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Research on the Collaborative Training Path of Interdisciplinary Industrial Talents Based on Parallel Computing Technology in the Engineering Modern Industrial Colleges

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Abstract With the transformation of the real estate industry to digitalization and service, the demand for interdisciplinary composite talents is increasingly urgent. This study focuses on the interdisciplinary housing industry talent cultivation path based on parallel computing technology in the construction of modern industrial colleges in engineering disciplines, and proposes a teaching resource platform architecture based on mobile cloud computing, which integrates Hadoop distributed storage (HDFS), MapReduce parallel computing framework, and secure encryption algorithms (PRE, ABE) to realize the dynamic management of teaching resources and efficient scheduling. At the same time, a student ability assessment model is constructed by combining multi-source data feature extraction and conceptual map analysis, quantifying the importance of knowledge points by using PageRank and HITS algorithms, and dynamically tracking the learning effectiveness through behavioral sequences (LSA residuals, DFT/CWT transformations) and forum sentiment analysis. Comparative analysis through simulation experiments verifies the platform's significant advantages in resource integration speed, efficiency and sharing performance. With 4000Mbits of resources, the integration speed stabilizes at more than 22Mbits/s, and the traditional platforms NativeXML and WebServices drop to 15.83Mbits/s and 11.95Mbits/s, respectively, and the resource The integration efficiency reaches more than 99%, while the traditional platform is only 97.86% at the highest), and the data loss under the high concurrency scenario (2500 users) is only 5.01KB, while the traditional platform reaches 244.81KB at the highest. The user satisfaction survey reveals that more than 80% of students adopting the Cloud Computing platform are considered to be very satisfied with the practicality of the course content, the ease of use of the resources, and the technical support, which are significantly superior to the traditional platform.

Index Terms parallel computing, mobile cloud computing, interdisciplinary talent cultivation, housing industry, teaching resources platform

I. Introduction

Modern industrial college is a concept put forward by China in 2018 in the Opinions on Accelerating the Construction and Development of New Engineering Sciences and Implementing the Excellence Engineer Education and Training Program 2.0, and it is an educational concept stripped of traditional higher education, aiming to serve the modern industrial system, and constantly adapting to the changes in the market demand in an innovation-based way. Modern industrial colleges are new organizational forms that cultivate future industry-specific talents, aim at serving the modern industrial system, and constantly adapt to changes in market demand in a basic way of innovation, and are oriented to the industry with distinctive characteristics and close ties with the industry by taking the urgent needs of regional industrial development as a traction [1]-[4]. However, its current training mode, ignoring the knowledge correlation and contact integration between different disciplines, the updating speed between teaching materials and related industrial technology does not match, and the hours consumed in practical teaching of stand-alone simulation teaching are long [5]-[7]. In addition, the cultivation mode of composite construction talents is single, unable to cope with the demand of all aspects of design, construction, operation and maintenance [8].

With the development of social economy and urbanization, housing industry has become a field full of opportunities and challenges. As one of the basic industries, the housing industry has an increasing demand for talents, and talent training and career development have become the core issues for the development of the industry [9]-[11]. The housing industry is a complex and huge system, involving various links such as design, construction and operation. These links cannot be separated from the support of professional architects, engineers, designers and other professionals. Therefore, to realize the development of the whole industry chain, it is urgent to cultivate interdisciplinary housing industry talents [12]-[14].

This paper focuses on the application of parallel computing technology in the collaborative training of interdisciplinary housing industry talents, and systematically discusses the characteristics of industry talent demand, teaching resource platform architecture and multi-source data feature extraction method, aiming to provide theoretical support and practical path for the construction of talent training system adapted to the transformation and upgrading of the industry. First of all, we analyze the real estate industry from the three dimensions of industry chain characteristics, transformation and upgrading trend and talent knowledge structure demand. The high contribution of the industry to the GDP and the strong correlation with upstream and downstream industries determine that the training of talents needs to cover the whole chain of positions such as valuation, brokerage and asset management. The urgent demand for digital services and asset operation in the era of inventory housing further highlights the importance of interdisciplinary knowledge and practical ability. On this basis, we propose a teaching resource platform architecture based on mobile cloud computing, which realizes the dynamic integration and efficient management of teaching resources by means of distributed storage (Hadoop HDFS), parallel computing framework (MapReduce) and secure encryption technology (PRE, ABE algorithm). The platform not only supports real-time processing and fault-tolerant recovery of massive data, but also optimizes the efficiency of resource scheduling through data localization computation, providing technical guarantee for the implementation of interdisciplinary curriculum system. Further, a student ability assessment model is constructed by combining conceptual graph analysis and multi-source data feature extraction methods. The PageRank and HITS algorithms are used to quantify the importance of knowledge points, and multi-dimensional data features, such as behavioral sequences (LSA residuals, DFT/CWT transformations) and forum sentiment analysis, are used to dynamically track students' knowledge mastery and comprehensive ability. Through normalization and integration of statistical indicators, a standardized evaluation system is finally formed to provide data-driven support for teaching feedback and cultivation program optimization.

