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Managing the integration of teaching resources for college physical education using intelligent edge-cloud computing

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Abstract

These days, colleges and universities have accumulated many resources in teaching and scientific research due to the acceleration of education information in China. However, many teaching resources are in short supply due to a lack of standardized resource construction and the closeness of management methods. Physical education significant teaching resources in Chinese colleges and universities must be utilized. If not integrated, it would seriously restrict the development of physical education in China. However, the traditional management of physical education teaching resources tends to worsen the data management, which is easy to cause the loss of physical education teaching resources data. With the development of the Internet of Things (IoT), cloud computing, and other technologies, intelligent edge cloud computing can ensure the integrity of physical education teaching resources and improve utilization. In this paper, cloud computing is used to manage physical education teaching resources in colleges and universities, and virtualization technology is used to research physical education teaching resources. Moreover, a resource scheduling method is proposed to ensure equal load distribution across various edge resources. The proposed strategy also provides increased utilization levels for computing resources. The comparison between the sports teaching resources under cloud computing and traditional sports teaching resources found that cloud resource management's sharing degree of teaching equipment has increased by 20.6% compared with conventional resource management. The sharing degree of courses has increased by 16.5%, and the utilization rate of sports venues has increased by 27.1% compared with traditional resource management. The utilization rate of sports film and television materials increased by 30.7%. Teachers and students benefit significantly from college and university teaching resources in the context of cloud computing. It demonstrates how cloud computing may assist colleges and universities in managing and integrating their teaching resources more effectively. The management and integration of college sports resources through cloud computing can promote the mutual exchange of college resources and have practical significance for the development of college education.

Keywords Cloud computing, Resource management integration, Sports teaching resources, Virtualization technology

Introduction

In the current age of the internet, edge-cloud-enabled management is an essential component of the integration approach for teaching resources, significantly enhancing education quality. This approach utilizes edge computing and cloud computing technologies to enable the management and integration of teaching resources in an intelligent, efficient, and scalable manner. Its key benefit is the

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ability to provide real-time data processing and analysis at the edge of the network, resulting in faster access to educational content and more personalized learning experiences [1]. Additionally, edge-cloud-enabled management can improve teaching resources' security and privacy by distributing data storage and processing across the edge and cloud networks, reducing the risk of data breaches and ensuring safe and secure management of sensitive educational data [2].

However, digitizing instructional materials is the cornerstone of a country's effort to modernize its educational system and a crucial barometer. Higher education plays a significant role in Chinese education and is a scientific and technological advancement hub. Its duties include cultivating high-tech talent, researching, creating technology and scientific goods, and fostering technological and scientific advancement. Currently, the distribution of educational resources in Chinese universities is unbalanced, such as outdated equipment, insufficient teachers, and insufficient quality courses. There is minor communication between schools, making resource sharing impossible. It significantly impacted Chinese university talent training, limited university development, and slowing China's scientific and technological progress. The distribution of physical education teaching resources in traditional colleges and universities is highly uneven, the physical education teaching resources in different schools cannot be shared, and the advantages of teaching resources in different regions are also different, all of which seriously limit the development of physical education. Integrating sports teaching resources and intelligent edge cloud computing can realize the interconnection and sharing of sports teaching resources and improve the utilization rate of sports teaching resources.

The traditional management of physical education teaching resources has resulted in poor data management and potential data loss. However, with the development of technologies such as the Internet of Things (IoT), cloud computing, and intelligent edge cloud computing, the management of physical education teaching resources can be improved significantly [3]. This research paper examines the current state of teaching resources for physical education majors in colleges and universities and proposes integrating these resources into their curricula. The study explores the coordinated development of physical education teaching resources and demonstrates the feasibility of integrating resources based on integration base and scientific principles. Cloud computing is identified as a critical technology for managing physical education teaching resources effectively, and this paper highlights its advantages over traditional management approaches. The major contributions of our research can be summarized as follows:

- First, this paper uses cloud computing to manage physical education teaching resources in colleges and universities and virtualization technology to research physical education teaching resources.
- Second, it proposes a resource scheduling method that ensures equal load distribution across edge resources.
- Third, the proposed scheduling policy ensures increased utilization levels for computing resources such as edges and cloud.
- Finally, the papaer evaluates the proposed method that has enhanced the management, sharing of resources and utilization rate of educational resources. In addition, it further demonstrates the management benefits of integrating educational resources based on cloud computing.

The rest of the paper is summarized as follows. We offer an overview of the related works and resource management methods in Sect. 2. Section 3 discusses the teaching resource management method driven by cloud computing technology. The proposed Virtual Resource Scheduling (VRS) Algorithm is also discussed in this section. Experimental results and outcomes are discussed in Sect. 4. Finally, we conclude the paper in Sect. 5.

Related work

Integrating edge computing and cloud computing in education is a new field of study to enhance instructional resource administration and utilization. A critical implementation of this method is in physical education, where intelligent edge cloud computing can guarantee the integrity and security of instructional materials. Several studies have looked into the possibility of using this method to improve the performance of instructional tools, reduce latency, and provide more personalized learning experiences. The need to reform physical education instruction using a digital multimedia platform is urgent, given the ongoing popularization and use of computer network technology in many sectors.

From 2004 to 2019, Nabaskues-Lasheras et al. [4] examined the empirical data of the sociocultural process of competency in physical education and PE teacher education (PETE). After reading the study's substance, the authors discovered that all the research had been done in sports but not PETE. He developed four key themes: the field's structural components, exceptional athletes among pupils, the instructional implications of errors, and the field's practical value. College and university physical education instruction is a challenging effort of multifactor system optimization. The quality of physical education instruction in colleges and universities can be

improved by scientific, accurate, and objective evaluation of that instruction.

In addition to the above scholars and researchers, Zhao et al. [5] analyzed the issues that arise while evaluating physical education instruction in colleges and universities. The authors conducted research and developed the teaching of physical education in colleges and universities using three factors to create an assessment index system based on the notion of multiple intelligences: teaching link, teaching and learning link, and management link. The case study provided evidence of this system's usefulness [6]. The early work of Bao et al. [7] suggested an online and offline hybrid teaching quality evaluation approach based on mobile edge computing to improve physical education's online and offline hybrid teaching. Moreover, the authors individually determined the weights of the mixed teaching quality evaluation indicators, combined with the mobile edge computing, and utilized a fuzzy comprehensive evaluation model to successfully implement the online and offline mixed sports teaching quality evaluation. The simulation results demonstrated that this method could successfully lower the cost and inaccuracy associated with evaluating the quality of online and offline hybrid education while also increasing the effectiveness of the evaluation [8]. There has not been much research on physical education teaching resources, even though scholars have examined physical education teaching on the network, objects, elements, and assessment techniques.

