

## Research Article

# Optimization of Innovation and Entrepreneurship Education and Training System in Colleges and Universities Based on OpenStack Cloud Computing

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Received 1 June 2022; Revised 26 July 2022; Accepted 30 July 2022; Published 30 August 2022

Academic Editor: Juan Vicente Capella Hernandez

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With economic globalization and rapid development of science and technology, many colleges and universities pay more and more attention to the cultivation of students' innovative thinking and creativity, and innovation and entrepreneurship education has also become an important part of the education system. Due to the current unevenness of teachers in innovation and entrepreneurship education in colleges and universities, high training cost, and lack of strong atmosphere, this paper optimizes the innovation and entrepreneurship education and training system in colleges and universities through OpenStack cloud computing. This paper optimizes the cloud computing platform according to the OpenStack virtual machine and the multiobjective ant colony improvement algorithm and then designs the innovation and entrepreneurship education and training system. The multiobjective ant colony improvement algorithm uses the way ants find food to find the best information resource route from the traces left by the information trend in the cloud platform. In order to test the effectiveness of these methods, this paper uses the simulation method to test. The results show that, sometimes, the load utilization rate of the innovation and entrepreneurship education and training system in colleges and universities exceeds 80%, which is in line with the expected settings. Through the OpenStack cloud computing platform, it can provide a good innovation and entrepreneurship training environment for more users at low cost and low risk and promote the development of innovation and entrepreneurship education.

## 1. Introduction

Cloud computing, as a popular technical medium and model in the information society, is a huge leap in technology. Users use computing resources to change the economic model in the field of information technology, and it also promotes the development of other fields. Due to the characteristics of personalized customization of cloud computing application execution environment, more and more organizations are attracted to build high-performance computing clusters based on cloud platform technology. By using the OpenStack cloud platform to optimize the innovation and entrepreneurship education and training system in colleges and universities, it provides a rich resource and strong innovation and entrepreneurship score for college

talents, which is conducive to the development of innovation and entrepreneurship education.

By integrating limited social resources through cloud computing technology, it can effectively obtain information resources. It improves resource utilization and promotes the rapid development of the Internet and the Internet of Things. At the same time, it promotes people's understanding of the whole society and enables human society to control the material and energy of nature more precisely. It has a profound impact on economic development and social progress.

Through the related computing of OpenStack cloud computing, the user resources are integrated, and the coupling degree is associated, which enables users to independently apply resources and reduce application costs. In order to more effectively select innovation and entrepreneurship

education for students, this paper redesigns the cloud platform teaching system. It improves the teaching system and adds a teaching evaluation system and a monitoring system. It understands the dynamics of the course in real time and mobilizes the enthusiasm for learning.

## 2. Related Work

With the growth of social economy, people's lives are becoming more and more intelligent and data-based, and teaching is no exception. Nelmiawati has been researching the use of OpenStack to design a virtual machine room for cloud computing on a centralized network and has achieved some results. His tests were performed using a specific server specification and the OpenStack platform. The test results of the virtual computer room and the case study of the object-based programming course show that the server used in the test can run the virtual computer room of 9 computers well [1]. Yan-Ting enabled users to access computing, storage, networking, and other resources from a shared, configurable pool of resources conveniently and on-demand over the network. He used the existing IT equipment resources of the university to create a cloud platform university that is more in line with the scientific research needs of the university [2]. Cloud-based technology is driving positive changes in the way organizations communicate. Radwan et al. implemented three technologies of OpenStack cloud, webRTC call, and 3D stereo effect and realized the feeling of 3D video [3]. Albert et al. used Putnam's social capital framework. To achieve the goals of his research, he used a mixed approach to determine how teaching at multiple institutions affects the social capital of teachers within the Haitian AET system. The results showed a low positive correlation between teaching and social capital across multiple institutions [4]. These studies are instructive to a certain extent, but in some cases, the demonstrations are insufficient or inaccurate and can be further improved.

