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Article

Innovation of college physical education teaching and training mode based on mobile information technology of internet of things from a biomechanical perspective

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Abstract: With a new level of scientific and technological innovation, modern education has begun to combine science and technology. Information technology has been integrated into all aspects of education. Physical education (PE) has deepened the application of mobile information technology. In the context of PE, sports measurement equipment integrated with mobile information technology not only enables more precise measurements but also, from a biomechanical perspective, allows for a better understanding of the forces and movements involved in various physical activities. For example, wearable sensors can collect data on joint angles, muscle contractions, and movement patterns, which are crucial biomechanical parameters. This data can be analyzed to optimize training programs and correct movement techniques to prevent injuries and enhance performance. However, the opportunities provided by mobile information technology (which can be simplified into MIT for easy description later) also have a profound impact on PE teaching mode and method and pose new challenges to schools, teachers, students, and other related fields. Therefore, based on the research of MIT in PE training, aiming at the existing problems, this paper combined MIT to optimize and innovate, and discussed the PE teaching application of MIT, to promote the high-quality development of training. The combination of MIT and biomechanical analysis has led to an improvement in teaching quality and training effectiveness. The teaching quality and training effect of PE innovation training was better than the original training mode, and the teaching quality of PE innovation training was 8% higher than the original one. The training quality was 11% higher than the original one. This is attributed to the fact that the integration of human-computer interaction and the Internet of Things, along with biomechanical insights, facilitates more efficient movement training and seamless information transmission within the teaching process.

Keywords: sports teaching and training; mobile information technology of internet of things; human-computer interaction; computer vision; biomechanical

1. Introduction

MIT has become a necessary prerequisite for PE sports. Under the Internet of Things, PE resources should be collected, new PE teaching methods should be innovated, PE exercise activities should be optimized, students' enthusiasm should be aroused, and students should be encouraged to actively learn PE exercise activities. The interactive computer in sports training can monitor and analyze students' training behavior and knowledge with its image-processing technology. Under MIT, the PE training mode is changed to meet the actual needs of the Internet of Things environment. It mainly applies the Internet of Things technology to the detection, data recording, and measurement of sports training.

PE training and teaching are important courses to improve students' physical quality. To improve the physique and health level of college students, Guo and Li introduced functional exercise testing to comprehensively measure the exercise ability of major muscle groups and joints of the human body, and combine flexibility and strength quality [1]. Palamarchuk et al. determined the current level of professional activity innovation of PE and PE professionals. It was mainly to lay the foundation for the innovative model of sports training and to better integrate emerging technologies into training because it was also important to determine the main characteristics of innovation indicators [2]. Gawrisch proposed a conceptual framework to help pre-service PE educators develop technical education content knowledge based on occupational socialization theory. He also discussed the need to help pre-service teachers integrate technology into their careers [3]. Ni Chroinin described PE teaching methods to support pre-service teachers in learning how to promote meaningful PE experience, aiming to promote new understanding by sharing teaching principles that support pre-service teachers [4]. Maksymchuk et al. discussed the process of cultivating the teaching ability of future PE teachers in professional training and defined the concept of "future PE teachers' teaching mastery", which provided a reference basis for PE teachers to use mobile information technology in teaching and improve teaching quality in the future [5]. Fatullayeva Muazzam elaborated on the role of teachers in the formation of young people's spiritual and moral values in PE classes and believed that teachers must be prepared to organize general education work, especially the formation of spiritual and moral values [6]. Griban et al. provided a theoretical background for each stage of PE major formation and used fitness technology to carry out training activities for the incompatibility of PE teachers' professional preparation [7]. The above studies all described the importance of PE training innovation but did not combine the Internet of Things technology for innovation optimization.

