Construction of Mobile Education Platform for Entrepreneurial Courses of Economic Management Specialty Based on Cloud Computing

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Abstract. In order to solve the problem of unbalanced course resource scheduling of mobile education platform when the number of users increases, a mobile education platform based on cloud computing is constructed. In the hardware part, the FPGA chip of XC6SLX16 is selected as the platform, and the decoupling network is designed according to different power input to eliminate the noise on power pin. In the software part, according to the requirements of the economic management course, we integrate the scattered teaching to form the rich teaching resource base and realize the unified management of users, roles and organizations. In order to improve the concurrency performance of the platform, the entrepreneurial course resource database of economic management major is scheduled based on cloud computing. Design each function module of the mobile education platform, input the keywords can get the related more detailed development resources, realize the mutual communication discussion. The test results show that the platform has good performance, and can improve the network throughput and meet the design requirements.

Keywords: Cloud computing · Platform design · Economic management major · Entrepreneurial courses · Mobile education · Educational platform

1 Introduction

In the era of "Mass Entrepreneurship and Innovation", how to meet the needs of innovation-oriented national strategy and cultivate innovative and entrepreneurial talents in higher education is one of the key areas in the process of talent training. Vigorously promoting entrepreneurship education in colleges and universities is also of long-term significance to the scientific development of higher education and educational reform. Entrepreneurial activity is mainly concentrated in the retail sector, with less than 2% of

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entrepreneurs based on high-tech entrepreneurship. As the main group of college students, their entrepreneurship is mainly concentrated in the tertiary industry, mostly in the low-end services, high-end services, emerging technology and high-tech entrepreneurship. Under the current circumstances, it is of great value for institutions of higher learning to carry out innovation and entrepreneurship education: it is the only way to promote the national innovation-driven development strategy and high-quality social and economic development; and it is an effective way to promote the comprehensive reform of higher education and promote higher quality entrepreneurship and employment of college graduates. However, in general, the knowledge superiority and professional ability of college students in the field of engineering science and technology innovation and entrepreneurship are not given full play. With the development of the knowledge economy and innovative society, the mode of knowledge production has been gradually transformed to "marketization" and "capitalization", which have a lot of influence on the goal and link of talent training in colleges and universities, and promotes the continuous enrichment of professional education and the rise of entrepreneurship education. After the concept of "innovation and entrepreneurship education" was put forward, the concept of "facing all students" in entrepreneurship education has become a recognized concept of government, academic fields and institutions of higher learning. With the rapid development of mobile communication technology and the popularization and application of intelligent terminal equipment, mobile teaching platform have become an industry with rapid development and great market potential [1]. Mobile learning content means more and more, more and more rich. Students are also increasingly using mobile devices to learn and communicate. The Internet has changed the traditional model of learning and teaching. From today's information technology development, mobile Internet education will become the mainstream trend. Therefore, the new teaching-learning model will be mainly about mobile learning. The innovation of information technology and the change of information knowledge systems are so fast in the information age that it is necessary to master the knowledge of new fields to solve practical problems. Learning in the mobile environment has become a trend in the information society, and has become more and more popular in colleges and universities. In this way, students can get updated teaching information at any time and anywhere in the school. Not only that, this mobile teaching platform in interactive Q&A, breaking with traditional teaching and learning methods, will not delay the teacher's rest time, will not increase the teacher's burden. Therefore, combined with innovation and entrepreneurship education, it is necessary to develop a complete platform for the mobile learning of entrepreneurship courses. Cloud computing technology can store very large files in the cloud nodes, cloud computing platform can also provide a distributed parallel computing framework. With the cloud computing platform, time-consuming computing tasks can be broken down into smaller tasks, which can then be handled by individual cloud nodes simultaneously, dramatically reducing overall task execution time. Based on cloud computing, this paper constructs a mobile education platform for entrepreneurial courses of economic management specialty to improve the learning flexibility and ease of use of the platform.

