Construction of College Physical Education Network-assisted Teaching Platform under the Background of Internet Plus Education

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Abstract. With the rapid development of Internet technology, internet plus model has been gradually applied in the field of education to realize intelligent construction. As a practical course, physical education in colleges and universities also needs to overcome the difficulties in teaching forms and methods, so as to realize the reform of traditional teaching mode. In this regard, this paper takes the current situation of physical education teaching in colleges and universities as the research object, and based on the actual requirements of the transformation and upgrading of physical education teaching, puts forward a set of effective design scheme of college physical education network-assisted teaching platform, and constructs a new mode of college physical education that meets the needs of all-round talent training in the new period. The platform adopts standard Javaweb technology to realize front-end interface construction and back-end server development, and combines streaming media technology, data analysis and processing technology and multimedia teaching technology to form a smart teaching application integrating remote login, live lecture, resource sharing, data evaluation and other functions. Practice has proved that the platform can effectively complete the diversified expansion of teaching content, realize the innovation of teaching methods, improve students' learning efficiency, and provide important reference and guidance for the teaching reform and talent training of college physical education courses.

Keywords: internet plus; college physical education; network-assisted teaching platform; Javaweb; computer application

1 Introduction

Under the background that "internet plus" has become a national development strategy, the rapid rise of internet plus education has greatly changed the current teaching mode and education management mechanism in colleges and universities. [1] The comprehensive integration of a series of digital information technologies provides numerous teaching methods and teaching forms for college teaching practice, which promotes the improvement of teaching efficiency and helps students broaden their horizons and realize personalized development. Among them, the online teaching mode or mixed teaching mode represented by "online class" has outstanding resource advantages and strong faculty, and is also flexible, open and extensible, which is the key link to promote the innovative practice of information teaching in colleges and universities and the only way to promote the high-quality development of higher education. However, compared with other professional disciplines, college physical education,

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as a highly comprehensive and practical discipline, is often difficult to organically integrate with online education due to various courses, limited venue space, lack of teaching resources, and shortage of professional teachers, so that college physical education courses are obviously lagging behind under the internet plus education system. [2] In view of this, this paper believes that the implementation of "internet plus physical education" teaching mode is bound to be based on the network-assisted teaching platform. At the same time, this paper aims at the characteristics of college physical education courses and the actual needs of teachers and students, and constructs a web-based college physical education network-assisted teaching platform, and puts forward a set of comprehensive solutions to promote the network and digital transformation of college physical education courses. [3] The platform integrates the practical advantages of Javaweb technology, streaming media technology, data analysis and processing technology and multimedia teaching technology, reshapes the teaching process of physical education, promotes the adjustment and optimization of teaching mode, improves the teaching service and management mechanism, and contributes to the intelligent construction of college physical education.

2 System construction

The design and development of college physical education network-assisted teaching platform will involve front-end architecture, back-end architecture, database architecture and security architecture. At the same time, in the choice of technical system, the network-assisted teaching platform will be built with Javaweb technology as the core, and the superposition of live teaching functions will be completed with the help of streaming media technology framework.

First of all, the network-assisted teaching platform uses B/S architecture to separate the front-end and the back-end, and at the same time uses the Node.js middle layer to replace the traditional back-end template rendering, so as to decouple the front-end and the back-end, leaving only the necessary data interfaces. [4] The front-end architecture is based on the Vue framework, combined with Ajax, Echarts and other components to complete the design and deployment. The back-end architecture relies on SSM framework to complete the construction. In the configuration of development environment, Linux CentOS 7.0 is selected as the bottom operating system, Tomcat 8.0 as the Web server, 1.8.0_281 as the JDK, Eclipse Version 2020 as the integrated development tool and MySQL 5.7 as the database server.