MIT teaching is an important teaching method, which deeply affects the training effect. Yang analyzed the key technologies applied in the PE simulation system and discussed the innovative application of computer technology in sports, providing typical cases of virtual reality technology applied to PE training in colleges and universities for teachers and students [8]. Zhang analyzed the reform of education information service based on artificial intelligence technology, conducted in-depth and innovative research on it, and made clear the difference and connection between informatization and PE training [9]. Goad et al. described the functions of innovative technologies used in online PE and discussed the characteristics, functions, and potential applications of PE activities, mobile fitness applications, and mobile fitness games [10]. Krause et al. briefly introduced the educational technology requirements, challenges, and strategies of the teacher education project, and suggested that actions be taken in the PE project to solve the problems that prevent PE students from entering the teaching career [11]. Mischenko et al. Natalya approved a media project to increase the level of PE coaches' digital ability and gave the PE coaches' cognition, integration activities, and individual incentive elements in the digital professional ability evaluation [12]. Karasievych et al. verified the newly created or updated teaching conditions through experiments to train PE teachers in future middle schools to carry

out PE and PE activities [13]. The above studies have elaborated the application of MIT in PE training, but there are still many deficiencies in training innovation.

With the support of the Internet of Things technology, PE pays more attention to providing rich data information by using MIT and invests a lot of teaching resources in PE teaching by setting target scenes in rich virtual reality. Human-computer interaction can not only control students' learning state but also improve students' learning efficiency through intelligent devices. The monitoring of intelligent devices can be used to visualize students' learning conditions, thus helping teachers observe students' conditions. Therefore, this paper analyzed the problems in PE training in the MIT environment, applied MIT resources to PE education and training, and applied MIT to publicity and evaluation activities in the field of e-sports. At the same time, MIT is also used to improve the quality of PE education and training to meet the needs of students' independent learning and growth, thus optimizing the efficiency of PE training.

2. Current situation of PE training and teaching under mobile information technology

(1) The significance of mobile information technology in PE training.

Modern information technology can optimize the basic conditions of PE training, achieve an effective exchange of PE information, and meet the actual needs of student's independent learning and PE sports [14,15]. MIT can further develop students' sports skills and interests, and improve their learning quality. It is mainly through changing the teaching and interaction methods in the classroom. At the same time, MITPE has improved the PE teaching effect, broken the time limit of PE teaching, and inspired students to have a deeper understanding of the problems in PE teaching and training. This is of great help to improve students' academic performance, enhance their self-confidence, and carry out high-quality teaching, as shown in **Figure 1**. In addition, teachers can also provide effective guidance for students on the network and strengthen the specific relationship between teachers and students. Teachers can better conduct PE exercises among students and control the harmonious development of the classroom.

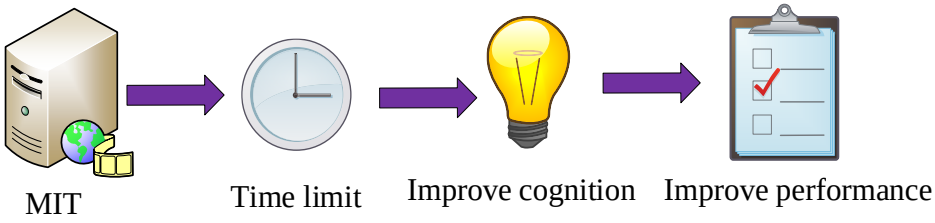

Figure 1. The significance of mobile information technology in PE training.

(2) Current situation of mobile information technology in PE training.

With the improvement of the quality of school network construction, information-based PE teaching has become an important form of PE education. Students can obtain extensive PE information through the network and professional websites, and students and PE teachers can maintain long-term interactive learning [16]. Students can not only obtain extensive PE knowledge through the network but

also continuously receive PE competition, physical, psychological, and other related information. Through mobile networks, students can freely obtain knowledge and information as needed. Because the mobile network does not limit students' time and location, it can provide students with the ability to access resources at any time. MIT has been fully integrated into PE teaching activities, and students tend to use visual and vivid network information resources to obtain PE knowledge. However, the application quality of MIT in PE teaching needs to be further improved, as shown in **Figure 2**. On the one hand, the informatization of PE training needs to be improved, and rich network resources need to be provided according to the actual situation of students. On the other hand, in the new information environment, teachers should provide network opportunities between teachers and students, and establish information interaction and exchange modules between students and teachers in the network information platform, to provide a solid network platform for students to ask questions and teachers to solve questions, thus improving the efficiency of students' information resources acquisition.