2 Hardware Design of Mobile Education Platform for Entrepreneurship Courses of Economic Management Specialty

Considering the expansibility of the mobile education platform, the external circuit connects it to the mobile education platform through the I/O of the extended FPGA. Each part of the circuit has different working voltage requirements, so we need to configure different power circuits for each part of the circuit on the mobile education platform. In addition, due to the use of the MRAM chip, but also for the DDR3 chip to provide a separate memory power management chip. The hardware architecture of the mobile education platform for entrepreneurship courses in economics and management is shown in Fig. 1.

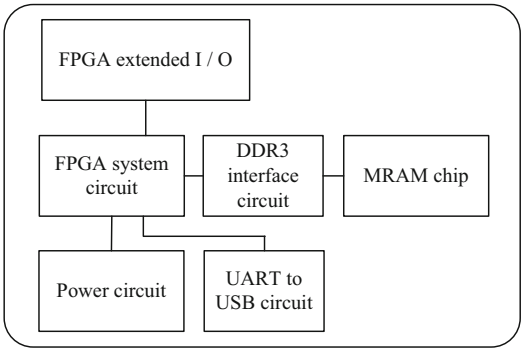

Fig. 1. Hardware architecture diagram

As for the FPGA chip that needs to be selected for the platform, we choose the FPGA chip with the lowest cost when the internal resource of the FPGA chip can satisfy the circuit function design. The FPGA chip of XC6SLX16 is chosen as the platform in this paper. The main function of the peripheral circuit of FPGA chip is to ensure the normal operation of FPGA, in addition, it also includes FPGA configuration chip circuit and FPGA clock circuit. The whole circuit board provides a single 12 V input power supply through a vertical power outlet, which is the source of all the power, and then uses TI's TPS series step-down chips to depressurize 12 V to get the power supply voltages of other chips. In the actual design, the DONE pin is connected to the LED lamp to indicate the configuration of the FPGA; the PROGRAM B pin is connected to an external key so that the FPGA can be reconfigured at any time through the key; the SUSPEND pin is pulled high because it does not need to run in power-saving mode; and the JTAG pin is finally connected to the 14 pin JTAG connector. This platform uses TPS65232 to reduce 12 V voltage to 5 V, 3.3 V, 1.8 V and 1 V, and uses TPS65001 to get 1.8 V AC voltage. The TPS65232 contains a PWM step-down controller and two adjustable synchronous step-down regulators. In order to ensure the stability of the chip, TPS65232 has set the overcurrent protection circuit internally, also may control two step-down controllers through the pin EN _ BCKn when to start. The correct design of the

power system can lead to better overall performance, lower clock jitter, and more stable systems. Therefore, when designing the power input circuit of FPGA, it is necessary to design the decoupling network for different power input to eliminate the noise on the power pin, and the decoupling capacitor is used. The principle of power decoupling is shown in Fig. 2.

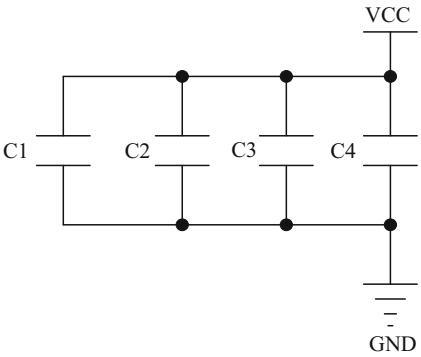

Fig. 2. Power supply decoupling principle

The bank3 of the FPGA chip is connected to the MRAM chip to design the DDR3 interface read-write controller, so the bank uses the same voltage as the MRAM chip for power supply. Compared with DDR2, DDR3 has lower power consumption, faster storage speed and lower price. Therefore, this platform uses the dual 32-bit DDR3 interface EMIF which is reserved for DM8168 to provide more storage space. DDR3 circuit requires the use of 4 pieces of 16-bit DDR3, each channel two, configured as a dual-channel 32-bit, can achieve the highest address 2 GB. In the construction of this platform, DDR3 adopts the cross storage mode, and EMIF0 and EMIF1 can work at the same time when accessing data. Use a clock input frequency of 50 MHz. It should be noted that the power supply terminal of the crystal oscillator needs to be filtered, and the output terminal series resistance can be used to prevent the reflection of high frequency signal from disturbing the signal source and play the role of eliminating the reflection wave from stabilizing the clock signal.