II. Parallel computing-based real estate industry talent demand analysis and interdisciplinary teaching platform construction

II. A. Characteristics of talent demand in the real estate industry

II. A. 1) Long industry chain and high industry relevance

From the perspective of the real estate industry's contribution to GDP, real estate development investment accounted for nearly 18% of GDP, a greater direct contribution to the national economy. From the perspective of industry relevance, changes in the real estate industry deeply affect the development of upstream and downstream industries such as construction, building materials, decoration, etc., which indirectly brings greater impetus to the overall economic development. Higher vocational real estate majors focus on cultivating high-quality technical and skilled talents in demand for positions (groups) such as real estate appraisal, real estate brokerage, real estate marketing planning, housing inspection and monitoring, real estate mapping, property space operation and maintenance management, property equipment and facilities management, property asset management, urban community management and smart city management.

II. A. 2) Industry transformation and upgrading, urgent demand for talents

After experiencing the incremental era of rapid development, China's real estate industry has gradually entered the inventory era of big data-driven product optimization and services. Digitalization has become the core driving force for the transformation and upgrading of China's real estate industry. With the reversal of supply and demand, home buyers have not only returned to rationality, but also have higher requirements for housing quality, transaction standards and community operation and management. With the development of mobile Internet, people have been in the dry digital, online environment, at the same time, the state efforts to dry real estate long-term mechanism construction, to prevent financial risks, real estate asset management, consulting services, property services, intermediary services and other market value-added services will grow rapidly, becoming a new impetus for economic development. In the real estate industry “last kilometer” development of the rapid period, around the real estate development and stock of property assets, operation, marketing and transaction process of talent demand is urgent.

II. A. 3) Knowledge and skills together

The dual attributes of real estate product security and commodities, real estate market imperfect competition determines the real estate professional training with comprehensive, complex and diverse characteristics. Professionals not only need to master the basic theoretical knowledge and professional knowledge necessary for technical application ability, but also need to be strong in the comprehensive use of various knowledge and skills to solve practical problems on the spot. Therefore, the training of higher vocational real estate professionals should pay full attention to the important role of practical teaching in the process of cultivating students' technical application ability, and it is more necessary to cooperate with enterprises in depth, and formulate the talent training mode and curriculum system in line with the needs of the industry, enterprises and the society.

II. B.Realization of teaching resource platform architecture based on mobile cloud computing

The urgent demand for composite talents in the real estate industry requires the Modern Industrial College to break through the traditional teaching mode. For this reason, building a teaching resource platform based on mobile cloud computing has become a key technical path to realize interdisciplinary collaborative training.

II. B. 1) Mobile Cloud Computing Platform Layer

The mobile cloud computing platform layer is the foundation and core of the teaching resource platform, which builds a cloud environment through software technology and hardware resources to provide data services, computing services, storage services and security services for the teaching resource layer in the middle layer. These services are realized through virtualization technology Vmware Workstation, distributed storage Hadoop distributed file system, and parallel computing technology MapReduce programming framework. The platform adopts a distributed storage system that can meet the needs of storing different types of teaching data. Fault-tolerant processing, parallel processing of data, load balancing, etc. are all realized by MapReduce programming.

Hadoop distributed file system makes the ownership and control of data on the network separate, to share data between different devices, some important private data will be at risk, so the mobile cloud computing platform should first ensure data security. The solution of the security service is to encrypt the data stored to the cloud server in advance, the commonly used algorithms are Proxy Re-Encryption Algorithm (PRE), Attribute Based Encryption Algorithm (ABE), and then decrypt the data when the user accesses to the data on the cloud server according to the need.

II. B. 2) Parallel computing techniques

On the basis of ensuring data security and storage efficiency, how to efficiently handle massive teaching data becomes the core challenge of platform construction. At this time, the introduction of parallel computing technology provides a solution for scheduling computing tasks and fault-tolerant recovery in a distributed environment.

Parallel computing technology is built on top of the distributed file system to process and compute the data stored in the distributed file system. Most cloud computing systems use MapReduce programming framework, which is mainly used to solve the problem of parallel computation of massive data. The working principle of MapReduce programming framework is: the division of the most data in the sea, distributed to the sub-nodes to complete the computation in parallel, and then integrate the intermediate results to get the final result, with the following functions: first, data division and computation task scheduling, the system will be First, data division and computation task scheduling, the system divides the data into data blocks, each data block corresponds to a computation task, and automatically schedules the computation nodes to process the data blocks. Second, data/code interlocation, the computing nodes try to process the data distributed on their local disks as much as possible, so that there is less data communication. Third, system optimization, intermediate results can be merged and processed before entering Reduce nodes to improve communication efficiency. Fourth, error detection and recovery. Hardware or software problems in the computation process, MapReduce framework can detect and isolate the error node, and timely allocation of computing tasks to other nodes.MapReduce use functional programming ideas, the complex parallel computing process is highly abstracted into Map (mapping) and Reduce (reductio ad absurdum) two functions.

II. C.Feature extraction

The construction of the teaching resource platform lays the foundation for the collection and storage of multi-source data, while how to extract effective features from the data to quantify students' abilities requires the use of conceptual graph analysis and statistical modeling methods.