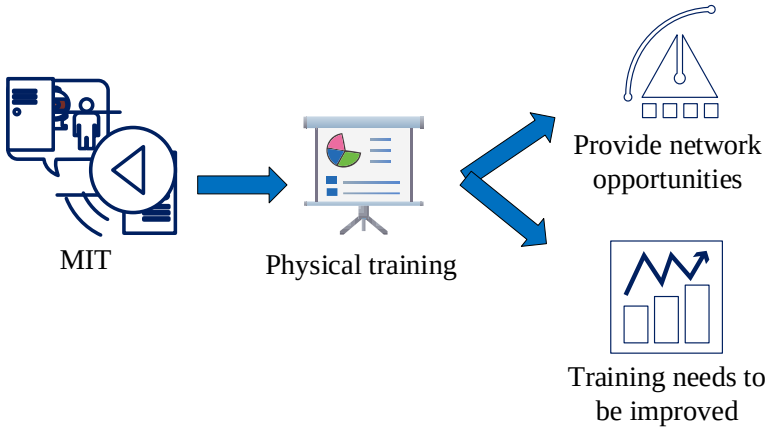

Figure 2. Current status of mobile information technology in PE training.

(3) Problems in PE teaching and training.

The current problems in PE teaching and training can be analyzed from five aspects, as shown in **Figure 3**. First, the teaching tradition is deeply rooted. In the process of PE education and training, it is difficult to get rid of the inherent limitations and constraints of traditional teaching and training methods, which seriously hinder the innovation of PE education [17]. The second is to emphasize generality and ignore the universality of personality. At the same time, many schools mainly teach PE with traditional knowledge and technology, which is not conducive to a more in-depth study of students' personalities in PE teaching. Because it hinders the development of students' thinking logic and original quality. Third, the unscientific educational phenomenon of focusing on innovation, weakening basic knowledge, blindly following PE innovation, and ignoring PE foundation and theory are the biggest obstacles to training innovation. The fourth is that the PE evaluation system is not perfect. At present, PE education evaluation is mainly based on performance evaluation and always based on harmonious teaching modes and textbooks. This PE teaching evaluation system only evaluates students' performance in PE knowledge and skills, and cannot reflect students' will and self-esteem in PE teaching, which hinders

the development of students' initiative, autonomy, and creativity. The fifth is to neglect the role of teachers in teaching. In the teaching process, teachers should properly handle the relationship between knowledge intake and students' physical quality, and reasonably allocate students' knowledge, exercise load, communication, and emotional experience. In addition to improving students' technical difficulty and deepening their knowledge, the assessment of teachers' progress is also reflected in their creative thinking of emotional progress.

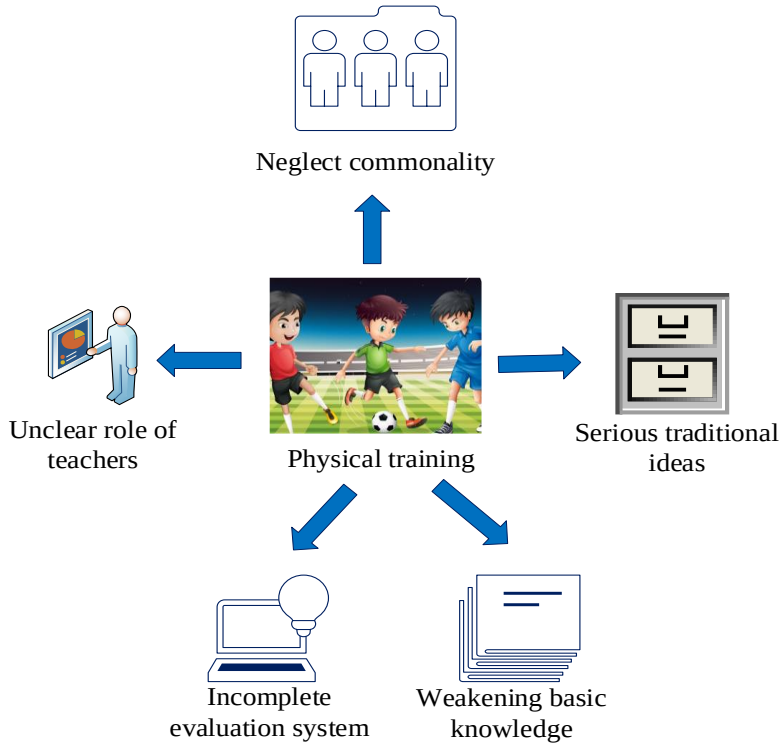

Figure 3. Problems in PE teaching and training.