3 Software Design of Mobile Education Platform for Entrepreneurship Courses of Economic Management Specialty

3.1 Analysis of Demand for Mobile Education in Entrepreneurship Courses for Economic Management Majors

The Mobile Education Platform for Business Start-up Courses of Economic Management Specialty aims to provide users with a mobile education platform with richer content and more convenient use by combining the rich educational resources generated by the informatization of domestic colleges and universities. Achieve users to use

mobile terminal devices for convenient learning. So that learning is no longer subject to geographical and time constraints, can better use of the fragmented time of users. The mobile education platform based on cloud computing is shown in Fig. 3.

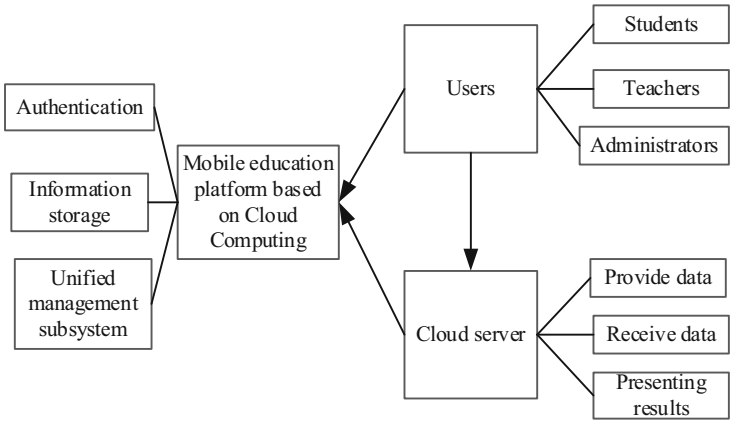

Fig. 3. Mobile education platform based on cloud computing

The construction effect of the mobile education platform is measured by the goal of entrepreneurship curriculum of economic management specialty. The goal of the entrepreneurial curriculum is to express the overall objectives of talent training in different sides and different extension directions. Based on the concept and value orientation of entrepreneurial education, the objectives of entrepreneurial curriculum should be layered and clear, with students as the center, subject knowledge as the basis, and social needs as the orientation. [2] Based on the characteristics of entrepreneurship education, the objectives of entrepreneurship education should include three levels: the cultivation of entrepreneurship awareness, the mastering of entrepreneurship knowledge, internalization and the generation of entrepreneurship experience. The composition of the entrepreneurship education curriculum objectives is shown in Fig. 4.