II. C. 1) Concept map data feature extraction

For students' concept map data, it can be parsed into tree structure and network structure. For the tree structure this study parsed: the number of nodes, the number of layers, and the maximum layer width represent the richness, depth, and breadth of knowledge, respectively. For the network structure features are extracted using PageRank and Hits algorithms respectively.

PageRank algorithm is a web link analysis algorithm created by Google and is a method that is used to identify the importance of a web page.PageRank algorithm is based on two basic assumptions: the quantity assumption and the quality assumption. The quantity assumption means that the more incoming links a web page receives from other web pages, the more important that web page is. The quality assumption means that the more high quality pages are pointed to, the more important the page is. In the Student Concept Map network, for a given concept node, the PageRank value is calculated as follows:

$$PR(p_i)=\frac{1-c}{N}+c\sum_{p_j\in M(p_i)}\frac{PR(p_j)}{L(p_j)} \tag{1}$$

where N is the total number of conceptual graph nodes, $L(p_j)$ is the conceptual node p_j out degree, c is the damping coefficient (generally taken as 0.85), and $M(p_i)$ is the set of all conceptual nodes induced by the conceptual node p_i. The PageRank value of each node can be calculated by continuously iterating the formula (1).

The Hits algorithm is also a web page connection analysis algorithm. The Hits algorithm uses authority and hub values to characterize the importance of a web page. The "Authority" page refers to a high-quality page about a certain field, such as Zhihu in the Q&A field. The "Hub" page refers to a number of "Authority" pages, such as the hao123 homepage. The algorithm has two basic assumptions, which are mutually reinforcing: high-quality "Authority" pages will be pointed to by many high-quality "Hub" pages; The vendor-quality "Hub" page will point to a number of high-quality "Authority" pages. In the Student Concept Map Network, the Authority value and calculation formula are as follows:

$$auth(p)=\sum_{q\in p_{to}}hub(q) \tag{2}$$

$$hub(p)=\sum_{q\in p_{from}}auth(p) \tag{3}$$

In Equation (2), p_{to} refers to the set of all conceptual nodes induced by the conceptual graph node p, and $hub(q)$ refers to the Hub value of the q node. In Equation (3), p_{from} refers to the set of all nodes of the conceptual graph node p, and $auth(q)$ refers to the Authority value of the q node.The node quality represented by the PR value, the Authority value, and the Hub value, the node quality in conceptual graphs can be expressed as the degree of importance of the conceptual's knowledge points, and the present study calculates separately the the variance of the three indicators to represent the distribution ability of students' knowledge.

For the data of the whole semester, the knowledge of each chapter is more different, for example, “Introduction to C” is less than “Pointers” by nearly 2/3 of the concepts. Therefore, in this paper, we normalize the characteristics of each chapter's concept map with the following formula:

$$X_{nom}=\frac{X-X_{\min}}{X_{\max}-X_{\min}} \tag{4}$$

II. C. 2) Multi-source data characterization

In this subsection, preliminary feature extraction is performed on online learning behavior data, forum speech data, and concept map data, which are symbolically represented and meaningfully explained below.

(1) beha_lsaF(n): the set of residual values extracted from the behavioral sequences by LSA, and the part of residual values less than or equal to 1.96 is removed.

(2) beha_dftF(n): the sequence of polynomials obtained by DFT transformation of the sequence of the number of behaviors counted with a granularity of one day, where the number of polynomials depends on the length of the time series, and in this study, because the time interval of the school year was divided and counted by day, the term n=120.

(3) beha_cwtF(n): the sequence of the number of behaviors counted by one day as a granularity of the number of behaviors obtained by CWT transformation, the length of the digital sequence is the same as explained above, so the item n = 120.

(4) beha_C: indicates the total number of behaviors of the student for the semester.

(5) beha_typeC: indicates the number of behavioral types of students this semester.

(6) foru_C: indicates the total number of forum speeches made by the student this semester.

(7) foru_L: indicates the total number of characters in the student's forum speech this semester.

(8) foru_posF(n), foru_neuF(n), foru_negF(n): denotes the positive, neutral, and negative ratings of students' forum speeches, respectively, where n depends on the number of speeches.

(9) tree_node_cF(n), tree_leve_cF(n), tree_max_wF(n): denote the number of nodes according to the tree structure to parse the conceptual graph, the number of nodes, the number of layers and the maximum layer width, where n depends on the number of times the conceptual graph is drawn for the course.

(10) netwprvarF(n), netw_hubvarF(n), netw_autvarF(n): denotes the variance of PageRank, Hub, and Authority values of nodes parsing the conceptual graph according to the network structure, where n is the same as above.

For samples some data feature dimensions are not necessarily consistent, such as beha_lsaA(n) length depends on the number of filtered residual values greater than 1.96, so the features need to be further processed to ensure that the feature dimensions are consistent. For features with consistent feature dimensions, such as beha_cwtF(n) and foru_C, the feature dimensions produced by each student in each course are 120 and 1, and the original feature structure can be retained without processing. This study focuses on finding the mean, variance, and median of the partial series. The formulas for calculating the mean, standard deviation, and median are shown below.

$$\overline{x} = \frac{\sum_{i=1}^{N} x_i}{N} \tag{5}$$

where $\overline{x}$ is the sequence mean and N is the sequence length.

$$\sigma = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i - \overline{x})^2} \tag{6}$$

where N is the sequence length, $\overline{x}$ is the sequence mean, and σ is the standard deviation.

$$X_m = \begin{cases} X_{(N+1)/2}, & N \in 2k+1 \\ X_{N/2} + X_{N/2+1}, & N \in 2k \end{cases} \quad k \in Z \tag{7}$$

where the median formula requires pre-sorting the data in ascending order, z denotes the whole integer and x_m is the median.