Other academics have also talked about instructional resources in this context. For example, Wang et al. [9] attempted to integrate virtual reality technology into modular instruction in terms of teaching resources. The authors created virtual simulation resources using two lesson plans. In addition, visual, interactive, expandable, updateable, and optimized resources have been created. The two modules are merged into a virtual simulation system based on these resources, and this system is successfully used in real-world projects. This study's findings have opened up new possibilities for modular instruction and served as a useful guide for next course instruction. The cloud computing system delivers the necessary services in accordance with the limitations of the service level agreement and service quality, which is a significant issue for both users and cloud service providers. Zheng et al. [10] conducted a thorough analysis of instructional resources using the most sophisticated modeling and simulation framework for cloud computing. The proposed study offered guidance on how to choose the most suitable framework for instructors of cloud computing systems.

Other academics have also talked about instructional resources in this context. In these, Wang et al. [11] attempted to integrate virtual reality technology into modular instruction in terms of teaching resources. The authors created virtual simulation resources using two lesson plans. In addition, visual, interactive, expandable, updateable, and optimized resources have been created. The two modules are merged into a virtual simulation system based on these resources, and this system is successfully used in real-world projects. This study's findings have opened up new possibilities for modular instruction and provided a valuable guide for the next course instruction. The cloud computing system delivers the necessary services under the limitations of the service level agreement and service quality, which is a significant issue for users and providers. Therefore, Zheng et al. [12] thoroughly analyzed instructional resources using the most sophisticated modelling and simulation framework for cloud computing. The study offered guidance on choosing the most suitable framework for instructors of cloud computing systems.

Therefore, it is vital to provide instructional materials to raise student engagement in learning and teaching effectiveness to achieve education information technology. A customized matching system for managing instructional resources was created by Shi et al. [13] using the collaborative filtering (CF) algorithm. The results of the experiments demonstrated that the suggested CF algorithm could successfully increase the quality of recommendations and deliver individualized learning resources to each user. The study's findings offered a novel concept for individualized teaching resource recommendations and revealed a fresh approach to the digitization of education [14]. The administration and integration of teaching resources have not been merged by scholars studying educational resources, although they have used a variety of methodologies. In this regard, the study analyzed the management and integration of cloud computing in the administration and integration of college physical education teaching materials.

According to the preceding literature, the current digital teaching resource service system in universities and colleges can no longer meet the requirements of college teaching and scientific research. To effectively integrate the digital educational assets of universities in the region and realize the best-balanced allocation of digital educational assets, a developing, thorough, and diverse regional digital educational resource development and mutual service system is required [15]. Intelligent edge-cloud-enabled management could offer an excellent option for the consolidation and integration of teaching resource management in universities, serve as an illustration for enhancing the change management manner of university education resources, decrease the cost of both hardware and software in the creation of school

educational resources, allow teachers and students to conduct mobile learning wherever they are, and improve the information. It is critical to enhancing the instructional level of higher learning significantly. Therefore, in this paper, cloud computing was introduced to manage college physical education teaching resources through the duplication and low utilization of current teaching resources. The findings indicated that cloud computing had enhanced the management and sharing of resources for college sports and the utilization rate of educational resources, which further demonstrated the management benefits of integrating educational resources based on cloud computing.

Teaching resource management under cloud computing

The role of cloud computing in teaching

Cloud computing has a significant effect on education, offering numerous advantages to both pupils and teachers. Cloud-based tools enable collaborative learning and remote access to educational materials, fostering collaboration and removing the need for physical presence. Cloud computing also provides cost-effective options by removing the need for costly tools and software. Furthermore, it offers safe and dependable storage and administration of educational data, facilitating information access and sharing. In simple words, cloud computing has changed the face of education, making it more available, flexible, and effective. Due to these, users can obtain the resources they need from the Internet [16]. Network users can be made aware of the location of the resources or the hardware required to use cloud computing. It is a computing architecture that naturally developed from grid computing, distributed processing, and parallel processing. Big data and cloud computing shape an advancement in computer technology [17, 18]. Public cloud, private cloud, and hybrid cloud are the three categories of cloud computing. It is separated based on how cloud providers and consumers are related. Figure 1 depicts the precise service mode.

Public cloud

The public cloud is a cloud environment shared by one or more businesses and individuals that provides cloud computing services to the general public through the Internet. On the Internet, the public cloud is a widely accepted and applied computing system, such as searching data on the Internet, sharing pictures and articles on microblogs, and chatting with friends online. It is characterized by transferring data from personal computers to open cloud computing systems and opening them to all online users for free. It is highly scalable, cost-effective, and multitenant, enabling numerous people to share processing resources. The public cloud is also highly adaptable, allowing access to resources from any location at any moment, making it perfect for remote workers. Cloud providers have data protection mechanisms in place, but users are accountable for their data's security in the cloud. Therefore, the public cloud is a simple option that offers computing resources on demand without needing large infrastructure expenditures. In addition, the supplier of network data is responsible for the management, maintenance and updating so that users can quickly obtain and share data through computers, mobile phones, laptops, handheld computers and other Internet devices [19, 20].