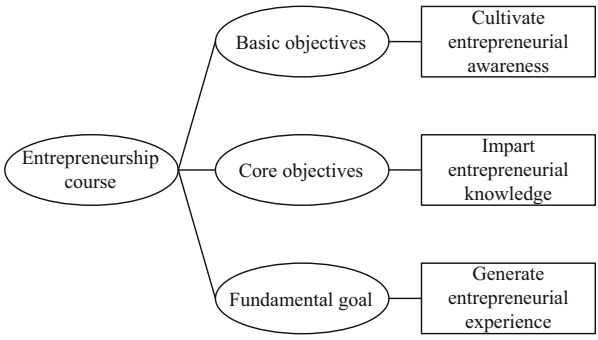

Fig. 4. Entrepreneurship education curriculum objectives

Based on the goal of the entrepreneurial courses for economic management major, the mobile teaching platform integrates the scattered teaching to form a rich teaching resource database. Through personalized curriculum customization, students can customize their own courses according to their own circumstances. The mobile education platform has the functions of education information portal, application store of teaching resources, open learning platform and so on. It will bring users a full range of multimedia services related to teaching, such as teaching information, resource sharing, teaching affairs management and individual course customization. The function menu module mainly belongs to the operation scope of the teacher's authority. The teacher implements the teaching plan, publishes the teaching information, uploads, downloads, updates the teaching materials in this module, and feedback the students' learning and teaching situation on time. Mobile teaching platforms shall achieve unified identity authentication, verify the identity of user login, realize the storage of organizational structure and personnel information, and realize the unified management of users, roles and organizational structure of various subsystems [3]. Ensure the identity of users in different applications is consistent. Mobile phone client belongs to the operation category of students, knowledge module, teaching information module and teaching feedback module, click on the micro video learning, view learning information, upload learning works. After the education portal provides a unified entrance for users, users can enter into the main interface and see the sub-links of each subsystem. Users can enter into each subsystem only with a single click, and do not need to re-enter the user password to submit a login request. Thus, users can directly enter into their respective application systems after a login. At the same time, the backstage can manage the users, and all users are organized by organization management. The cloud server ECS mainly provides data for the PC terminal management system. When the PC terminal sends a request to the WeChat server, the server immediately responds, calls the Database class for database operation, and presents the result on the PC terminal. The mobile teaching platform assigns an organization ID to each organization, under each organization ID can include 1 organization administrator ID and a specified number of ordinary user ID. The organization administrator is the super administrator user of an organization, and can configure and manage all the equipment and ordinary users of the organization. User management shall include user registration management, user inquiry, user addition and deletion, user access rights management, user locking and unlocking, user grouping management, and user access record viewing.

3.2 Establishing Course Resource Scheduling Model of Entrepreneurship Based on Cloud Computing

As the number of users increases, the service needs of users become more diversified and hierarchical. In the data center of mobile teaching platform, the amount of resources available for scheduling is different, the processing capacity of computing nodes is different, and the storage capacity of nodes is different. In order to ensure the stability of the service environment of the mobile education platform, this paper makes use of cloud computing to schedule the course resources of economic management specialty. To some extent, the selection and conciseness of entrepreneurial courses for economic management specialty determine the scientificity and reasonableness of course construction.

The choice of curriculum content should consider the particularity of entrepreneurship education, pay attention to the social value and the dynamic development of the external industry market. In order to improve the resource utilization of cloud nodes and the speedup performance of asynchronous data parallelism, the strategy of starting multiple users in each cloud node is proposed. The scheduling process of cloud computing production environment is divided into four layers: cloud computing user layer, cloud computing task collection layer, virtual resource node collection layer and data center layer. The four levels involve three levels of mapping: one-to-many tasks for users, multi-task corresponding to multi-virtual resource nodes, and the many-to-many relationship between virtual resource nodes and data centers. For example, if a single cloud node starts two users at the same time, ideally, when one user gets a batch, the other user might be performing a GPU calculation, and when that user performs a GPU calculation, the other user might be getting a batch. The two processes of each iteration of the two users complement each other, thus greatly improving the utilization of node resources. To address high concurrency, use clustering to separate applications from static resources, such as static resources and server applications, in static resource servers and application servers respectively. It also uses Nginx as a reverse proxy server and front-end server to process request server integration for forwarding different requests, such as static resource request and application request. Enable load balancing among cluster servers. Firstly, the processing capacity of all resource nodes is collected, and then the 2D time matrix is obtained according to the task length in the task set. The matrix represents the matrix formed by the processing time of the task assigned to the resource node. The minimum execution time of each task at each resource node is extracted from the matrix, and a one-dimensional array of length n is obtained [4]. Based on the array, the task with the shortest expected execution time is selected, and the shortest task is mapped to the corresponding resource node for processing. HDFS is stored in blocks, and files are divided into blocks and stored on HDFS. The default size for Block is 64 MB. Using blocks with HDFS has several benefits. Files can be divided into blocks and stored on different disks so that HDFS can hold files that are larger than a single disk space [5]. Particle swarm optimization is used to schedule cloud computing tasks. Particles are composed of two basic properties: velocity and position. The formula for calculating the velocity attribute is as follows:

$$\beta_{t+1} = \varpi\beta_t + \varphi_1\chi_1(\delta - \alpha_t) + \varphi_2\chi_2\left(\delta' - \alpha_t\right) \tag{1}$$