3. PE teaching and training innovation under internet of things technology

(1) Application of human-computer interaction in PE training.

Sports training plan is the guiding principle of the whole process of sports training. The scientificity, legitimacy, and feasibility of the plan would directly affect the effect of sports training. Based on the application of intelligent technology to establish the "athletes training information database", the evaluation index system of athletes' physical fitness and training effect is established using computer vision technology. In addition, the physical fitness and training performance data of athletes are included in the training physical fitness evaluation model in the database to conduct a comprehensive quantitative measurement and evaluation of the training effect of athletes. According to the evaluation of various stakeholders, the training content should provide a solid foundation for the development of the training plan [18]. In addition, by integrating intelligent technology into the device, students' training data and physical function changes can be quickly obtained without using complex measuring methods. Using intelligent portable devices, it can measure the

physical performance of students in the state of movement or inactivity, and compare it with personal differences, as shown in **Figure 4**.

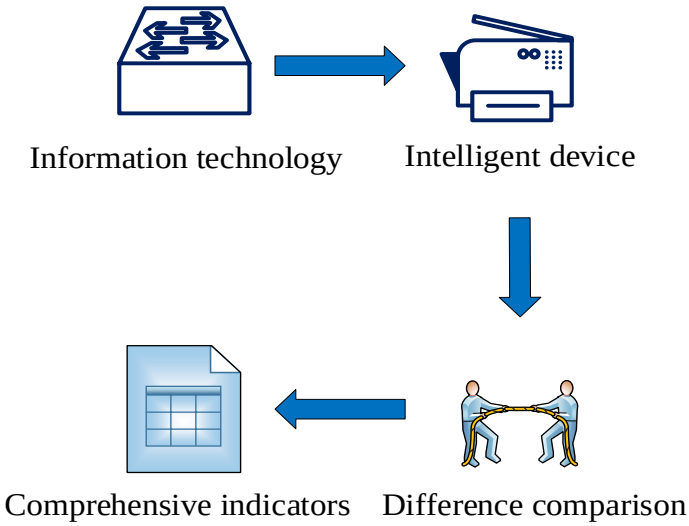

Figure 4. Application of human-computer interaction in PE training.

(2) Innovative measures of PE teaching and training mode under the Internet of Things mobile information technology.

The innovation of PE teaching and training mode under MIT can start from the following aspects, as shown in **Figure 5**.

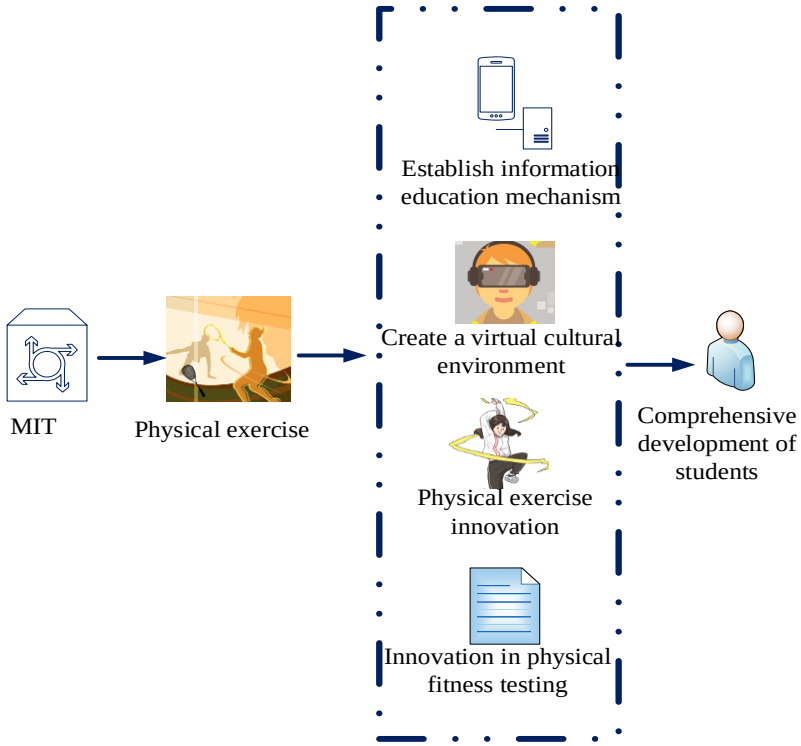

Figure 5. Innovative measures of PE teaching and training mode under mobile information technology of the internet of things.