Finally, in order to eliminate the difference in magnitude finally the normalization of the features generated from each data source was done separately according to equation (4).

III. Simulation experiment of teaching resource platform based on mobile cloud computing

After completing the analysis of the characteristics of the real estate industry talent demand and the design of the architecture of the interdisciplinary teaching resource platform based on parallel computing technology, in order to verify the actual effectiveness of the platform, this chapter launches the systematic testing of its resource integration speed, efficiency and sharing performance through simulation experiments, so as to provide data support for the practical application of the core technology.

III. A. Experimental setup

III. A. 1) Experimental data

In order to verify the effectiveness of the practical application of the proposed method, modern industrial colleges of engineering disciplines in five universities were selected as experimental subjects. 500 teachers and students were selected from each university, totaling 2500 participants. The types and quantities of digital teaching resources used in the experiment are as follows: (1) e-textbooks: 300 volumes, with an average of 55 MB per volume, totaling about 16.5 GB; (2) video courseware: 20,000, with an average of 700 MB each, totaling about 14 TB; (3) case studies: 3,000, with an average of 2 MB per article, totaling about 6 GB; and (4) an online test bank of 200, 000 questions, averaging 1KB per question, totaling about 200MB; (5) Interactive teaching tools: totaling about 3G.

III. A. 2) Experimental environment

In order to ensure the stability of the experiment and the security of the data, the configuration of the experimental terminal equipment was carefully selected to meet the needs of complex application scenarios. The configuration of the experimental environment is as follows: the server is Dell PowerEdge R740xd, with a central processor Intel Xeon Gold 6248R, 20 cores and 40 threads, 2.7GHz main frequency. Memory 256GB DDR4 ECC RDIMM, 24 memory slots. Hard disk capacity of four 1.90TB NVMe SSDs (RAID 10) totaling 7.60TB

III. A. 3) Experimental preparation

The digital teaching resources are integrated and shared by implementing the above proposed method. First, the digital teaching resources database is constructed by relying on MySQL database to ensure the structure and security of resources storage. Subsequently, the cloud platform technology is introduced to deeply process and efficiently integrate the teaching resources to realize the extensive sharing and flexible access to the resources.

The purpose of this experiment is to verify the advantages of the above parallel computing-based interdisciplinary teaching resource platform (hereinafter referred to as "cloud computing platform") in terms of resource integration and sharing performance through simulation and comparison tests. By comparing the performance of the experimental group (cloud computing platform) with that of control group A (NativeXML-based resource platform) and control group B (WebServices network-based resource platform) in the same simulation environment, the performance data of the platform is provided to support the actual application of the platform. In this paper, a unified simulation environment is built to ensure that the three platforms run under the same network conditions, hardware equipment and operating system.

In order to realize the intuitive quantitative evaluation of the operational performance of the three platforms, this paper takes the integration speed of teaching resources in the platform and the amount of resource data loss in the sharing process as the indicators for evaluating the platform's resource integration performance and resource sharing performance.

III. B. Simulation test and analysis of the performance of interdisciplinary teaching resource platform based on parallel computing

In this section, we will launch simulation tests for the three core indexes of platform resource integration speed, efficiency and sharing performance, and compare and analyze the advantages and disadvantages of different technology paths with the experimental data.

III. B. 1) Speed test for integration of platform resources

In the resource integration performance test, the experimental group, control A group and control B group are installed and configured respectively in the simulation environment. The same teaching resource files were uploaded to the three groups of platforms, and the total time to complete resource integration was recorded for each group of platforms and divided by the amount of integrated resource data to get the integration speed test results. Repeat the experiment for 10 times and take the average value as the final experimental result, the comparison of the resource integration speed test results of the 3 groups of platforms is shown in Figure 1.