In formula (1), β represents the velocity of particles; t represents the iteration time; φ_1 and φ_2 acceleration constants, respectively, indicate the degree of dependence of particles on their own historical optimal solution and the global optimal solution of the population; random numbers between 0 and 1 for χ_1 and χ_2 increase the randomicity of the particle optimization process and prevent particles from moving in the same direction too early; δ and δ' represent the historical optimal solution and the global optimal solution of the population; α_t represents the search location of particles; and ϖ represents the inertia weight. Assuming that particles are searching in D dimensional space, the formula for calculating the position attribute may be:

$$\alpha_{t+1} = \alpha_t + \beta_{t+1} \tag{2}$$

In formula (2), α_{t+1} represents the position of the iterated particle. In each iteration, the particle updates the direction and velocity of the next flight based on its own and the population's experience. According to the defined utility function, the corresponding value of each particle is calculated, and the global optimal solution is found. Block based management is much simpler than file based management. Because the block size is fixed, the number of blocks needed to store the file can be easily calculated. At the same time, you can use a simple data structure to store the block's metadata. The linear decreasing inertia weight can improve the convergence speed of the algorithm and obtain a better global optimal solution. The formula of inertia weight is as follows:

$$\varpi = (\eta_1 - \eta_2)\frac{\mu_{\max} - \mu}{\mu_{\max}} + \eta_2 \tag{3}$$

In formula (3), η_1 and η_2 are two fixed inertia weights; $\mu_{\max}$ and μ represent the maximum number of iterations and the current number of iterations. By adjusting the size of $\eta_1 - \eta_2$ and η_2, the maximum and minimum inertia weights can be controlled, and the convergence speed, the development range and the local development ability can be improved. Build the cloud platform using Hadoop in the server cluster, and then build Spark on top of that. Cloud computing platforms, with HDFS provided by Hadoop and parallel computing engines provided by Spark, are well suited for parallel computing that requires iterative iterations [6]. In the cloud computing environment, after the user submits the application, that is, the task of cloud computing and the usage request of the virtual machine instance, the task is assigned to the corresponding virtual machine resource node by the task scheduling algorithm, and then the virtual machine is mapped to the data center according to the virtual machine scheduling algorithm.

3.3 Design of Functional Modules of Mobile Education Platform for Entrepreneurial Courses

Mobile teaching platform education learning function, students can click the corresponding chapter for learning, keywords input can get more relevant detailed development resources, exchange, testing, etc. Teachers explain the contents of the corresponding chapters, group messages, exchange of discussion and so on. Login module is divided into the student side and the teacher side. Users can choose according to their own identity, students use their own study number and password to log in, teachers use their own staff number and password to log in. If the wrong choice role, you can return to re-select. If you forget your password, you can retrieve it according to your ID number. Through the unified authentication center to user identity authentication, support the mailbox, user accounts, student numbers and other forms of authentication, and can expand other forms of authentication. Student's personal information module contains the student's picture, name, student number, gender, grade, major, college, school and other information, in addition to the personal information module has "change password", "change mobile phone number" function. The teacher's personal information module is very similar to the student's, including the teacher's picture, name, employee number, title, college, school, mobile phone number, and also "change password", "change mobile phone number" function. Login integration does not need to modify the original subsystem, and is automatically logged in by the Unified Information Portal according to

the configured login script. The implementation principle is as follows: The Information Portal configures each subsystem with a JavaScript auto-login script that executes a script to automatically log in when entering the platform from navigation. The idea is to dynamically create a Form on an embedded page, and then automatically submit it. The platform administrator pre-assigns access to different information and customizes the content and layout, depending on the role and level of security of the user [7]. The background management of cloud service application includes curriculum resources arrangement, keyword reply, personalized function menu, test questionnaire, data statistics analysis, platform maintenance and so on. Bulletin module is when the teacher has something to notify, namely the announcement, all students will receive the announcement. Students in the announcement module, click the announcement details, you can see all the announcements list, unread red dot logo, read the red dot to cancel. The teacher end also has the announcement details, the function is the same with the student end. What is different with the student end is the teacher end has the announcement function, sets up the announcement the subject, the date and the content, then releases the announcement. The construction of entrepreneurial courses for economic management needs more practical. The relevant knowledge imparted in the subject curriculum can be applied in practice to support the development of practical activities. This practical theoretical knowledge should be added to the content of the course to educate students with practical theories or practical training courses. The timetable module is designed to make it easier for students to use, similar to the curriculum grid, where students can see information about all of their classes during the week, as well as places and teachers. Set up a number of both theoretical teaching supplemented by practical activities at the integration of theory and practice courses. The essence of entrepreneurship education is to create a platform for practical activities and provide students with more and better practical teaching, which is the essence of entrepreneurship education. The teacher's side of the curriculum is slightly different, in the teacher's side, the teacher can see all the courses they taught, click to see the list of all students in this course click each student can see the personal information of the students. Through the design of hardware and software, the paper completes the construction of mobile education platform of economic management professional entrepreneurship courses based on cloud computing.