Secondly, the streaming media technology framework consists of anchor terminal, streaming media server, client and other modules, as shown in Figure 1 for the live broadcast function architecture. [5] Among them, the collection of audio and video files needs the support of microphones, cameras and other equipment, and at the same time, it also needs the encoder for compression. After receiving the audio and video digital signals, the encoder FFmpeg will convert the audio and video digital signals into streams according to AAC audio compression coding algorithm and H.264 video compression coding algorithm respectively, and package them in MPEG2-TS and FLV formats respectively to improve the storage and transmission efficiency of files. [6] After the data stream is transmitted to the streaming media server according to the RTMP transmission protocol, it will be transcoded in real time, that is, different algorithms will be used to adjust the code rate of audio and video files to ensure normal playback under different network conditions and different client devices.

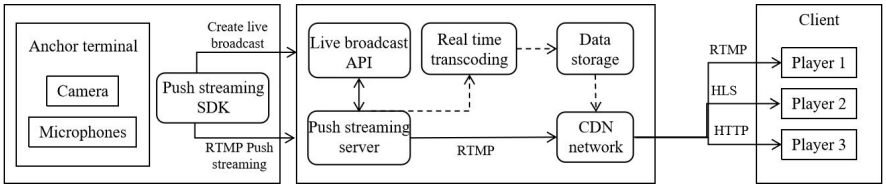

Fig. 1. Streaming media technology framework

Finally, all the architectures and modules in the platform are integrated, packaged and distributed to the server. After configuring the corresponding ports, users can log in from the client browser.

3 Functional implementation

3.1 Student side

Course management. Student users can log in to the platform through the client browser of any device, and enter different functional modules in turn to complete the learning tasks of physical education courses according to the prompts. Under the pre-class management module, student users can see the teaching arrangements of different types of courses, and can choose courses to join the study according to their own personality preferences. Table 1 shows some physical education course information.

Table 1. Summary table of physical education courses

No.	Course	No.	Course	No.	Course
001	Track and filed	004	Volleyball	007	Badminton
002	Basketball	005	Tennis	008	Aerobics
003	Football	006	Table tennis	009	Martial arts

Live course. The online teaching of the platform involves autonomous learning and live course learning. Before the live broadcast of the course, the platform supports student users to finish the course preview online, that is, they can learn independently through some texts, pictures, PPT, micro-lesson videos and other materials uploaded by teachers and users in advance, which is convenient for student users to quickly obtain the teaching difficulties and key points of the course and pave the way for the subsequent live broadcast teaching. [7]

Under the live course function module, student users can directly watch all the contents taught by teachers online through the FFplay player on the platform page, or they can directly follow the teachers to practice their actions and skills. In addition, in the process of live teaching, student users can interact with teachers through the "barrage" function. The text barrage sent by the students will be displayed simultaneously on the students' side and the teachers' side. The following is the sending and receiving function code of the barrage. When the barrage is sent out, it will also be saved in the form of information queue, which provides convenience for subsequent display and management. [8]

```
public class DanmakuClient {
  public void sendDanmaku(String sender, String content) {
    DanmakuMessage message = new DanmakuMessage(sender, content);
    danmakuManager.addDanmaku(message);    }
  public void displayDanmaku() {
    while (danmakuManager.hasDanmaku()) {
      DanmakuMessage message = danmakuManager.getDanmaku();
      System.out.println(message.getSender() + ": " + message.getContent());  }
```

During the operation of live classroom function, there is an obvious one-to-many relationship between the anchor and the client, and the viewing experience of student users is easily affected by factors such as network bandwidth, total access, network distribution and so on, resulting in problems such as congestion, delay and disconnection. [9] In order to strengthen the concurrency control ability of the platform and ensure students' viewing experience, the platform will be upgraded from two aspects: CDN network acceleration and load balancing.

The principle of CDN network acceleration is to compress a series of static resources and cache them in network nodes in advance to reduce the load of servers. The common compression algorithms are Brotli and Gzip, and both of them can be directly deployed in the server or CDN network, and the compression can be achieved by configuring the parameters. Table 2 shows the configuration reference of the two algorithms. [10] In the simulated test environment, when faced with 1285 HTML documents containing 3 languages, Brotli algorithm has certain advantages in decompression speed and compressibility compared with Gzip algorithm of the same type (the lower the compression ratio, the better), as shown in Figure 2. On the whole, the compression performance of Brotli is 18%-23% higher than that of Gzip algorithm.