1) Establish an information education mechanism.

To give full play to the role of MIT in controlling students' PE activities, it is necessary to use modern information collection systems to establish data collection and processing centers. MIT provides comprehensive monitoring of students' physical movements in an increasingly complex sports environment and uses PE training data on a large scale [19]. PE activities can be more effectively controlled and optimized through recording, systematization, processing, analysis, and application. To compare and guide data, it is necessary to store athlete data. By combining digital information with text information, it could realize multiple functions of digital video and video data, and create conditions for information extraction and application. To ensure the teaching quality, teachers can see the situation of the classroom at any time through intelligent devices. Therefore, the existing cameras can be used for the central control of the control room. Teachers can control in the control room. Through video monitoring and evaluation, teachers' enthusiasm can be effectively improved.

2) Innovative virtual training environment.

Under MIT, to promote students' training enthusiasm, it is necessary to carry out sports training activities in a virtual environment [20]. The focus is to use modern biomechanics and computer technology to simulate visual effects, improve the training effect, and improve the relevance of sports training and the effectiveness of training evaluation. It can realize the multi-dimensional judgment of bungee jumping lessons, improve the accuracy of bungee jumping lessons in the virtual bungee jumping game environment, cultivate students' psychology, improve teaching efficiency, and achieve the purpose of improving the effectiveness and verisimilitude of students' training.

3) Innovation in extracurricular physical exercise.

As an important part of PE, extracurricular PE exercise effectively meets the needs of students' daily PE activities, enlivens the school atmosphere, and makes the campus atmosphere more active. In combination with the information management system, MIT can be used to monitor students' participation in extracurricular activities and effectively narrow the gap of insufficient supervision [21]. The PE Department, in cooperation with the School Information Office, has developed a special plan to establish the original input system for each stadium and develop an application to collect information about student activities. Students can use their mobile phones to connect to the local induction system to provide time and place information for use. They can reuse and camera equipment to monitor the equipment, and then upload the collected information to the management headquarters for unified processing.

4) Innovation in physical fitness testing.

The main function of the physical fitness test is to monitor and control students' physical conditions, then mobilize students to participate in PE activities so that they can pay more attention to PE activities, and then collect data and develop courses and exercise programs for future schools. In addition, using MIT testing equipment to evaluate students would help improve the accuracy of data. Using the correct tools to evaluate students' academic performance is much more accurate than manual measurement and calculation. On the other hand, with this equipment, it is easy to organize and coordinate the work, thus avoiding the management of the test group. After the test, students can directly submit results according to the feedback results of the test equipment, thus improving the speed of score entry.

4. Application of neural network algorithm in PE teaching and training mode innovation

To study the effect of PE teaching and training mode innovation under MIT, this paper tests PE teaching and training methods through a neural network algorithm and improves and innovates the existing deficiencies according to the test results, to promote the improvement of PE teaching quality and the optimization of training effects. Among them, the network algorithm is to turn information into a concept and use symbols to express it. Then, it performs logical reasoning according to the symbol operation and serial mode. Firstly, the PE teaching quality evaluation model can be established as follows:

$$A = f(a_1, a_2, \cdots, a_n) \tag{1}$$

In the formula, *f* is the evaluation function of PE teaching, and *a* is the evaluation index. Then use a neural network to calculate the output of the teaching and training input layer, and the output in the training can be:

$$M_i^1 = a(i) \tag{2}$$

Then according to the training output, the input and output of the hidden layer in PE teaching can be found as follows:

$$M_j^2(b) = f\left(N_j^2(b)\right) \tag{3}$$

$$N_j^2(b) = \sum_{i=0}^{n} x_{ij}^2 M_i^1 \tag{4}$$

In the formulas, Equation (3) is the output function of the hidden layer, and Equation (4) is the input function. Then find the positive and negative symmetric function of the PE teaching function according to the activation function:

$$Q(a) = \tan(a)\frac{e^a - e^{-a}}{e^a + e^{-a}} \tag{5}$$

Then find the input and output functions of the network output layer in the training layer according to the function of the hidden layer:

$$M_j^3(b) = y\left(N_j^3(b)\right) \tag{6}$$

$$N_j^3(b) = \sum_{i=0}^{m} x_{im}^3 M_i^2(b) \tag{7}$$

Equation (6) is the output function of the training, and Equation (7) is the input function of the training. Then, use the activation function to convert the input and output functions into nonnegative evaluation functions:

$$y(a) = \frac{e^b}{e^b + e^{-b}} \tag{8}$$

Then establish the fuzzy similarity matrix *T* as:

$$T = \begin{bmatrix} t_{11} & t_{12} & \cdots & t_{1m} \\ t_{21} & t_{21} & \cdots & t_{2m} \\ \vdots & \vdots & \vdots & \vdots \\ t_{n1} & t_{n2} & \cdots & t_{nm} \end{bmatrix} \tag{9}$$

Among them, *t* is the variable factor in training. A fuzzy similarity matrix is used to evaluate the correlation between training and teaching. Finally, according to the evaluation function and similarity matrix, the similarity of the matrix is obtained as follows:

$$t_{mn} = \begin{cases} 1, m = n \\ \dfrac{s}{\sum_{i=1}^{m} |a_{1t} - a_{nt}|}, m \neq n \end{cases} \tag{10}$$

5. Experimental analysis of PE teaching and training innovation under mobile information technology

To study the experimental effect of PE teaching innovation, this paper evaluates and analyzes the training effect and training situation of students under PE innovation mode through neural network algorithm under the Internet of Things MIT, and finds the existing problems. It then uses the computer to monitor and analyze the problems and finally optimizes and improves the innovation mode, to promote the effect of PE training. First, it investigated the satisfaction of teachers and students of a school with the PE training innovation model under MIT, and judged the practical effect of the innovation model according to its degree, including 200 teachers and students, as shown in **Table 1**.

Table 1. Satisfaction of teachers and students with sports training innovation mode under mobile information technology.

	Satisfied	**Commonly**	**Dissatisfied**
Teacher	157	31	12
Student	167	24	9
Total	324	55	21

According to the survey data in **Table 1**, the teachers and students of the school are quite satisfied with PE training innovation under MIT, and the number of teachers and students satisfied with PE training innovation accounts for 81% of the total number, the general number accounts for 13.75% of the total number, and the dissatisfied number accounts for 5.25% of the total number. Among the satisfied teachers and students, they think that the innovative training mode can not only improve the training effect, but also facilitate the monitoring of the movement in the training, and then compare it with the standard movement to narrow the movement gap. It is mainly to compare the form, strength, and aesthetic feeling of student actions and standard actions, and then optimize and improve those that do not meet the standards. Dissatisfied teachers and students feel that training innovation can not stimulate exercise interest well, and training innovation can not grasp the intensity of

training. Then, it would analyze the training effect and teaching quality of the PE training innovation model, investigate the changes in the proportion of students' enthusiasm and exercise time in a week, and study the impact of innovative training on PE according to its changes, as shown in **Figure 6**.

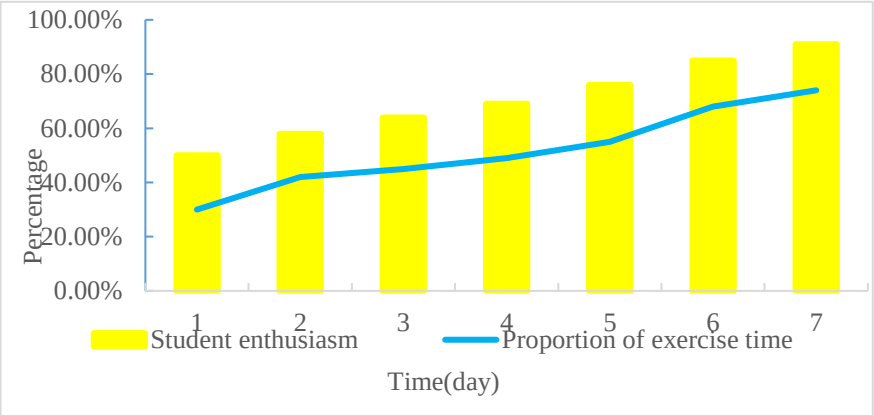

Figure 6. Changes in the proportion of students' enthusiasm and exercise time in a week.

