Analysis and Research on the Current Situation of Informationization in Physical Education Teaching in the Context of "Internet+" in Universities

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Abstract. The trend of integrating information technology with university physical education (PE) is captured in the "Internet+" era. This study analyzes the current state of PE informatization globally and utilizes cloud computing and AI to enhance teaching resources and evaluation. It introduces a micro-services-based PE teaching platform with intelligent features, proven to enhance teaching efficiency and student outcomes through tests. This platform also improves user experience, offering innovative strategies for PE teaching reform in universities. This research is pivotal for advancing PE modernization and informatization.

Keywords: university physical education; teaching informationization; cloud computing.

1 Introduction

The rapid integration of information technology and education marks the "Internet+" era, significantly affecting university physical education. Traditional teaching methods fall short, necessitating a shift towards informationization supported by cloud computing and AI. This offers prospects for enhanced resource sharing, teaching optimization, and quality improvement. Yet, the informationization of university physical education is nascent, with challenges in platform architecture, module development, and data security needing urgent solutions. This study aims to evaluate the current state, explore technological applications, and propose a novel platform design to guide and inform development efforts in this field.

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2 Key Computer Technologies in Informationization of University Physical Education Teaching

2.1 The Application of Cloud Computing in the Construction of Teaching Resources in University Physical Education

Leveraging cloud computing, universities are innovating in physical education by developing resource platforms with extensive storage and easy access. A notable university's platform, featuring teaching videos and training guides, utilizes cloud technology to offer 500GB of resources for diverse educational needs. Accessible on various devices, this platform supports flexible learning and teaching, recording over 200,000 visits in 2021 with a 95% satisfaction rate among users. This approach exemplifies the potential of cloud computing in enriching physical education resources, demonstrating significant user engagement and approval[1]. Table 1 shows the composition of resources on the platform.

Table 1. Composition of Teaching Resources on the Cloud Platform

Resource Type	Quantity (units)	Percentage (%)
Teaching Videos	1,200	25%
Action Demonstrations	2,500	50%
Training Guidance	800	15%
Theoretical Lectures	500	10%

2.2 The Application of Artificial Intelligence Technology in the Evaluation of University Physical Education Teaching

Artificial intelligence (AI) is revolutionizing physical education evaluations by addressing the inefficiencies and biases of traditional methods. A university's AI-based system utilizes computer vision and machine learning for sports action evaluation, capturing data via cameras and employing algorithms for analysis. This system offers precise, quantitative feedback, achieving over 95% accuracy and increasing evaluation efficiency tenfold[2]. With a student acceptance rate above 90%, AI's application underscores its potential to significantly improve the objectivity and speed of physical education assessments, highlighting a shift towards more reliable and efficient evaluation methodologies.

3 Design of Informationized Platform for University Physical Education Teaching Based on Computer Technology

3.1 Platform Architecture Design

The platform adopts a microservices architecture based on Spring Boot, splitting the system into multiple independent microservices, each responsible for specific business functions. Communication between microservices is achieved through RESTful APIs, enabling independent development, deployment, and scalability. This architecture offers advantages such as high flexibility, strong maintainability, and easy integration. Additionally, the platform adopts a front-end and back-end separation design philosophy[3]. The front-end utilizes the Vue.js framework for data interaction with the back-end via Ajax. The back-end employs the Spring Boot framework to provide RESTful API interfaces and integrates Spring Cloud ecosystem components such as Eureka (service registration and discovery), Zuul (gateway), and Feign (service invocation) to support the microservices architecture. Figure 1 illustrates the overall architecture design of the platform.

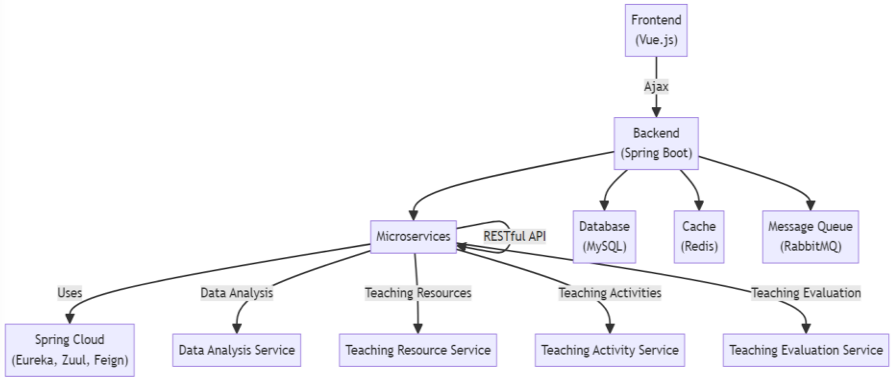

Fig. 1. Architecture Diagram of the Physical Education Teaching Informationization Platform