Table 2. Brotli algorithm and Gzip algorithm configuration information

Brotli algorithm	Gzip algorithm
brotli on;	gzip on;
brotli_static off;	gzip_vary on;
brotli_comp_level 11;	gzip_min_length 1024;
brotli_buffers 16 8k;	gzip_buffers 128 32k;
brotli_window 512k;	gzip_comp_level 6;
brotli_min_length 20;	gzip_http_version 1.1;

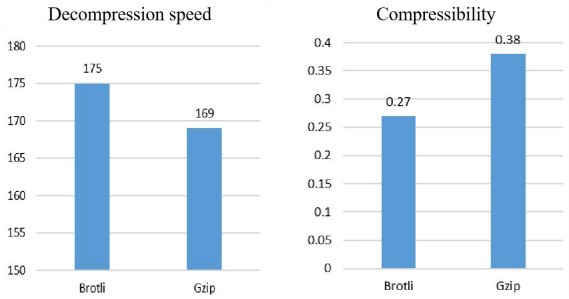

Fig. 2. Utility comparison of Brotli algorithm and Gzip algorithm

In the aspect of load balancing, Nginx load balancing server is used to realize it. Nginx balanced load server relies on different operation strategies to complete the planning, classification and coordinated distribution of user requests, so as to give full play to the processing advantages of back-end server clusters and promote the rational and effective utilization of host resources. Common load balancing strategies include polling, weight polling, fastest response time and hash calculation of original address. Among them, polling and weighted polling strategies are mainly suitable for static resources, and the performance of back-end servers is required to remain stable. The fastest response time strategy is not limited by the processing power of the back-end server, and can be applied to dynamic and real-time scenarios. The original address hash calculation can be based on the IP address of the back-end server, and the obtained value is the server serial number, which is suitable for high-frequency user request scenarios. [11] In addition, Nginx load balancing server can also set the scheduling status of each back-end server to further enhance the load balancing effect. Table 3 shows the common status information of back-end servers.

Table 3. Load balancing status of back-end servers

No.	Status	Description
1	Down	The current back-end server does not participate in the load balancing strategy
2	Backup	Enable the reserved backup back-end server when other back-end servers fail
3	Max_fails	Allow the number of failed requests, reflecting the current back-end server status
4	Fail_timeout	The request failed and timed out. When Max_fails failed, the current back-end server entered the pause time

In the simulation test of the platform, in order to verify the operation effect of Nginx load balancing server, two Nginx proxy servers and three back-end servers were set. The user requests entered the proxy servers at a speed of 0.75μs/ server, and the response speed of the back-end servers was 120ms/ server. Under 1000 concurrent requests, the actual application effects of different load balancing strategies are shown in Table 4. The results show that the polling strategy is the best and meets the platform design requirements.

Table 4. Statistical Results of Request Processing Delay

	Average delay	Tail delay
Polling	88μs/ piece	113μs/ piece
Weight polling	103μs/ piece	357μs/ piece
Fastest response time	117μs/ piece	161μs/ piece
Original address hash calculation	94μs/ piece	126μs/ piece

After-school training. After the live lecture, student users can train according to the training tasks assigned by teachers, and complete the collection and detection of sports data with sports bracelets and other equipment. At the same time, the platform also supports student users to upload video files of the training process, which is convenient for subsequent teaching evaluation.

3.2 Teacher side

On the teacher side, teacher users have the functions of system management, online live broadcast and data statistics. System management includes the maintenance of digital teaching resources, student information management and other detailed functional modules. Under the online live broadcast module, teachers can complete the operations of publishing live course information, starting live broadcast, ending live broadcast and so on. When the live lecture is over, teachers can check the live broadcast and accumulated live broadcast data under the statistics.