According to the data in **Figure 6**, the proportion of students' enthusiasm and exercise time has been rising this week. The initial value of students' enthusiasm is 50%, and it increases to 91% on the seventh day. The initial percentage of exercise time was 30%, which increased to 74% on the seventh day. The improvement in students' enthusiasm shows that MIT can improve their interest in teaching. Combining knowledge with technology and using intelligent devices to promote students' interest in knowledge, can improve students' enthusiasm. The increase in the proportion of exercise time also shows that PE exercise innovation under MIT has received students' love, and students' exercise can also be detected through MIT during the exercise process. Teachers can evaluate the innovative effect of training through students' exercise and also can evaluate students' learning situations. Next, the neural network algorithm is used to analyze the similarity of PE training under MIT and the change of evaluation function value within a week, as shown in **Figure 7**.

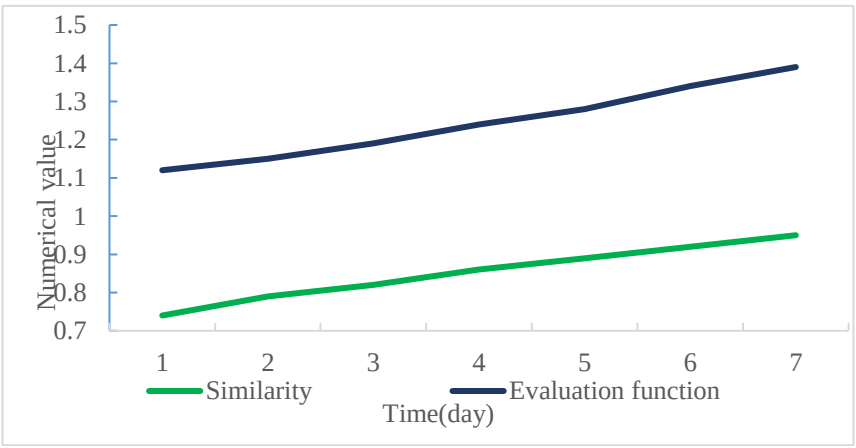

Figure 7. Similarity of sports training and change of evaluation function in a week.

According to the data described in **Figure 7**, the similarity of PE training and the value of the evaluation function is growing with time, and this week, the similarity has increased by 0.21, and the value of the evaluation function has increased by 0.27. The increase of similarity shows that MIT can make PE exercise more similar to the standard action through computer vision monitoring, and improve the training effect to a certain extent. The growth of the evaluation function shows that the effect of applying MIT to PE teaching is constantly improving, and MIT can also promote the diversified development of training methods to achieve comprehensive quality training of students. Then it compares the PE training innovation mode under MIT with the original PE training teaching quality and training effect, and evaluates the actual application effect of innovative PE training according to the comparison, as shown in **Figure 8**.