3.2 Module Design

The platform's module design follows the principle of "high cohesion, low coupling," dividing the system into several major modules, including teaching resource management, teaching activity management, teaching evaluation management, data analysis, and decision-making. Each module contains multiple sub-modules to further refine the functionalities. For example, the teaching resource management module includes sub-modules such as resource uploading, resource approval, and resource retrieval; the teaching activity management module includes sub-modules such as course scheduling, grade registration, and attendance management. This modular design ensures a clear system structure, well-defined responsibilities for each module, and facilitates development and maintenance. Additionally, the platform provides a mobile app, enabling data synchronization and complementary functions with the web platform[4]. Table 2 presents the user usage statistics of the platform's main functional modules.

Table 2. User Usage Statistics of the Platform's Main Functional Modules

Functional Module	Average Daily Users	Average Duration per User (minutes)
Teaching Resource Management	500	30
Teaching Activity Management	800	45
Teaching Evaluation Management	200	15
Data Analysis and Decision-making	50	60

3.3 Database Design

The platform utilizes MySQL relational database for persistent data storage. The database design follows the principles of normalization theory, appropriately dividing entity attributes to avoid data redundancy and anomalies. Additionally, specific indexes are designed for high-frequency query scenarios to enhance query efficiency. The database primarily includes core tables such as user information, teaching resources, teaching activities, teaching evaluations, system logs, etc., with relationships established between tables through foreign keys. To ensure data security, the platform implements an access control mechanism based on RBAC (Role-Based Access Control), where users of different roles can only access data within their authorized scope. Furthermore, regular database backups are performed to prevent data loss[5].

4 Key Algorithm Design and Implementation of the Platform

4.1 Personalized Recommendation Algorithm

The platform employs a personalized recommendation algorithm based on collaborative filtering. This algorithm infers the preference levels of different teaching resources for students based on their historical learning behaviors and resource evaluations, generating personalized recommendation lists[6]. Specifically, the algorithm first collects student learning logs, such as video viewing, document downloads, homework submissions, etc., to form a "student-resource" interaction matrix. Then, it calculates the cosine similarity between students to identify the K most similar students (typically ranging from 20 to 50). Finally, based on the ratings of these K students for teaching resources, it predicts the ratings of candidate resources for the target student using weighted averaging, and generates recommendation lists according to the predicted ratings. The mathematical description of the algorithm is as follows:

$$\hat{r}_{ui} = \frac{\sum_{v \in S^K(u)} sim(u,v) \cdot r_{vi}}{\sum_{v \in S^K(u)} sim(u,v)}$$

Here, $\hat{r}_{ui}$ represents the predicted rating of user u for item i, The numerator part, represented by $\sum_{v \in S^K(u)} sim(u,v) \cdot r_{vi}$, calculates the sum of the product of the similarity between user u and each user v in its similar user set $S^K(u)$, and the rating of user v for item i.The denominator part,represented by $\sum_{v \in S^K(u)} sim(u,v)$, is the sum of the similarity between user u and all users v in its similar user set $S^K(u)$, $\mathrm{sim}(u,v)$represents the similarity between user u and user v, and r_{vi} represents the actual rating of user v for item i. To evaluate the effectiveness of the recommendation algorithm, we randomly selected 1000 students as test users and conducted cross-validation using the leave-one-out method. Experimental results show that the algorithm achieves an average absolute error (MAE) of 0.68, a root mean square error (RMSE) of 0.85, and a recommendation accuracy of 73%. The graph below demonstrates the RMSE performance of the algorithm under different values of K. It can be observed that when K = 30, the algorithm achieves the lowest RMSE, indicating optimal recommendation performance.

4.2 Automatic Scoring Algorithm

The platform utilizes an automatic scoring algorithm based on skeleton point detection and action recognition to provide objective and accurate evaluation of physical movement videos submitted by students. Firstly, algorithms such as OpenPose are employed for human pose estimation to detect key skeleton points (e.g., elbows, knees, wrists) from video frames, generating a sequence of skeleton point coordinates. Subsequently, the coordinate sequences are fed into a pre-trained LSTM (Long Short-Term Memory) neural network to recognize the action category. Finally, considering both the action category and skeleton point trajectories, a comprehensive assessment of the action's standardization and correctness is conducted, resulting in quantitative scoring[7]. The process of this algorithm is illustrated in Figure 2.