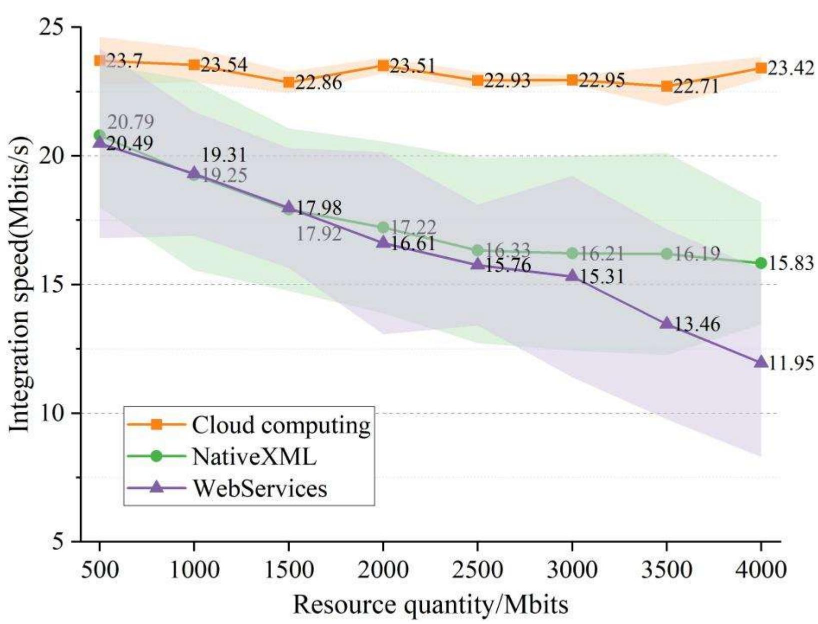

Figure 1: Comparison of the integration speed of different platform resources

Figure 1 compares the integration speed of the cloud computing platform with the platform based on NativeXML and WebServices at different resource amounts. The experimental results show that the integration speed of the cloud computing platform is significantly better than that of the control group, and remains stable and always higher than 22Mbits/s as the amount of resources increases from 500Mbits to 4000Mbits, whereas the integration speed of the control group (NativeXML and WebServices) exhibits a significant decreasing trend with the increase in the amount of resources.The integration speed of NativeXML at 500Mbits is 20.79Mbits/s, but drops to 15.83Mbits/s at 4000Mbits; WebServices drops from 20.49Mbits/s to 11.95Mbits/s. This decreasing trend not only affects the efficiency of resource integration, but may also have a negative impact on the user experience and overall performance of the platform. This suggests that cloud computing platforms have efficient task scheduling and distributed computing capabilities to effectively cope with the demands of large-scale resource integration, whereas traditional platforms suffer significant performance degradation when the load increases.

III. B. 2) Efficiency testing of the integration of platform resources

In order to further verify the effectiveness of the proposed method, the integration efficiency of different types of teaching resources was comparatively analyzed, and the results of the integration efficiency of different teaching resources are shown in Figure 2.

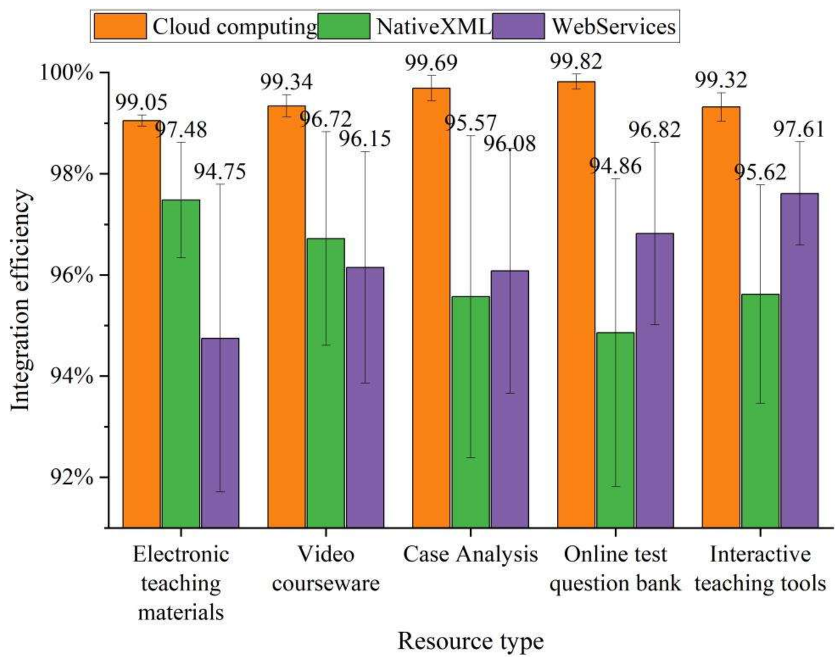

Figure 2: The results of the integration efficiency of different teaching resources

As can be seen in Figure 2, cloud computing platforms show high efficiency close to 99% or more in all resource types, with a maximum of 99.82% (online test bank) and a minimum of 99.05% (e-textbook). On the other hand, the integration efficiency of traditional platforms is generally low and fluctuates widely: NativeXML is as high as 97.86% (online test bank) and as low as 95.57% (case study); WebServices is as high as 97.61% (interactive teaching tool) and as low as 94.75% (e-textbook). The data show that the cloud computing platform is able to quickly complete resource classification, indexing and storage and support high concurrent access through distributed storage and parallel computing technologies, thus significantly improving the immediacy and reliability of resource integration.

III. B. 3) Performance testing of platform resource sharing

In the performance test of interdisciplinary teaching resource sharing, the same number of users are set up on each group of platforms to simulate the scenario of concurrent access and sharing of resources by multiple users. The simulation experiment is launched to allow users to search, download and upload resources on the platform. During the experiment, record the amount of resource data loss that occurs during resource sharing on each group of platforms. The same 10 experiments are conducted, and the average value is taken as the final experimental result. A comparison of the resource sharing performance test results of the three groups of platforms is shown in Figure 3.