With the development of intelligence and Internet, cloud computing, which combines the application of information technology and network application, is widely used. Singh et al. proposed a mathematical model to find redundant information based on overlapping regions. He employed a combinatorial metaheuristic to achieve optimal coverage, taking the effect of overlapping regions into account in the objective function to reduce the amount of redundant information perceived by the working sensor set. Improved genetic algorithms and binary ant colony algorithms are used as metaheuristic tools to optimize multiobjective functions [5]. Awad et al. used multiobjective particle swarm optimization (MOPSO) and multiobjective ant colony optimization (MOACO) intelligent algorithms to optimize data replication selection and placement in cloud environments [6]. Yi et al. studied the scheduling and collision-free routing problems of AGVs. He gave a mathematical programming model for this problem and improved the algorithm on the basis of multiobjective programming to optimize the pheromone matrix. He compared the performance of the two methods by using the available test problems for calculations. He conducted an empirical evaluation of an improved ant colony algorithm. The results show that the improved algorithm improves the

performance of the existing algorithm [7]. These studies can analyze the relevant situation, but the specific research needs to be improved.

## 3. Method of Innovation and Entrepreneurship Education and Training in Colleges and Universities Based on OpenStack Cloud Computing

*3.1. Virtualization of OpenStack.* OpenStack cloud platform is a cloud computing solution architecture, not a single cloud computing resource service [8]. The OpenStack project consists of several different components that work together to complete cloud computing services. The development language used by the OpenStack project is python, and the source code of the project is released under the Apache license. The main function of the OpenStack cloud platform is to integrate various physical computer hardware resources. It provides a convenient web control panel interface for cloud platform system administrators to facilitate cloud platform resource management [9]. The OpenStack cloud platform can provide flexible and easily scalable cloud computing services for large public cloud services and small private cloud services. It simplifies the implementation of cloud computing technology and increases cloud computing. It makes the cloud computing architecture more flexible and scalable [10].

The key technologies of cloud computing mainly include computer virtualization technology, computer distributed programming and computing technology, cloud storage technology, resource management, and scheduling technology [11]. OpenStack cloud platform can also be understood as a computer operating system. It uses OpenStack cloud platform users to manage all computing service resources, network service resources, and storage service resources in the cloud platform through the control panel component of the Internet Web service interface. The role of OpenStack cloud platform in cloud computing software and hardware architecture is similar to that of a physical computer operating system, as shown in Figure 1.

Cloud computing is the product of the integration of traditional computer technology and network technology, and it is also a key strategic technology and means to lead the innovation of the information industry in the future [12]. In the classification of OpenStack, this paper only makes approximately linear resource allocation according to the allocation requirements of CPU, memory, storage, and other resources, but does not consider the differentiated requirements of different virtual machines for different resources [13]. In a heterogeneous environment, different physical servers have different performances, and some CPUs have strong computing power. However, disk IO performance and network bandwidth are reduced, and some servers have outstanding disk IO performance. However, the computing power is weak, and some servers have weak overall performance but have large network bandwidth [14]. Similarly, for users, each user has different requirements for various resources. Therefore, it can meet the needs of different users by dividing into a variety of different service