4 Experimental Research

4.1 Experimental Preparation

Mobile platform testing is a vital work, we must combine the developed system with other resources, and carry out various tests in the actual running environment to ensure that all parts of the function are normal. Through the test, we can find out the potential problems of the mobile teaching platform and whether the relevant functions meet the requirements in the actual operation, so that developers can adjust and optimize the existing problems in a timely manner, so as to ensure the reliability of the platform and enhance users' experience. Integration testing is the simultaneous testing of software as it is assembled. According to the different ways of assembling modules, there are two kinds of testing methods: top-down combining and bottom-up combining. This system

adopts top-down combining method to test. Server Test Environment: Intel Core i5-4210u, dual-core 1.7 GHz CPU, 64-bit Windows 10 Professional OS, 8 GB RAM; Java Language JDK Version 1.7.0, Tomcat Server Version 6.0, MySQL Database Version 5.0.22; Server Performance Test with Apache JMeter 3.0

4.2 Results and Analysis

Taking the mobile teaching platform for example, we set up four different testing scenarios to simulate the number of concurrent requests of 1000, 2000, 5000 and 8000 users, respectively. In the above four tests, the number of successful concurrent requests is counted, and the throughput of the mobile teaching platform is used as the measurement index of the platform stress test. This paper compares the throughput of the mobile education platform based on cloud computing with that based on data mining and personalized recommendation. The test results for the platform are shown in Tables 1–4.

Table 1. 1000 throughput comparison of requests (MB/s)

Number of tests	Mobile education platform for entrepreneurial courses of economic management specialty based on cloud computing	Data mining based mobile education platform for entrepreneurial courses of economic management	Mobile education platform for entrepreneurship courses of economic management specialty based on personalized recommendation
1	946.4	812.4	807.4
2	953.7	826.8	848.8
3	968.8	868.5	859.5
4	959.5	835.6	826.3
5	957.6	822.2	833.2
6	961.3	843.3	862.5
7	942.2	819.6	820.1
8	956.1	855.2	851.4
9	960.5	822.5	824.8
10	943.2	837.1	845.2

As can be seen from Table 1, the throughput of the cloud based management entrepreneurship course mobile education platform for 1000 concurrent requests is 954.9 MB/s, representing an increase of 120.6 MB/s and 117.0 MB/s over the data mining and personalized recommendation based mobile education platform.

As can be seen from Table 2, the throughput of the cloud -based entrepreneurship courses in economic management mobile education platform was 924.4 MB/s for 2000 concurrent requests, representing an increase of 220.3 MB/s and 211.3 MB/s over the data mining based and personalized recommendation based mobile education platforms.

Table 2. 2000 throughput comparison of requests (MB/s)

Number of tests	Mobile education platform for entrepreneurial courses of economic management specialty based on cloud computing	Data mining based mobile education platform for entrepreneurial courses of economic management	Mobile education platform for entrepreneurship courses of economic management specialty based on personalized recommendation
1	923.4	702.4	720.6
2	926.8	697.8	734.7
3	938.5	684.6	721.4
4	922.6	696.2	725.8
5	913.2	703.3	702.5
6	906.3	722.5	716.2
7	932.6	715.2	703.3
8	925.2	709.3	692.6
9	921.5	706.6	685.2
10	934.2	703.2	728.5

Table 3. 5000 throughput comparison of requests (MB/s)