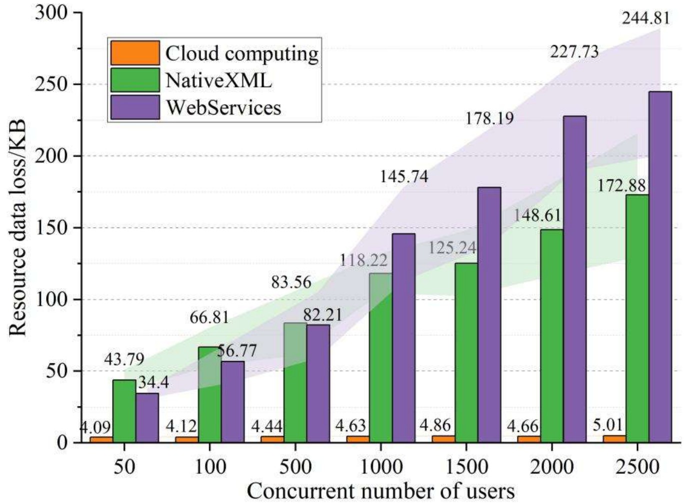

Figure 3: Comparison of resource sharing performance of different platforms

Figure 3 shows the resource data loss amount of each platform under different concurrent user numbers. The data loss of the cloud computing platform is always stabilized at less than 5KB, and the amount of data loss is only 5.01KB under 2500 high concurrent users, showing strong stability. This means that in the vast majority of cases, the small amount of lost resources does not have much impact on the overall utilization of resources, thus ensuring the smoothness and satisfaction of users when using the platform. In contrast, in the control group, when sharing resources, the amount of data lost gradually increases with the number of concurrent users, from 43.79KB for NativeXML (50 users) to 172.88KB (2,500 users), and from 34.4KB to 244.81KB for WebServices, especially in the scenario of 1,000 users (1,000 users). In the above scenarios, the amount of data loss in the control group far exceeds that of the cloud computing platform, and WebServices reaches 244.81KB at 2500 users.This trend not only affects the efficiency and stability of resource sharing, but also may lead to serious impacts on the normal use of resources due to the loss of critical data, which in turn greatly reduces users' trust and satisfaction with the platform. This verifies that the cloud computing platform can effectively reduce the risk of data loss and ensure the efficiency and stability of resource sharing through fault-tolerant recovery and load balancing technologies, while the performance of traditional platforms is severely limited in high concurrency scenarios. Therefore, when building an interdisciplinary teaching resource platform for modern industrial colleges of engineering in universities, adopting cloud computing technology will be an effective choice that can significantly improve user experience and platform performance.

The three sets of experimental data together show that the cloud computing platform based on parallel computing technology is significantly better than the traditional method in terms of resource integration speed, efficiency and sharing stability. Its core advantages are reflected in the fact that MapReduce, a parallel computing framework, optimizes task scheduling and data processing capabilities, guaranteeing the high efficiency of large-scale resource integration; distributed storage and secure encryption technologies, such as Hadoop and PRE/ABE algorithms, improve the reliability and security of resource management; fault-tolerant mechanisms and load-balancing designs effectively cope with highly concurrent scenarios and reduce the risk of data loss. These results provide strong technical support for the construction of interdisciplinary teaching resource platform, and also lay a practical foundation for the optimization of collaborative cultivation path of industry talents.

IV. Research and analysis on the path of training personnel specializing in the interdisciplinary housing industry

The results of simulation experiments show that the teaching resource platform based on parallel computing technology significantly outperforms traditional methods in terms of resource management efficiency and stability. Based on this, Chapter 4 will further explore the practical application effect of the platform in the interdisciplinary housing industry talent cultivation path, and verify its teaching support capability through multi-dimensional user satisfaction analysis.

IV. A. Experimental setup

In order to verify the practical effects of different cultivation paths, this study deploys three cultivation paths in three engineering-based modern industrial colleges: path 1: a cloud computing platform based on parallel computing technology, supporting distributed resource integration and high concurrent access; path 2: a resource platform based on NativeXML, adopting traditional data parsing and localized resource management; path 3: a resource platform based on WebServices network, relying on centralized service architecture. WebServices network-based resource platform, relying on centralized service architecture.

Each university selects 500 students, totaling 1500, randomly assigned to the three paths, and the experiment cycle is one academic year.

User satisfaction analysis quantifies student feedback through questionnaires and behavioral data analysis. The questionnaire survey on students' course satisfaction: a questionnaire containing a 5-point Likert scale (1-point-very dissatisfied; 2-point-dissatisfied; 3-point-fair; 4-point-satisfied; and 5-point-very dissatisfied) was designed to cover the dimensions of course content utility (e.g., integration of cross-disciplinary knowledge), resource ease of use (e.g., platform operation smoothness), and technical support (e.g., data processing response speed); the questionnaire survey of teaching method satisfaction The questionnaire assessment dimensions include interactivity: the usability and effectiveness of functions such as online discussion and real-time Q&A; flexibility: the adaptability of blended teaching (online resources + offline practice)); and technical support: the ability to support complex tasks (e.g., large-scale data analysis).