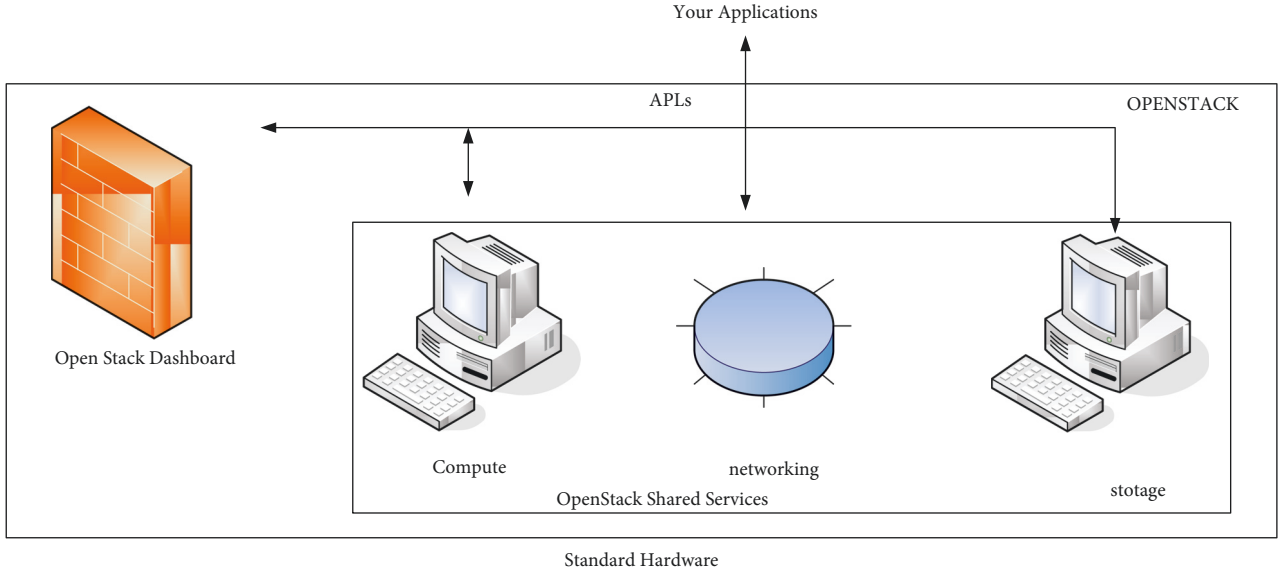


FIGURE 1: OpenStack cloud platform system.

TABLE 1: Resource quantization notation representation.

Resource type	Symbol name	Symbolic representation	Symbolic interpretation
CPU	VCNm	Virtual machine CPU performance	The number of CPUs after virtual machine $m$ quantization
	RCNm	Physical machine CPU performance	The number of CPUs after physical machine $m$ quantization
The Internet	VNNm	Virtual machine network performance	The number of bandwidths after virtual machine $m$ quantization
	RNNm	Physical machine network (xingn)	The amount of broadband after physical machine $m$ quantization
RAM	VCNm	Virtual machine memory performance	The amount of memory after virtual machine $m$ quantization
	RMNm	Physical machine memory performance	The amount of memory after physical machine $m$ quantization
Storage	VDNm	Virtual machine storage capacity	The amount of storage space after virtual machine $m$ quantization
	RDNm	Physical machine storage capacity	The amount of storage space after physical machine $m$ quantization
	VINm	Virtual machine hard disk IO performance	The number of access IOs after the virtual machine $m$ is quantization
	RINm	Physical machine hard disk IO performance	The number of storage IOs after physical machine $m$ quantization

types. At the same time, for different service types of virtual machines, this paper sets up virtual machine template images that focus on services. As users have more and more personalized requirements, users can also customize various requirements. The virtual machine needs to carry more network applications and occupies a large amount of network bandwidth. For example, for a virtual machine that needs to host a streaming media server and provide services such as DNS or CDN, the bandwidth will become the bottleneck of its performance. The main resource requirements of virtual machines for network traffic-based services are network bandwidth. The quantification of various resources is shown in Table 1.

A collection of virtual machines:

$$VM_m = \{VM_0, VM_1, VM_2, \dots\}. \quad (1)$$

The resource status of physical machine  $n$  can be expressed as

$$RM_n = \{RCN_n, RMN_n, RDN_n, RIN_n, RNN_n\}. \quad (2)$$

The resource status of virtual machine  $m$  can be expressed as

$$VM_m = \{VCN_m, VMN_m, VDN_m, VIN_m, VNN_m\}. \quad (3)$$

The main objectives of virtual machines are infrastructure virtualization, system virtualization, and virtual server virtualization in cloud computing. It simplifies the access and management of IT resources for cloud users through certain computer technologies [15]. In addition, for virtual machines of different service types, the resources of virtual machine  $m$  can be represented as service resources and auxiliary resources [16]. Service resources refer to the resources that are mainly required by the corresponding service type, and auxiliary resources refer to other resources other than the main requirements resources of the corresponding service type. Therefore, the resources of various