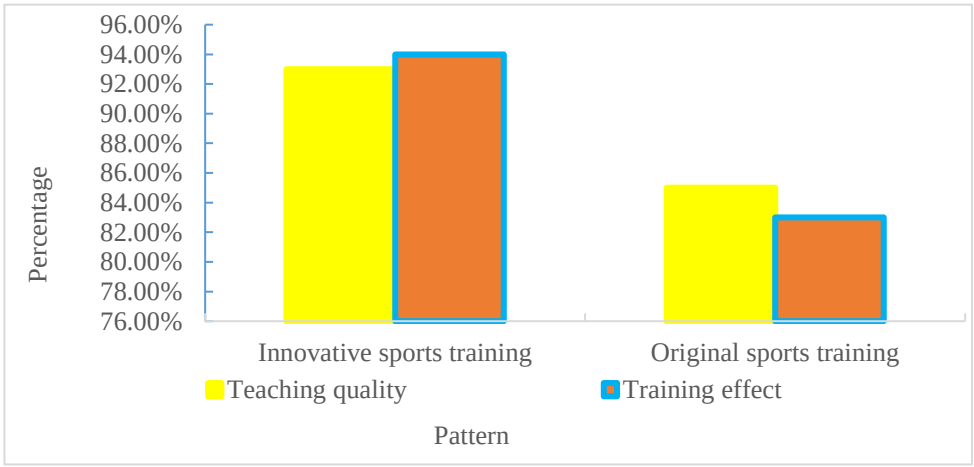

Figure 8. Comparison of teaching quality and training effect between sports training innovation mode and original sports training under mobile information technology.

According to the data in **Figure 8**, the teaching quality and training effect of PE innovation training are better than the original training mode, and the teaching quality of PE innovation training is 8% higher than the original training mode. The training quality is 11% higher than the original one. The improvement of the training effect shows that the innovative training mode can improve the physical quality of students, ensure effective training of students, and avoid potential safety hazards in training. The addition of intelligent devices at MIT can also improve training security and students' sense of experience. It is possible to formulate a personalized training plan that conforms to the differences between different students through intelligent devices. The improvement in teaching quality shows that MIT can monitor teachers and students in real-time, help teachers monitor students' training, and also improve students' learning effect.

6. Discussion

The integration of the Internet of Things (IoT) with PE is becoming increasingly significant, heralding a new era in educational methodologies. As we embrace MIT within the PE context, it is essential to consider how these advancements can enhance teaching quality and student engagement. One of the most promising applications of

MIT is computer vision, which can monitor students' movements in real-time, ensuring proper techniques are used and minimizing the risk of sports injuries [22,23].

From a biomechanical perspective, understanding the mechanics of human movement is crucial for optimizing performance and preventing injuries. By utilizing computer vision technologies, educators can analyze students' movements, providing immediate feedback that aligns with biomechanical principles. For instance, if a student is performing a squat incorrectly, the system can alert them to adjust their posture, thereby reducing the likelihood of injury and enhancing the effectiveness of the exercise. This immediate feedback loop fosters a safer and more effective learning environment, encouraging students to participate actively in PE classes [24,25]. Moreover, the application of MIT enriches the resources available for PE education. Traditional teaching methods often lack diversity, but with the integration of IoT devices, educators can create dynamic and engaging learning experiences. For instance, wearable devices can track students' performance metrics, such as heart rate and movement patterns, allowing for personalized training regimens that cater to individual needs.

This data-driven approach not only motivates students but also promotes innovation in teaching strategies, as educators can experiment with different methods based on real-time analytics. However, it is important to acknowledge the limitations of current research in this area. The sample sizes in studies exploring PE and MIT applications are often small, which may not provide a comprehensive view of the potential benefits and challenges [26]. Furthermore, while this study proposes innovative training modes, further research is necessary to validate these findings and establish a robust framework for integrating MIT into PE curricula [27]. In conclusion, the convergence of PE and IoT presents a unique opportunity to revolutionize teaching methodologies. By leveraging computer vision and biomechanical insights, educators can enhance student engagement and safety, ultimately leading to higher quality PE instruction. As we continue to explore and innovate within this space, it is crucial to address existing research gaps to ensure that future PE teaching is both effective and inclusive.

7. Conclusions

At present, the relationship between PE and the Internet of Things is getting closer and faster. In the new MIT teaching environment, all disciplines must better adapt to the specific circumstances of teaching. Computer vision can control the state of motion and effectively prevent sports injuries. The application of MIT in PE teaching would help students to participate more in PE teaching, improve PE teaching quality, and encourage students to innovate and develop. The application of MIT can enrich PE education resources, realize the diversification of PE education, constantly research and innovate practical PE teaching methods, integrate MIT into the classroom, and promote the deepening of PE education reform. Due to the small number of people investigated in this study, there are still many deficiencies in PE and training innovation mode. In addition, the PE innovation training in this paper can also provide a basis for future PE teaching.

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Conflict of interest: The author declares no conflict of interest.

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