Private cloud

A private cloud is a cloud computing service exclusively available to a single entity, usually for internal use. Instead of a public cloud, a private cloud is not accessible to the general public. It is frequently housed within an organization's own data center. Because the organization

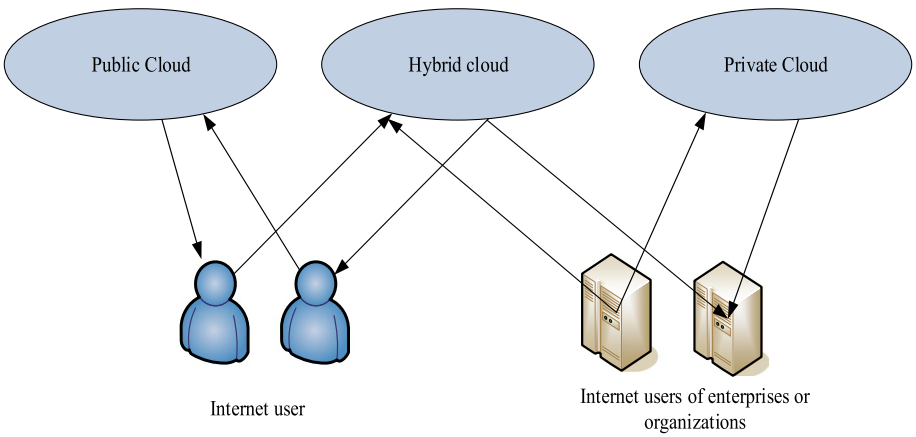

Fig. 1 Cloud computing service mode

has complete control over the computing resources and can customize the service to suit their particular requirements, the private cloud offers higher control and security. Private cloud services are perfect for organizations that require a high degree of security or have regulatory requirements that public cloud services cannot meet. However, the private cloud can be more costly because the organization is liable for the expenses involved with managing and maintaining the infrastructure.

Hybrid cloud

A hybrid cloud is a computing system in which public and private cloud services are used. It enables organizations to benefit from the scalability and cost-effectiveness of public cloud services while still controlling sensitive data by using a private cloud for specific apps. A hybrid cloud also allows organizations to quickly move workloads between public and private clouds, allowing them to benefit from each cloud platform's best features. This strategy allows organizations to use public cloud services for non-critical applications while keeping essential data and applications on-premises in a private cloud. However, managing a hybrid cloud system is complicated and necessitates meticulous preparation to guarantee data security and accessibility. At present, most operators have adopted the hybrid cloud approach to deploy cloud computing.

At the network terminal, the service mode adopted by users and the use of services to obtain resources are called cloud computing services. Cloud computing service architecture includes platform services (PaaS), infrastructure services (IaaS), and software services (SaaS). Its basic hierarchy is shown in Fig. 2.

In addition to the above, cloud computing is a service linked to information technology, applications, and the Internet that offers on-demand, flexibly scalable, and low-cost processing services over a network. Nevertheless, it continues to face issues such as poor security, high costs, trouble in governance, legal risks, a dearth of resources and knowledge, unstable technology, and stringent network performance standards. It collects all data at the network's periphery and analyses it on a central server. Since most devices, such as cell phones, are near the periphery and need more storage space and processing power, they cannot handle or analyses the gathered data. Even though most devices can connect to WiFi or other high-speed networks, their hardware skills must be enhanced. As a result, standard gadgets must be enhanced for processing information or evaluation. The design of the cloud infrastructure is depicted in Fig. 3.

In the integration strategy for teaching resources, cloud edge computing is a system architecture that efficiently provides instructional material and helps students and instructors. This design comprises several components, including the cloud, the periphery, and end-user devices. The architecture's central hub is the cloud, storing and managing instructional materials and resources. The cloud offers a scalable and adaptable system to meet the growing demand for instructional materials. The edge is the component that sits between the server and end-user devices. The border is in charge of handling and analyzing data produced by end-user devices and providing a smooth and dependable link between end-user devices and the cloud [21]. Students and instructors use end-user devices to obtain educational material and tools. These gadgets include laptops, tablets, cell phones, and other linked devices. The integration method is the seamless merging of these components to provide a cohesive and effective educational experience. The educational material and resources are kept in the cloud in this method, and end-user devices reach them via the edge, which provides the required