service-type virtual machines can be expressed as a virtual machine  $m$  for a transaction-type service:

$$\begin{aligned} \text{VM\_}S_m &= \{\text{VCN}_m, \text{VMN}_m\}, \\ \text{VM\_}A_m &= \text{VM}_m, \text{VM}_{S_m} = \{\text{VDN}_m, \text{VIN}_m, \text{VNN}_m\}. \end{aligned} \quad (4)$$

The virtual machine  $m$  of the data IO type service:

$$\begin{aligned} \text{VM\_}S_m &= \{\text{VDN}_m, \text{VIN}_m\}, \\ \text{VM\_}A_m &= \text{VM}_m, \text{VM}_{S_m} = \{\text{VCN}_m, \text{VMM}_m, \text{VNN}_m\}. \end{aligned} \quad (5)$$

Virtual machine  $m$  for network traffic type service:

$$\begin{aligned} \text{VM\_}S_m &= \{\text{VNN}_m\}, \\ \text{VM\_}A_m &= \text{VM}_m, \text{VM}_{S_m} = \{\text{VCN}_m, \text{VMN}_m, \text{VDN}_m, \text{VIN}_m\}. \end{aligned} \quad (6)$$

**3.2. Virtual Machine of the Multiobjective Ant Colony Improved Algorithm.** The initial deployment of virtual machines is to optimize power consumption, cloud platform load balancing, user SLA violation rate, and other multidimensional goals to achieve optimal deployment of virtual machines under the constraints of physical machine bandwidth, disk storage, CPU, and memory [17]. The initial deployment of virtual machines on cloud platforms can be simplified as a multidimensional packing problem, that is, virtual machines are optimally deployed to physical machines under multiple optimization objectives and constraints. The improved multiobjective optimal deployment strategy based on the ant colony algorithm can avoid the waste of system resources and improve the overall performance of the system.

An optimized virtual machine initialization deployment strategy is indispensable for improving the stability and load balancing of the entire platform. This chapter proposes an improved multiobjective optimal deployment strategy based on the ant colony algorithm for the initial deployment of virtual machines. Ant colony algorithm is a biological intelligence heuristic algorithm. The abstract method of virtualizing computer resources can access the abstracted resources in the same way as before the abstracted resources through the virtualization technology.

Ant colony algorithm simulates the process of real-world ants searching for food. In the initial case, the ants do not have any information on the food destination [18]. In the process of finding food, ants hide a pheromone on the way to find food. Because this chemical evaporates slowly, the pheromone concentration in part indicates the distance of the journey to find food. When other ants find the pheromone, they head towards their destination. Ants take a different route. If a shorter route appears, then the concentration of the pheromone is greater for that route. More and more ants will be attracted to the new route. Eventually, most ants will focus on the shortest route. This will find the optimal path. If the route is shorter from the food, the concentration of pheromones on the route will be higher, and more and more ants will be attracted to join the route. So, in this way, the ant colony finds the shortest path to the

food location. A multiobjective ant colony optimization algorithm is used to find the best data replica placement based on the minimum distance, the number of data transfers, and the availability of data replication.

