardization with concrete values, helping students identify and correct problems. Meanwhile, teachers can deliver personalized corrective suggestions to improve technical teaching efficiency.

4.3. Personalized sports prescriptions and stratified teaching

Smart wearable devices continuously collect students' sports and physiological data, and the teaching platform builds exclusive sports portraits to precisely describe students' cardiopulmonary endurance, explosive power and other indicators. Based on such data, teachers can design personalized teaching contents and scientifically group students for group event training to boost training fairness and effects^[9].

Taking endurance running teaching as an example, teachers first organize placement tests where students complete 1000m jogging with smart bands. The platform collects heart rate changes, pace fluctuations, and recovery speed data, combined with previous classroom performance, to divide students into a basic consolidation group, an ability improvement group, and an advanced breakthrough group with differentiated training goals. For students with weak cardiopulmonary endurance in the basic group, low-intensity aerobic training alternating between one-minute fast walking and two-minute jogging is arranged. Teachers check heart rate recovery via band data after each set to adjust training duration and gradually improve basic physical fitness. For secretarial and accounting majors who sit for long hours, periodic training for neck and shoulder relaxation and core activation can be added, with devices monitoring movement force to improve postural problems caused by sedentary work.

4.4. Diversified process-oriented teaching evaluation

The application of smart wearable devices can directly promote the reform of physical education evaluation modes. Many higher vocational colleges have incorporated process data collected by smart devices into final grades, including sports volume compliance and technical movement standardization^[10]. During every physical class, the device automatically records students' exercise duration, average heart rate compliance and training completion rate, which are synchronized to the system and counted into usual grades. Scores accumulated by technical practice compliance in each class also serve as evaluation evidence for skill learning.

This evaluation method focuses on students' classroom participation and progress throughout the semester. Students with weak physical fitness who keep consistent training can obtain good process scores as long as they maintain regular participation and steady progress, making evaluation fairer and better motivating

students to attach importance to daily exercise. All sports data are automatically summarized into physical health files to track students' physical fitness changes during their college years.

4.5. Cultivation of students' sports interest and self-management ability

In classroom teaching, teachers can utilize data functions of smart wearable devices to design gamified and interesting teaching modes, replacing monotonous traditional training and mobilizing students' initiative. Combined with curriculum objectives, teachers can design classroom ranking lists, physical fitness challenges and virtual cross-country tasks, adjusting activity difficulty and training tasks according to data collected by wearable devices. Students can view personal sports data, physical fitness changes and training results on terminals. Long-term participation in digital interesting teaching activities makes students pay more attention to their physical conditions, adjust exercise rhythm and training intensity independently, and gradually form good habits of scientific exercise, effectively improving their self-management ability in sports.

5. Conclusion

The integration of smart wearable devices into higher vocational physical education classrooms is more than a supplement of teaching tools; it addresses practical problems including incomplete student supervision, inaccurate evaluation and superficial teaching. Real-time heart rate monitoring to control sports load, quantitative analysis to correct technical details, and support for stratified teaching and process evaluation enable teaching to match students' individual levels while preventing sports risks in advance and improving classroom efficiency and safety. The popularization and application of such devices currently face challenges such as high costs, data security and insufficient teacher competence, which require joint efforts from colleges and teachers for gradual improvement. In the long run, optimized functions of smart wearable devices can be combined with VR and AR technologies to build immersive sports scenarios and support students' lifelong healthy development.

Disclosure statement

The authors declare no conflict of interest.

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