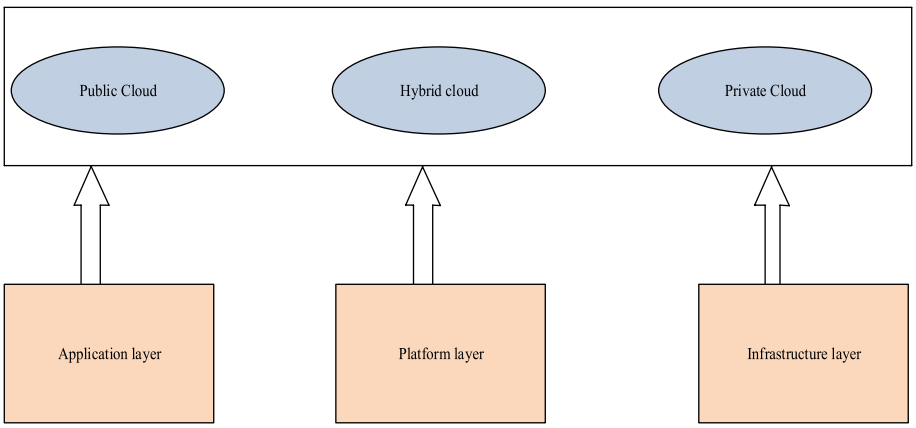

Fig. 2 Basic hierarchy of cloud services

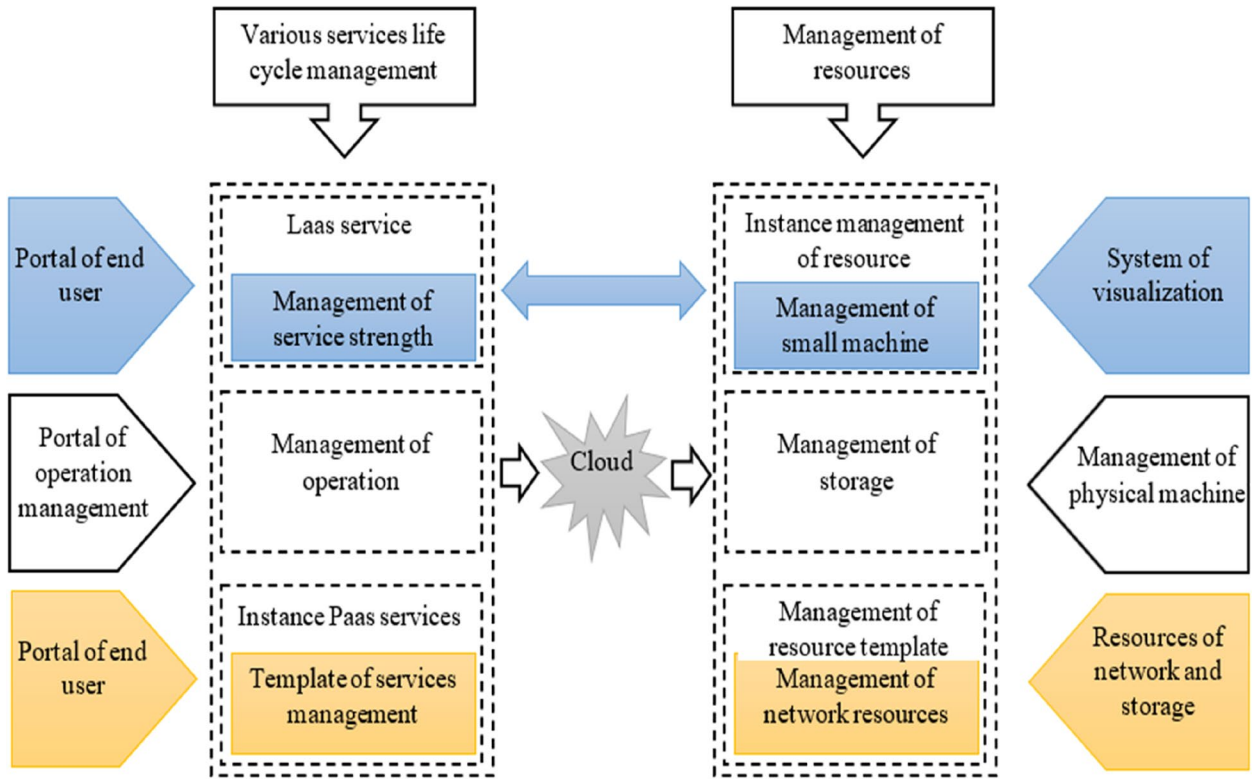

Fig. 3 Design of the cloud infrastructure

processing and analysis capabilities. Figure 4 explains the overall architecture of cloud edge for the integration of teaching resources.

According to the above Figure, the architecture of cloud edge-based teaching resources has several advantages for instructional materials. First of all, it allows for the effective and efficient distribution of instructional material and tools, making them more straightforward for students and instructors to access and use. Second, it offers a scalable and adaptable infrastructure to meet the growing demand for instructional materials. Finally, it ensures that instructional materials are always available and up to date by providing a seamless and reliable connection between the end-user devices and the cloud.

In addition, the critical technologies used in cloud computing include data management, virtualization, and software development. Virtualization is a way to realize computing, software, storage, and system resources. With virtualization technology, users can access resources in the cloud, which is no different from previous resources. This abstraction of resources would not be affected by geographical location or infrastructure resources. An essential purpose of virtualization is to simplify IT resources' management, access, and expression, including infrastructure, systems, and software, and provide a standard interface for their resources to accept input and output. Virtualization technology can refine multiple resources, integrate resources, and separate software and hardware. Furthermore, virtualization technology has transformed the way educational institutions handle teaching tools by allowing the construction of virtual computers capable of simulating various computer settings, operating systems, and apps. Using virtualization, instructors can give students hands-on experience in a secure and regulated environment, eliminating the need for costly hardware and software expenditures. Virtualization also enables simple replication of virtual computers, allowing for sharing of instructional tools across multiple locations and nations. Furthermore, virtualization will help students to study at their speed and convenience because virtual machines can be accessed from any device with an internet link. Therefore, virtualization technology has proven to be an effective instrument for increasing the quality of instructional materials and students' learning results.

Note that flexible deployment refers to reasonable deployment of virtual machines in physical locations and copying their images to corresponding physical nodes. The entity nodes in virtual machines used for instructional materials perform several essential tasks. For

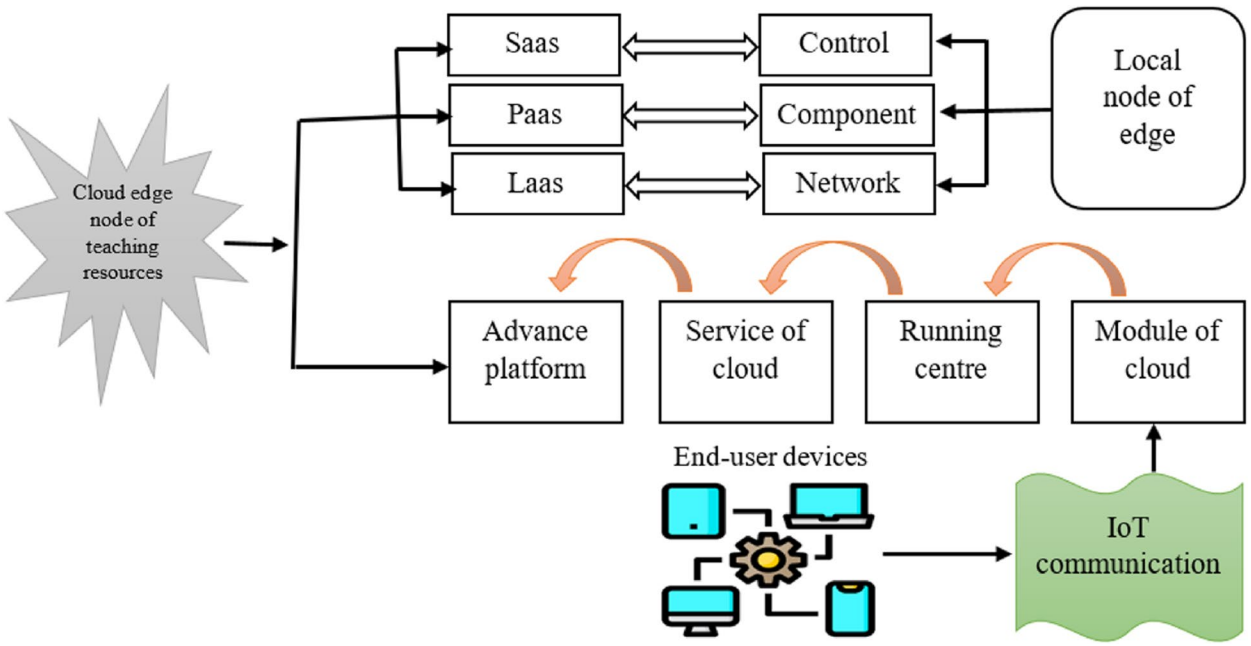

Fig. 4 The overall architecture of cloud edge for the integration of teaching resources

starters, they serve as the primary interface between the virtual computer and the physical host system, coordinating contact. Entity nodes also manage the virtual machine's resources, such as assigning memory, computing power, and storage. They ensure that each virtual machine has enough resources to run efficiently and without interruption from other virtual machines or the host system. Furthermore, entity nodes can handle the network connections of the virtual machine, enabling students to access the virtual machine directly from their own devices. Students can study at their speed and ease rather than being restricted to using real instruments in a specific place. Dynamic location virtualization can dynamically locate the management of the cloud center on the entity node, and has a flexible migration mode. It is unnecessary to perform any operation on the virtual machine. When load balancing occurs, the virtual environment would also be migrated. Because all resources in the virtual environment are transparent, run on different physical platforms, and all resources are logical, virtualization technology is a perfect tool for automatically allocating resources.