IV. B. Satisfaction analysis

IV. B. 1) Analysis of Student Course Satisfaction

Students are the main body of educational activities, and understanding students' satisfaction with the curriculum is the most important way to evaluate teachers' teaching. Through students' feedback on teaching, it can help teachers to improve teaching, optimize the curriculum of colleges and universities, improve the quality of teaching, and cultivate higher quality talents. Figures 4, 5 and 6 show the analysis of students' satisfaction with the courses of the three cultivation paths respectively.

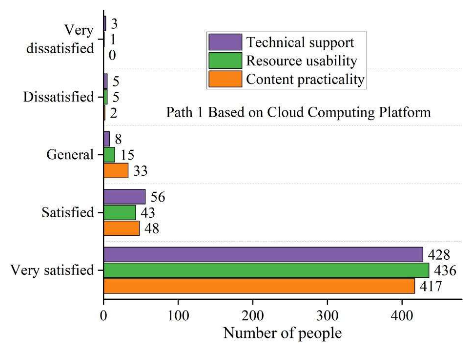

Figure 4: Analysis of students' Course Satisfaction with Training Path 1

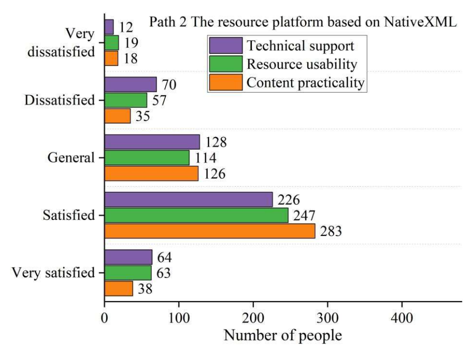

Figure 5: Analysis of students' Course Satisfaction with Training Path 2

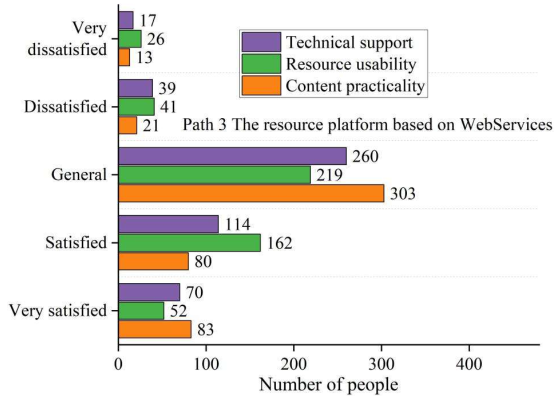

Figure 6: Analysis of students' Course Satisfaction with Training Path 3

Fig. 4, Fig. 5 and Fig. 6 compare the distribution of student satisfaction in the dimensions of course content practicability, resource usability and technical support, among which 83.4% of the students in path 1 based on cloud computing platform are "very satisfied" and only 0.4% are not satisfied with the content practicability, indicating that the interdisciplinary knowledge integration effect is significant. In terms of ease of use of resources, 87.2% were "very satisfied", and the platform operation was smooth, with only 1.2% having negative feedback; In terms of technical support, 428 students were "very satisfied", highlighting the supporting role of parallel computing technology in data processing efficiency. However, only 56.6% of the students in path 2 based on the NativeXML platform thought they were "satisfied" in terms of content practicability, but 10.6% were dissatisfied" or above, reflecting the shortcomings of traditional platforms in knowledge integration. In terms of resource usability, 15.2% were "dissatisfied" or above, indicating that the efficiency of resource scheduling was insufficient. In terms of technical support, 82 students were dissatisfied or above, indicating that localized resource management is difficult to cope with complex task requirements. In terms of content practicability, 60.6% of the students in Path 3 based on the WebServices platform thought that it was "average", neutral evaluation was the main one, and only 16.6% were "very satisfied", indicating that the centralized architecture has a weak ability to integrate interdisciplinary content. In terms of the ease of use of resources, a large proportion of students still thought it was "average", 32.4% of the students thought it was "satisfactory", but 13.4% had negative feedback, indicating that the stability of resource sharing was insufficient. In terms of technical support, 260 students thought it was "fair", 22.8% were "satisfied", and 11.2% were "dissatisfied", indicating that the technical support capacity was limited. In general, path 1 has significant advantages in terms of course practicability, ease of use of resources, and technical support, while path 2 and path 3 have different satisfaction due to technical limitations, which need to be optimized.

IV. B. 2) Analysis of satisfaction with teaching methods

Teaching style refers to the activities of teacher-student interaction consisting of a set of ways guided by teaching principles in order to achieve the teaching purpose, realize the teaching content, and use teaching means. Figures 7, 8 and 9 show the analysis of students' satisfaction with the three paths of teaching styles, respectively.