**Constraint 1** (SLA violation rate). For the problem of resource scheduling on the cloud platform, when the virtual machine created by it allocates physical machines, it must ensure the user service quality before further optimization of the cloud platform resource scheduling algorithm can be processed. The SLA contains the indicators of multiple services to ensure the service quality of cloud computing service providers. The CPU utilization function of the server node replaces the violation rate as a universal criterion. Then, the SLA violation rate function is defined as follows:

$$f_i^s = \ln(2 + j_{\text{cpu}} - 0.87). \quad (7)$$

**Constraint 2** (resource balance). Since the resources of each physical server are not the same, and different types of virtual machines have different requirements for different resource types [19]. The amount of physical machine resources remaining on each physical machine is determined by the placement scheme of different virtual machines. However, in order to avoid the barrel effect, the resource usage on each physical node in the cloud platform should be kept as balanced as possible, such as network bandwidth, disk, CPU, memory, and other resources. It is to prevent the shortage of any one of the resources and cause the waste of other resources. Resource scheduling refers to the process of adjusting resources among different resource users according to certain resource usage rules under a specific resource environment. The utilization rate of four kinds of resources including physical node network bandwidth, disk, CPU, and memory is studied separately.

$$\begin{aligned} f_i^{\text{load}} &= \frac{4}{(u_{\text{cpu}}/u)^2 + (u_{\text{mem}}/u)^2 + (u_{\text{bw}}/u)^2 + (u_{\text{disk}}/u)^2}, \\ u &= \frac{u_{\text{cpu}} + u_{\text{mem}} + u_{\text{bw}} + u_{\text{disk}}}{4}, \end{aligned} \quad (8)$$

$u_{\text{cpu}}, u_{\text{mem}}, u_{\text{bw}},$  and  $u_{\text{disk}}$  represents the utilization of server CPU, memory, network bandwidth, and disk.  $u$  represents the arithmetic mean of CPU, memory, network bandwidth, and disk four-dimensional resource utilization.  $f_i^{\text{load}}$  represents the deviation of the four resource utilizations of disk storage, network bandwidth, memory, and CPU from the average utilization [20].

**Constraint 3** (power loss efficiency). It is the total amount of power consumed by the server while it is running [21]. Under normal circumstances, the power consumed by the CPU accounts for the main part of the energy consumption of a server. A large number of research results show that there is a linear correlation between the power consumption of a physical node and the CPU usage on the physical node.

In other words, the power consumption of a physical node increases as the CPU usage on the server node

increases. The relationship between the power consumption of a physical server node and the CPU usage on it.

$$P_j = (P_j^{\text{busy}} - P_j^{\text{idle}}) \times U_j^{\text{cpu}} + P_j^{\text{idle}},$$

$$P_j = k \times P_j^{\text{busy}} + (1 - k) \times P_j^{\text{idle}} \times U_j^{\text{cpu}}, \quad (9)$$

$$\frac{P_j^{\text{busy}}}{P_j} = f_j^p,$$

where  $P_j^{\text{busy}}$  and  $P_j^{\text{idle}}$  represent the power usage of server  $j$  under full and no-load conditions, respectively.  $U_j^{\text{cpu}}$  represents the CPU utilization on physical node  $j$  [22]. Next, this paper analyzes the optimization problem of virtual machine initialization deployment. If the user applies to create  $m$  virtual machines, the cloud platform needs to deploy these virtual machines to  $n$  physical machines. In order to simplify the problem, it needs to add some constraints. When the utilization rate of one of the above four resources is zero,  $f_i^{\text{load}}$  takes the minimum value of 1/4, which indicates that the resource utilization rate of the entire cloud platform system is very unbalanced.

$$F_j = k_1 \times f_j^p + k_2 \times f_j^{\text{load}} + k_3 \times f_j^s,$$

$$\sum_{j=1}^n x_{ij} = 1, \quad \forall i \in I,$$

$$\sum_{i=1}^m R_{pi} \times x_{ij} \leq T_{pj} \times y_j, \quad \forall j \in J, \quad (10)$$

$$\sum_{i=1}^m R_{mi} \times x_{ij} \leq T_{mi} \times y_j, \quad \forall j \in J,$$

$$y_j, \quad x_{ij} \in \{0, 1\}, \quad \forall j \in J, \forall i \in I.$$

By default, the OpenStack cloud platform only performs weight calculation based on the remaining memory size of the physical node. That is to say, the more the memory remaining on the physical host, the greater the probability of being selected as the destination host for initial deployment of the virtual machine. Through this algorithm, the resource scheduling strategy aiming at reducing the cost is used to improve the resource utilization rate. It reduces the energy consumption cost of cloud computing and improves the operation efficiency of the cloud platform.