The data in the cloud environment would be managed in a distributed way, while providing users with parallel data services, which requires high throughput and high transmission rate. Distributed data management can reduce the transmission cost, improve the reliability of the system, and also facilitate data expansion. How to improve the random read rate and update rate of the system is an important problem faced by the current data management technology. Because cloud computing can store a large amount of data and conduct a large amount of analysis after reading, it requires sufficient data management capabilities to effectively process a large amount of data. The distributed programming technology of cloud computing provides users with a program design mode that meets their needs, and also provides users with fast services. Because programmers and users need to ensure the transparency of the program when calling complex tasks, it is also necessary to model the program.

Cloud computing resource management mainly covers user management, task management, resource management and security management. Integrating resources on the entity layer into a "resource pool" is a distinguishing feature from the single device virtualization technology, and middleware is used for resource pool scheduling [22]. Under certain circumstances, according to the law of resource utilization, there are different requirements for resource allocation. Resources are allocated by multiple users, and each computing task has one or more processes. At present, there are two methods for task scheduling: one is to schedule its resource consumption, and the other is to assign computing tasks to another computer. The first method is suitable for environments with relatively small amount of data. The second method uses large amount of data and ensures balanced resource data collation. The outcome of the resource management and scheduling process is shown in Fig. 5.

Advantages of cloud computing in teaching resource management

With the use of cloud computing technologies, it is possible to disrupt traditional teaching techniques while also advancing student learning. Additionally, it can address certain more conventional issues including resource information exchange, technical financing gaps, and technological shortcomings. The advantages of cloud computing in teaching resource management are mainly to ensure the safety of stored data, save software and hardware resources, improve teaching quality and realize teaching resource sharing.

It would guarantee the safety of data storage. The cloud server is an extremely fast computing device that can store a lot of data in the network era. It integrates cloud computing to create a larger computer network, which significantly accelerates computation. Additionally, customers can employ cloud computing technologies to handle a variety of challenging issues. For example, people can work in any place, automatically process and classify data, and enhance people's data access. In the cloud environment, the system stores data with high transmission rate, high probability and good distribution, and can store redundant data in the cloud server [23].

It effectively saves software and hardware resources. Teaching resources mainly include teaching materials, courseware, pictures, teaching materials and infrastructure. The way that digital instructional resources are stored in universities has undergone significant change as a result of the widespread adoption of cloud computing technology. For the departments and universities that need them, the storage of ECS can offer a sizable amount of instructional resources. It saves a lot of maintenance, upgrading and hardware equipment costs, thus effectively avoiding the situation of repeated construction of resource systems.

It is possible to raise education quality on all fronts. Cloud computing in the classroom can assist both students and teachers in finishing their respective jobs. Specifically, it allows students to obtain a lot of learning resources through intelligent terminals, saving a lot of reading time. Teachers can build a teaching system according to their actual needs, so as to innovate the teaching mode, promote the communication between teachers and students, and improve students' autonomous learning ability and teaching quality [24].

It ensures the sharing of instructional materials. Cloud computing technology enables the integration of various educational resources into a sizable resource library on the Internet, enabling relevant school departments to monitor and administer educational resources uniformly and ensuring full resource sharing. By leveraging cloud computing technology to optimize and integrate the educational resources of colleges and universities, building a cloud resource sharing system, the issue of uneven distribution of teaching resources in colleges and universities can now be promptly remedied. Figure 6 illustrates the benefits of cloud computing for managing teaching resources.

Current situation of university resource integration

How to use and manage teaching resources correctly is the key to improve teaching quality. At present, although some achievements have been made in the management of educational resources in Chinese universities, many problems still exist.

There is an asymmetry between the autonomy of educational resources and the highly closed educational resource system [25, 26]. Because the management system platform of the educational resource database is highly closed, it cannot change its educational management mode at will, making many expensive educational resources cannot directly serve the primary schools. However, colleges and universities do not have a standardized system and educational resource R&D and management, so they need to establish an educational resource system by themselves. Because the school resource management system is limited to individual

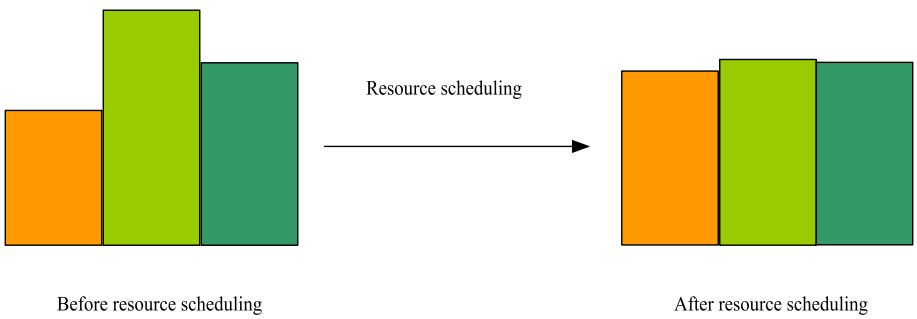

Fig. 5 Resource management and scheduling

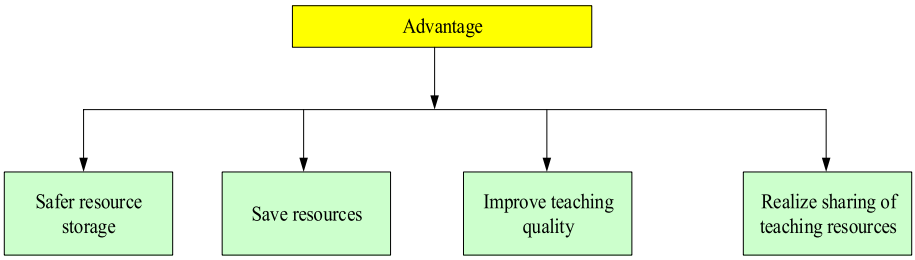

Fig. 6 Advantages of cloud computing in teaching resource management

teachers and cannot be fully opened to the public, there is a huge resource problem in the management of the school resource database, which leads to a large number of educational resources that cannot be fully utilized in the overall education of colleges and universities. This asymmetry of resources would lead to the unreasonable use of school resources and seriously affect the development of schools.