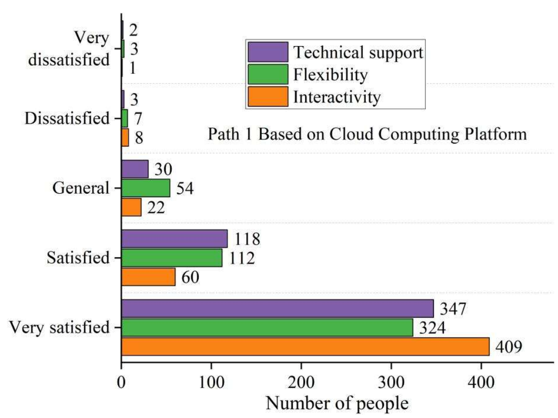

Figure 7: Analysis of Students' Satisfaction with the teaching method of Path 1

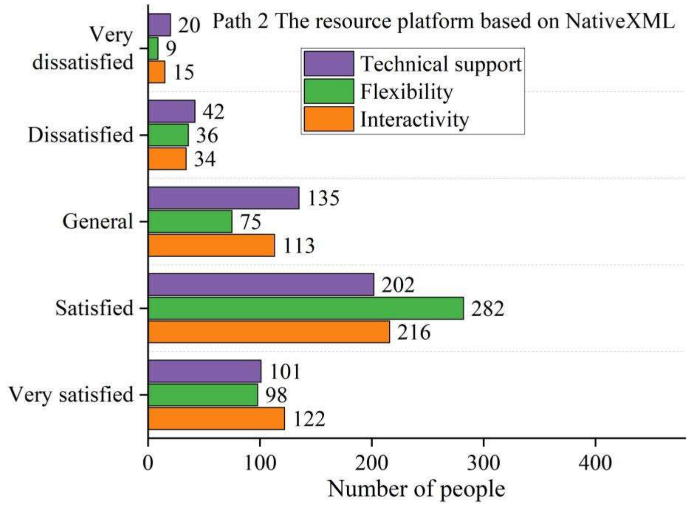

Figure 8: Analysis of Students' Satisfaction with the teaching method of Path 2

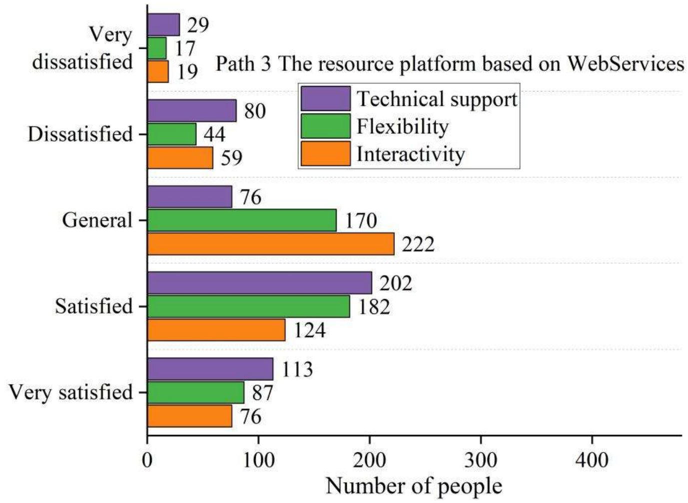

Figure 9: Analysis of Students' Satisfaction with the teaching method of Path 3

The above compares the satisfaction of the teaching methods of the three paths from the dimensions of interactivity, flexibility and technical support, and the path 1 of the cloud computing platform based on parallel computing is comprehensively leading in teaching interactivity, flexibility and technical support. In terms of interactivity, 81.8% of the students said that they were "very satisfied", and only 1.8% gave negative feedback, indicating that the real-time Q&A and online discussion functions were efficient. In terms of flexibility, 64.8% of students said they were "very satisfied", and the blended teaching was well adapted. In terms of technical support, 69.4% were "very satisfied", which verified the ability of parallel computing technology to support complex tasks. Although 43.2% of path 2 based on the NativeXML resource platform was "satisfied" in terms of interactivity, 9.8% had negative feedback, reflecting the insufficient response speed of the interactive tools on the traditional platform. There was also a negative feedback of 9.0% on flexibility, indicating that localized resources limited the dynamic adjustment of teaching. In terms of technical support, there was 12.4% negative feedback, highlighting the bottleneck of data processing capacity. In terms of interactivity, 15.2% of students felt "average" and 11.8% were "dissatisfied", indicating that the centralized architecture is difficult to support high-concurrency interaction. Although 36.4% were "satisfied" with flexibility, 34.0% were "average", indicating that the adaptability of teaching was weak. 40.4% of the technical support was "satisfied", but 21.8% had negative feedback, indicating that the technical support capacity needs to be improved urgently.

V. Conclusion

This study systematically verifies the technical advantages and practical efficacy of an interdisciplinary teaching resource platform based on parallel computing technology in the cultivation of housing industry talents. The experimental data show that the platform significantly surpasses the traditional method in terms of resource integration speed, efficiency and stability. Under 4000Mbits of resources, the integration speed is stable at more than 22Mbits/s, which is 39.1% and 84.1% higher than that of NativeXML and WebServices, respectively, and the efficiency of resource integration reaches 99.05%~99.82%, while that of traditional platforms is only 97.86% at most, and the amount of data loss in high concurrency scenarios (2500 users) is only 5.01KB, which is higher than that of WebServices. 5.01KB, 97.9% lower than WebServices.

Multi-dimensional user satisfaction analysis further supports the pedagogical applicability of the platform. Students adopting the cloud computing platform rated significantly better than the traditional platform in terms of course content usefulness (83.4% “very satisfied”), resource ease of use (87.2% “very satisfied”) and technical support (85.6% “very satisfied”) were significantly better than the traditional platform, and the negative feedback of NativeXML amounted to 16.4%.

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