Number of tests	Mobile education platform for entrepreneurial courses of economic management specialty based on cloud computing	Data mining based mobile education platform for entrepreneurial courses of economic management	Mobile education platform for entrepreneurship courses of economic management specialty based on personalized recommendation
1	706.4	647.4	668.3
2	711.8	668.8	626.6
3	712.5	659.7	632.5
4	705.6	646.4	613.4
5	708.2	622.2	605.8
6	723.3	635.8	622.2
7	725.2	613.7	631.6
8	706.5	602.2	644.2
9	711.6	661.6	605.5
10	718.2	624.8	638.3

According to Table 3, under 5000 concurrent requests, the throughput of the cloud based management entrepreneurship course mobile education platform is 712.9 MB/s, representing an increase of 74.6 MB/s and 84.1 MB/s over the data mining and personalized recommendation based mobile education platform.

Table 4. Throughput comparison of 8000 requests (MB/s)

Number of tests	Mobile education platform for entrepreneurial courses of economic management specialty based on cloud computing	Data mining based mobile education platform for entrepreneurial courses of economic management	Mobile education platform for entrepreneurship courses of economic management specialty based on personalized recommendation
1	512.4	458.9	411.2
2	506.8	456.7	419.6
3	515.6	428.4	423.0
4	512.2	426.6	436.5
5	519.5	437.2	433.4
6	508.2	430.5	437.8
7	507.6	459.8	452.2
8	511.3	462.3	449.3
9	506.7	438.2	416.6
10	523.8	441.0	435.2

As can be seen from Table 4, the throughput of the cloud based management entrepreneurship course mobile education platform for 8,000 concurrent requests is 512.4 MB/s, representing an increase of 68.4 MB/s and 80.9 MB/s over the data mining and personalized recommendation based mobile education platforms. The test results show that the mobile teaching platform constructed in this paper has good performance and meets the design requirements.

5 Conclusion

Entrepreneurship education is based on comprehensive quality education to develop and expand the quality of students. It opens up a new path for the cultivation of innovative and entrepreneurial talents. Curriculum is the carrier of education and teaching. The key to improve the quality of entrepreneurship education is curriculum. Mobile teaching platform can provide convenient conditions for the entrepreneurial courses of economic management, so that learning is no longer subject to geographical and time constraints. Based on cloud computing, this paper designs a mobile education platform for entrepreneurial courses of economic management specialty. The test results show that

the platform has good performance and can improve the network throughput. Follow-up research can further refine the operation of the platform, sort out more teaching resources and upload them to the platform, which can integrate these accumulated entrepreneurial knowledge with the platform and continuously improve the mobile education platform.

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References

1. Zhao, D., Xi, Di., Li, Y.Y.: Application application of mobile teaching platform in college biology courses——practical exploration based on speed-learning platform. J. Hubei Open Vocational College **33**(20), 163–165 (2020)
2. Liu, T.W., Sun, H., Fung, W.: An artifact-based simulation method for teaching intellectual property management in an innovation and entrepreneurship course. Asian Case Res. J. **25**(02n03), 193–212 (2021)
3. Xiao, X., Liu, X., Xiao, Z.: Construction and application of computer virtual simulation teaching platform for medical testing. J. Phys. Conf. Ser. **1915**(4), 042074 (7 pp) (2021)
4. Wu, Y.-l., Huang, W.: Real-time task scheduling simulation of cloud computing based on resource delay perception. Comput. Simulation **38**(9), 490–494 (2021)
5. Maghsoudloo, M., Khoshavi, N.: Elastic HDFS: Interconnected distributed architecture for availability–scalability enhancement of large-scale cloud storages. J. Supercomput. **76**(1), 174–203 (2020)
6. Mostafaeipour, A., Rafsanjani, A.J., Ahmadi, M., et al.: Investigating the performance of Hadoop and Spark platforms on machine learning algorithms. J. Supercomput. **77**(2), 1273–1300 (2020)
7. Wu N.Z., Xing, X.S.: The occurrence logic of big data supporting large-scale personalized teaching. Lifelong Educ. Res. **32**(2), 20–28, 39 (2021)