It is not standardized and quite blind. There is a blindness in resource construction, which is because resource construction often depends on the cooperation of many departments, which leads to the lack of unity in resource planning, nonstandard classification, unclear species, complex contents and forms. Some courses and teaching resources are invested repeatedly, and some professional resources are aging, but cannot be updated in time [27]. This would not only affect students' independent learning and management, but also affect the management and utilization of teaching resources in the campus network, thus affecting communication with the outside world [28]. Based on their own needs and the lack of recognized industry standards, universities do not attach importance to the development of resource databases.

The resources are not fully utilized. Due to the lack of effective resource sharing, the utilization rate of resources is low [29, 30]. Resources were eliminated before they could be fully utilized. This is because most resource databases need management systems, network environments and information processing capabilities of managers. In addition, there is no unified standard for resource construction, which results in inefficient use of resources. The current problems of universities in resource integration management are shown in Fig. 7.

Through the analysis of these problems, people think that to solve these problems, they need to solve the problems of resource heterogeneity, resource construction standardization, resource platform and so on. Through the construction of application data center, the sharing of teaching resources in colleges and universities is realized, and the "cloud" of colleges and universities is built.

Cloud computing based university resource integration

Based on cloud computing, universities must build an independent application and data center to share teaching resources [31, 32]. Here, the Education Resource Center regards it as a separate organization, such as a cloud computing service provider. This study offers a data center implementation plan based on resource sharing in light of the current state of instructional resource management. First, from the current cloud computing services, cloud services can be outsourced to 19Sales.force, Google, Amazon, etc. Second, a relatively independent

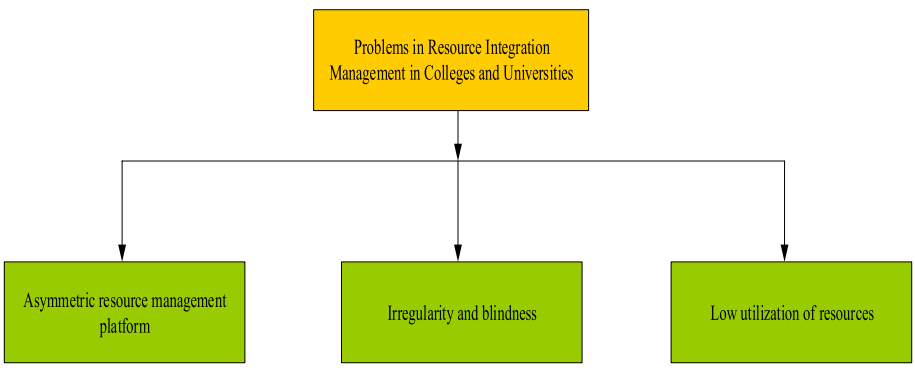

Fig. 7 Problems in resource integration management in colleges and universities

educational resource sharing service platform can be established. Both methods have their own advantages and disadvantages. The first is to simplify the procedure and cost of establishing the university resource information sharing system, shorten the construction period, and make it convenient and flexible to use. The second mode is more targeted and professional, which helps to maintain the independence and integrity of the university education resource system. Especially when cloud computing is not mature, it can ensure the integrity and security of teaching resources. How to select an application and data center for sharing, in fact, depends on the current situation in the building and classrooms of colleges and universities. The major goal of this study is to construct an application data center in order to facilitate the information exchange of teaching resources.

The traditional teaching resource management platform is closed, which makes it impossible for external software to call resources on the platform, and resources can only be obtained by accessing the platform [33]. The resource management platform established by this method would generate "resource islands", which would generate redundancy in computing power, network resources, memory, etc., and waste resources seriously. Because cloud services have strong interface capabilities, programmers can publish services to the network through the interface, thus providing services directly called by other applications, and also providing an efficient method for sharing teaching resources. Cloud computing builds a common language independent technology on multiple platforms, mainly by using image execution and service provision mechanisms. Applications on various platforms depend on its integration and connection. The traditional concept is that the services provided by network applications are technical problems, while cloud computing is to enable computer applications to take advantage of the services provided by network applications.

For users, cloud computing can provide users with a variety of different and powerful services, without purchasing, downloading or installing other clients, and without worrying about software updates and virus intrusion. People can put data such as files on the cloud for sharing and cooperation. For example, users can edit the same article together and use a strict authorization management mechanism to ensure the security of cooperation. This method includes the following steps: packaging or reconstructing existing teaching resources into service-oriented, providing new computing and data centers for basic applications, such as education, virtual laboratories, application servers, etc. On the basis of cloud computing, cloud access points and other infrastructures, resources are allocated through virtual technology. At the same time, a cloud access point was created to facilitate universities to quickly log on to the cloud. The ECS structure is shown in Fig. 8.

The proposed virtual resource scheduling algorithm

The foundational technology of a cloud system is virtualization [34, 35]. The ultimate objective of virtualization technology in the cloud computing environment is to enhance the performance of cloud services by enhancing the current cloud resource allocation methodology. However, due to the differences between cloud computing platforms and underlying infrastructure of various manufacturers, virtual resource scheduling algorithms in the cloud are also very different. Therefore, there are many scheduling algorithms based on different virtual resource configuration modes. In the teaching resource scheduling, there are many objects to be allocated, so the mathematical model of multi-objective optimization is adopted.

$$y = f(x) = [f_1(x), f_2(x)], ...f_m(x)] \tag{1}$$

$$S(x) = [S_1(x), S_2(x), ...S_n(x)] \leq 0 \tag{2}$$

$$G(x) = [G_1(x), G_2(x), ...G_i(x)] = 0 \tag{3}$$

In the formulas, x is the decision variable, y is the various teaching resources, n is the total number of objective functions, and $f_m(x)$ represents m objective functions. $S_n(x)$ represents n constraints under the management of teaching resources, and $G_i(x)$ represents the feasible conditions of i equations under the management of teaching resources.