*3.3. Design of OpenStack Ubiquitous Learning Environment University Innovation and Entrepreneurship Education and Training System Design.* Innovation and entrepreneurship education focuses on cultivating students' innovative spirit and entrepreneurial quality and attaches great importance to the cultivation of students' innovative spirit and practical ability [23]. Entrepreneurship can be divided into broad and narrow senses. Entrepreneurship in the broad sense refers to pioneering and innovative activities. In a narrow sense, entrepreneurship refers to entrepreneurs looking for business opportunities and establishing some active organizations. It uses limited resources to provide certain products

and services and ultimately create value. To crack the next entrepreneurship through the innovation and entrepreneurship education and training system in colleges and universities, the main body of college students' innovation is college students. It is a person who has received higher education, the object is a variety of limited resources, and its superior resources are rich in knowledge and information.

With the continuous development of entrepreneurship education, many people have begun to carry out entrepreneurship education, but they still do not pay enough attention to it. The problems of the entrepreneurship education system have gradually become prominent: the goal of entrepreneurship education is vague, the utilitarian tendency is clear, and it does not combine the characteristics of students and their own reality. Entrepreneurship education curriculum system is imperfect, lacking in quantity and weak in structure. The number of teachers is insufficient, the quality is uneven, and the degree of specialization is relatively low. Entrepreneurship education guarantee mechanism is not perfect, and teaching and management systems are not perfect and other factors. If they want to achieve their own sustainable development, they must have a comprehensive and systematic understanding of entrepreneurship education. It makes full use of its own advantages to build a sound entrepreneurship education system.

The ubiquitous learning platform is a comprehensive learning platform that provides teachers and students with learning, teaching, resource sharing, and mutual assistance [24]. The goal of entrepreneurship education in colleges and universities is to achieve the goal of entrepreneurship education, and entrepreneurship education is the basis for the formulation of teaching goals and teaching content. It is a measure of teaching effectiveness. It is beneficial to enhance students' innovative ability, practical ability, social adaptability, and lifelong learning ability and realize their own sustainable development. There are four main scenarios:

- (1) Learning: teachers can plan courses, create new courses, upload course materials, etc., on the platform. After logging in to the ubiquitous learning platform, students can view and find the courses offered on the platform and their related information, register courses, and study courses [25]. Students can view test scores and specific correction results to summarize their learning deficiencies. By taking exams, completing assignments, or helping grade other student work, students better understand course content, review lessons, and expedite feedback on assignments. Students can also download learning materials and then can view learning resources offline anytime, anywhere, which has great advantages over traditional teaching and satisfies the theory of ubiquitous learning.
- (2) Learning verification: allowing professors to verify student progress, test results, course grades, and course statistics, as well as the year's final test, organizing exams, and assigning homework. Based on these statistical observations, professors cannot justify any skepticism and make no progress, so alumni may be able to learn with mixed results.