In addition, teachers will focus on the analysis and evaluation of students' after-school training. When teachers initiate students' evaluation online, teachers and users can retrieve students' training images and sports data through the student information management module. Among them, sports data is collected by Fitbit sports bracelet, and data transmission is completed by constructing Service interface. Table 5 shows the basic sports data information. [12]

Table 5. After-class training exercise data of some student users

ID	100046	100317	100448	...
User ID	0005198z	0006671x	0006355k	...
Duration	0:43:11	0:37:19	0:35:44	...
Training time	0:29:01	0:27:08	0:30:16	...
Average heart rate	116 times/minute	121 times/minute	119 times/minute	...
Total kilocalories	139 kcal	158 kcal	147 kcal	...
Dynamic kilocalories	110 kcal	118 kcal	114 kcal	...

As shown in Table 3, the values of learning behavior characteristics are different in the expressed meaning and measurement unit, and further operations such as cleaning, integration, change and reduction are needed to keep the data in a certain standard and specification. As shown in Formula 1, it is a normalized calculation formula, where x represents the original data, X1 and X2 represent the minimum and maximum values in the original data set respectively, and X' represents the normalized value. After the numerical processing is

completed, the platform will automatically generate a motion analysis curve to improve the convenience and scientificity of analysis and evaluation. Figure 3 shows the exercise heart rate curve.

$$X' = \frac{X - X_2}{X_2 - X_1} \tag{1}$$

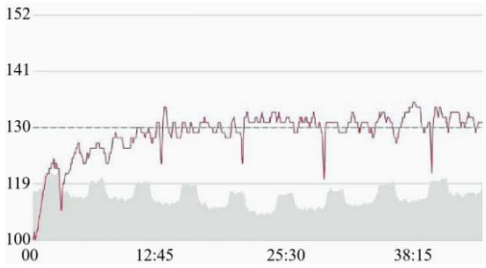

Fig. 3. Exercise heart rate curve

4 Conclusions

In order to realize the digital transformation of physical education teaching mode in colleges and universities, this paper aims at many difficulties faced at present, and constructs a network-assisted teaching platform for college physical education based on Web technology. The platform can optimize the whole process and all aspects of physical education from multiple angles, improve the teaching service and management mechanism, and set up a new paradigm for physical education in internet plus. In the follow-up research, the system will further enrich the interactive means between students and teachers, enhance the expansibility and adaptability of streaming media technology, and make contributions to the digital reform of higher education.

References

[1] Zhai Xuesong et al. Opportunities and Challenges of "Internet Plus Education" in Web3.0 Era[J]. Open Education Research.11 (2022)

[2] Shi Mingming. Research on the Path of Promoting the Construction of High-quality System of Physical Education in Colleges and Universities by Digital Technology[J]. Research on Innovation of Ice Snow Sports.12 (2022)

[3] Tang Yishan. Path Selection of Physical Education Classroom Teaching Reform in Higher Vocational Colleges under the Background of "Internet Plus"[J]. Sports Vision.03 (2023)

[4] Shi Feng. Development and Application of JavaWeb Based on MVC Pattern[J]. Electronic Technique.05 (2021)

[5] Huang Ping. Research on Real-time Streaming Media Technology Based on RTMP Data Transmission Protocol[J]. China New Telecommunications.02 (2023)

[6] David Kristiadi Marwiyati.Adaptive Streaming Server dengan FFMPEG dan Golang[J]Jurnal RESTI (Rekayasa Sistem dan Teknologi Informasi) .06 (2021)

[7] Zhou Fang. Transformation and Cultivation of Physical Education Teachers' Roles in Online Teaching Mode[J]. Industrial & Science Tribune.08 (2022)
[8] Yang Yaping. Design and Application of Online Live Interactive Teaching Platform in Open University[J]. Journal of Guangxi Open University.05 (2023)
[9] Xiao Rong. Discussion on CDN Content Distribution and Load Balancing Strategy[J]. Digital World.04 (2020)
[10] Pio Baake Slobodan Sudaric.Net Neutrality and CDN intermediation[J].Information Economics and Policy.03 (2019)
[11] Cai Yuntong. Research and Application of Streaming Media Load Balancing Based on Nginx[D]. University of Electronic Science and Technology of China.03 (2019)
[12] Zhao Chengyong. Application of Intelligent Sports Bracelet in Physical Education Teaching[J]. Contemporary Sports Technology.10 (2018)