This paper considers four kinds of resources: teaching facilities, equipment, courses, venues, and film and television materials. When solving this problem, it must be combined with multi-objective optimization because of its strong solving ability and complex virtual machine scheduling objects [36, 37]. When arranging and integrating teaching resources, the following conditions must be met:

$$\sum_{i=1}^{n} P_{ij} \leq 1 \tag{4}$$

$$\sum_{j=1}^{m} B_j \times P_{ij} \leq B_i \tag{5}$$

$$\sum_{j=1}^{m} K_j \times P_{ij} \leq K_i \tag{6}$$

In the above equations, P_{ij} is the mapping relationship between virtual machine and physical machine, B_j is the

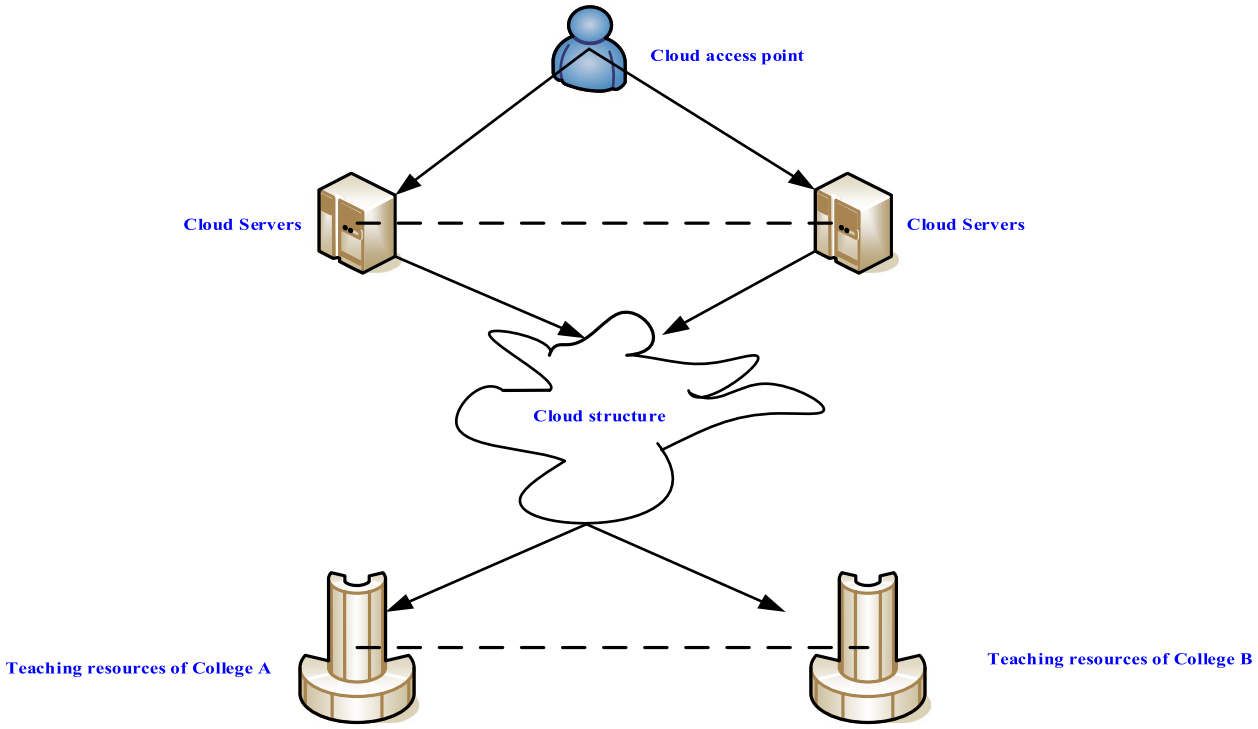

Fig. 8 The ECS structure

teaching equipment under virtual machine, and B_i is the teaching equipment under physical machine.

Various resources in teaching can be obtained through the virtualized resource pool, and these resources can be integrated through cloud computing to reasonably allocate different resources. It can also obtain the information of users according to the information feedback of resources to divide resources. Media resources, subject resources, teaching courseware, software resources, etc. are some categories into which the teaching resources can be separated. It can be stated as follows:

$$T = \{M, X, J, R\} \tag{7}$$

In the above equation, M represents media resources in teaching; X is the discipline resource; J is teaching courseware; R is a software resource. It can also be subdivided into many plates under several resources. The goal of virtualization management is to uniformly manage deployment resources and provide services on demand. Unified management is to centralize resources by shielding geographical distribution characteristics and physical heterogeneity, and conduct unified management or use. Because there is a unified interface between resource systems, it can provide good compatibility for each resource system, help system integration, and thus reduce the complexity of managing resources.

The key component of managing university teaching resources in a cloud computing environment is the management intermediary layer, which sits between the resource layer and the application service layer. It provides collaborative and interactive services for the basic resource layer and application services, dynamically manages and controls the management, access and scheduling of resources, and schedules a large number of application tasks to achieve effective utilization of resources. The system includes a large number of application containers, databases, message processing and other "middleware in the cloud" resources. In this service mode, users do not need to purchase any hardware or software, but only use the platform and services to create, test and deploy. It includes two main functional modules: business logic control and service interface. It provides students with access to resources, manages teaching resources safely and efficiently, and completes task scheduling accurately and timely. The effective management and integration of teaching resources can be realized by monitoring the resources of each department.

Experimental tests and results

This paper mainly compares the teaching resource management in the cloud computing environment (hereinafter referred to as cloud management) with the traditional teaching resource management (hereinafter referred to as

traditional management), mainly on the sharing degree and utilization rate of teaching resources. This paper uses virtualization technology to obtain the data of teaching resources under cloud computing. The equipment required in this paper is: a test machine (2-core processor above 2 GHz, 4 GBDRAM, SATA hard disk 250 GB) as the test machine, with loadrunner11 11 installed. One is the host of the cloud cluster, and the other three virtual machines (processors above 2 GHz, 2 GB DRAM, and 250 GB SATA hard disks) have RPM software installed [38, 39]. It is equipped with more than 100 Mbps SAN switches and routers. The system includes Linux, Eucalyptus, EC2, VMware and MySQL. On the cloud computing platform, a management system for university teaching resources based on cloud computing can be created. Students can access the campus website using this information to inquire about the management of traditional instructional resources. This paper simulates college physical education teaching resources, and uses cloud computing technology to build a college teaching resource management system, in which teaching resources can be shared.