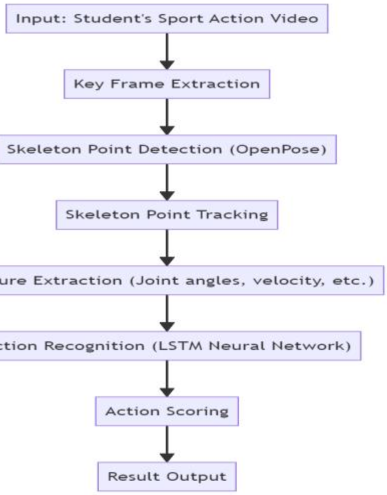

Fig. 2. Flowchart of the Automatic Scoring Algorithm

To train and test this algorithm, we collected 10,000 segments of student physical movement videos and had professional instructors manually rate them. Based on this, we evaluated the algorithm's performance metrics using 5-fold cross-validation. Experimental results show that the algorithm achieves an accuracy of 92% in action category recognition and a mean absolute error (MAE) of 1.2 points (out of 10) in scoring accuracy, with a correlation coefficient of 0.91 compared to manual ratings. Table 3 displays the recognition accuracy of different action categories.

Table 3. Recognition Accuracy of Different Action Categories

Action Category	Sample Quantity	Recognition Accuracy
Pull-ups	300	95%
Sit-ups	500	98%
Long Jump	400	90%
Basketball Shot	800	93%
Juggling	600	91%

5 Platform Application Effect Evaluation

The evaluation of a physical education informatization platform shows significant adoption and satisfaction among users. With 20,000 registered users and daily visits averaging 5,000, the platform has become a key tool in physical education. A survey among users reveals high satisfaction: 95% appreciate its functionalities, 90% of teachers report improved efficiency, and 85% of students find it boosts their learning interest[8]. The platform's personalized recommendations and automatic scoring are particularly valued, indicating their effectiveness in enhancing teaching and learning. These results underline the platform's success in meeting the needs of its educational community. Figure 3 illustrates the satisfaction survey results of the platform.

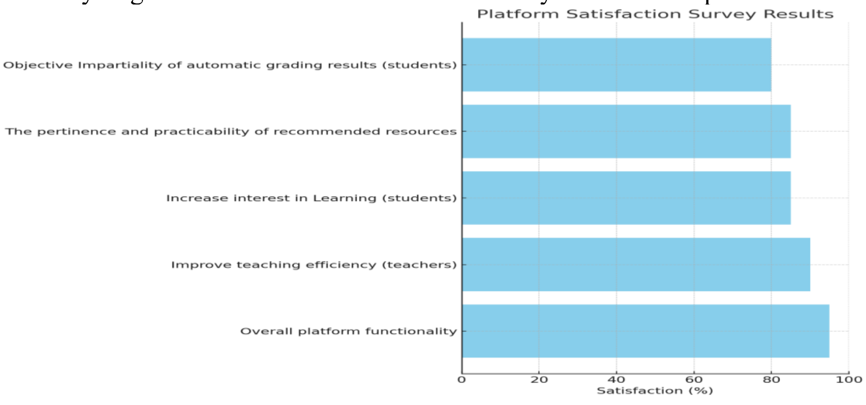

Fig. 3. Platform Satisfaction Survey Results

Lastly, we conducted a comparative analysis of the teaching effectiveness before and after the platform application. We selected the physical education scores of 100 students before and after platform implementation and found that after platform application, the average score of students increased from 78 to 85, with the percentage of excellent scores rising from 12% to 25%. Additionally, there was a significant improvement in students' average physical fitness scores, increasing from 75 to 82.

These data indicate that the platform application has significantly enhanced students' learning outcomes and physical fitness, achieving educational objectives. Table 4 displays the comparison of student scores and physical fitness scores before and after platform application[9].

Table 4. Comparison of Student Scores and Physical Fitness Scores Before and After Platform Application

Indicator	Before Platform Application	After Platform Application	Improvement
Average Score	78 points	85 points	+7 points
Excellent Rate	12%	25%	13%
Physical Fitness Score	75 points	82 points	+7 points

6 Conclusion

The "Internet+" era demands the informatization upgrade of university physical education. Analysis shows the widespread use of cloud computing and AI in resource construction and evaluation. This study introduces a microservices-based, innovative informatization platform featuring personalized recommendations and automatic scoring. Verified in practice, it significantly enhances teaching efficiency, student engagement, and learning outcomes, earning widespread acclaim[10]. This breakthrough offers valuable insights for developing physical education informatization, marking a pivotal step towards reform and innovation in the field, and demonstrating the profound impact of modern technology on educational methodologies.

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