The amount of times students log into the testing system can be used to calculate the degree of student sharing by examining the physical education teaching resources at a university. The number of nodes in the system can be used to intuitively determine the utilization rate of teaching resources. The exam is administered three times, with the average value being used to confirm the test's correctness. Figure 9 compares how they distributed educational resources.

According to the sharing degree of 9A traditional management resources, the average sharing degree of traditional resource management in teaching equipment is 53.5%, but the average sharing degree of cloud resource management in teaching equipment in 9B is 74.1%. Compared with traditional resource management, cloud resource management has increased the sharing of teaching equipment by 20.6%. The average sharing degree of traditional resource management in courses is 64.5%, and the average sharing degree of cloud resource management in courses is 81%, which is 16.5% higher than that of traditional resource management.

The research primarily discusses the usage rate of cinema and television materials as well as sports-related teaching resources when discussing the utilization rate of educational resources. The usage rate of resources from sports teaching websites and film and television content helps to explain the difference between the two resource management approaches. The comparison of the two resource management methods is shown in Fig. 10.

It can be seen from the traditional resource management in Fig. 10A that the average utilization rate of sports venues is 45.5%, and the average utilization rate of sports film and television materials is 38.3%. However, in the 10B cloud resource management, the average utilization rate of sports venues is 72.6%, and the average utilization rate of sports film and television materials is 69%. As can be shown, compared to traditional resource management, the utilization rate of cloud resource management has grown by 27.1% in sports arenas and by 30.7% for sports-related film and television content. It also demonstrates how the implementation of cloud computing in higher education can more effectively optimize and integrate the administration of educational resources, allowing for the prompt resolution of issues with poor sharing and low usage of educational resources in higher education.

Conclusions and future work

In this paper, cloud computing is used to integrate and manage the resources of colleges and universities. Cloud computing and its benefits for managing instructional resources are also described. By describing the current

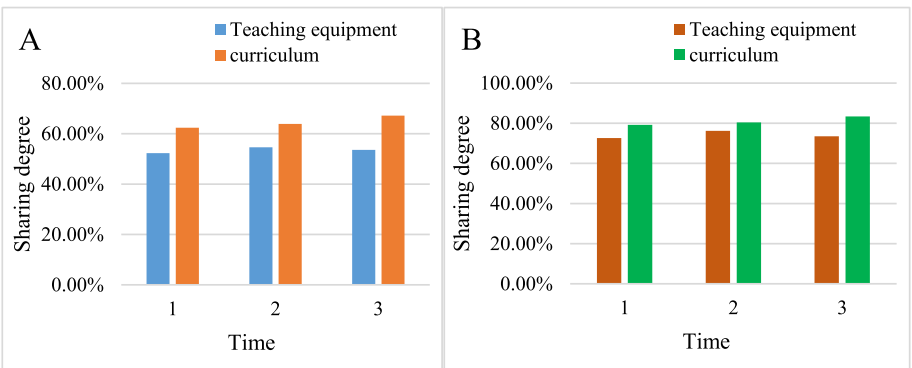

Fig. 9 Comparison of sharing degree of teaching resources. **A** Sharing degree of traditional resource management **B** Sharing degree of cloud resource management

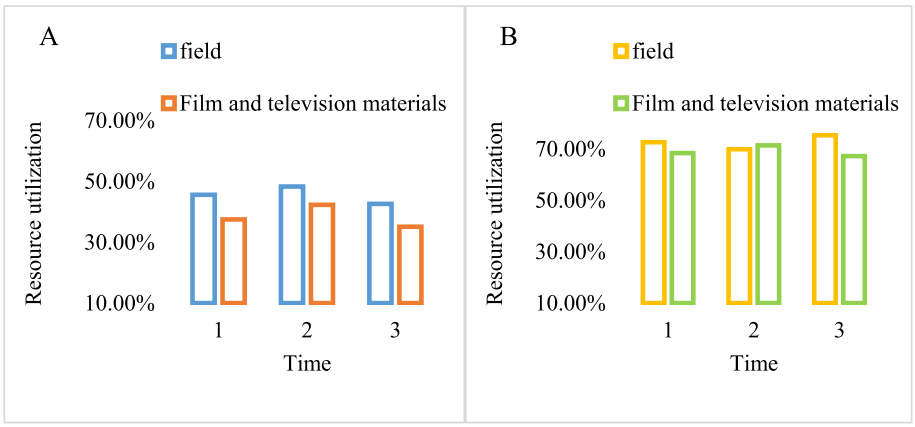

Fig. 10 Comparison of utilization rate of teaching resources. **A** Utilization ratio of traditional resource management **B** Utilization ratio of cloud resource management

university resource management, this paper introduces the virtual resource scheduling algorithm and explains the current university resource management method of cloud computing. Besides this, a scheduling technique ensures equal load distribution and increased utilization levels of computing resources. Later, through the comparison of experiments, it is found that the utilization rate of university teaching resource management under cloud computing is higher, and the degree of resource sharing is also improved. This paper compares the traditional university physical education teaching resource management mode with the university cloud computing resource management in many aspects. The results show that university cloud computing resource management can improve the sharing degree of teaching resources and the utilization rate of teaching resources.

The inadequacies in this paper are that there needs to be a detailed description of the regional teaching resource integration and a precise method for its integration rules. There is no standard implementation method in cloud computing. Future research would focus on finding efficient ways to utilize educational resources and upload them to the cloud. Although there would be significant implementation challenges, cloud and edge computing would be more beneficial for managing university resources and educational networks. Finally, we will improve the proposed scheduling algorithm to make intelligent decisions using machine learning.

Authors' contributions
Chang Wang: Writing the original paper. Di Wang: data collecting. The author(s) read and approved the final manuscript.

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Declarations

Availability of data and materials
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Publisher's Note

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