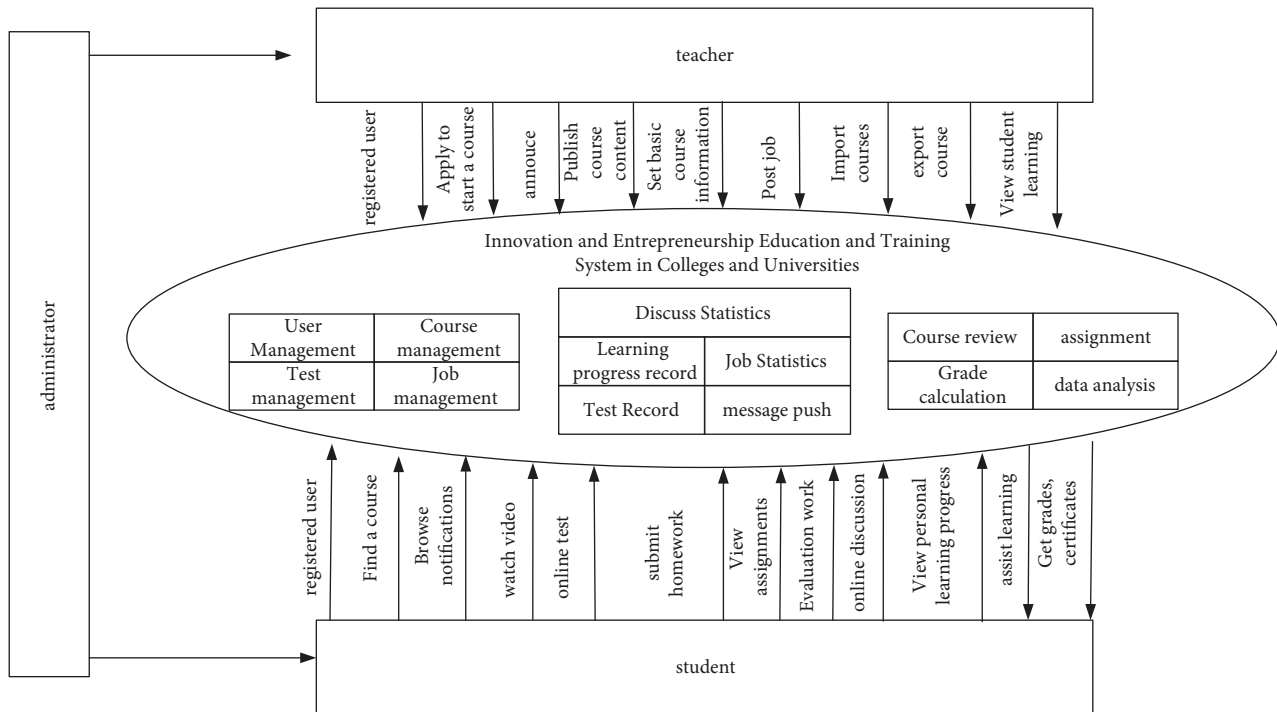


FIGURE 2: System application scenario diagram.

- (3) Feedback: students can give feedback on the course after the course, or they can write their own learning experience and experience in the forum. At the same time, it can evaluate and score teachers, course content, learning experience, etc.
- (4) Communication: when there are doubts in the learning process, students can communicate with teachers or other students and ask questions. It can also answer questions asked by others. Students and teachers can exchange knowledge with each other through discussions in the forum, and students can share materials with each other. The system application scenario is shown in Figure 2.

Platform administrators need to review teachers' registration information and manage permissions for other roles. The administrator needs to login to a separate page to set the global functions of the system, manage the system configuration, maintain the database, and monitor the operation of the system.

Figure 3 demonstrates the system functions of the open source ubiquitous learning environment. User login means that users can login to the system through their user name or e-mail address and password after completing the registration. Teachers can designate other students or manually select some students to correct their assignments, and they can also view historical assignments and correction records. Teaching material management: teachers can upload and download corresponding teaching materials and set the use rights of teaching materials, etc. [26].

The specific evaluation process of the homework evaluation subsystem and the ubiquitous learning system is shown in Table 2. When students submit homework in the

homework evaluation subsystem, the homework also needs to include the address to be sent back after correction. The address can be assigned automatically by the system or manually by the teacher. Students receive assignments and grade them and return the work when they are done, with an item in the work indicating the grade of the work. It checks whether the job obtained is a job that has been judged and specifies whether it needs to be modified or needs to be displayed according to the judgment situation.

The data table of the homework evaluation subsystem is shown in Table 3. The relevant data items are explained in the above two data tables. After a student passes the online test, the system obtains the student's test result data and stores it in the score database. After the corresponding functional function processing, the student progress monitoring system can view the relevant learning data of the students according to different needs.

#### 4. Optimization of Innovation and Entrepreneurship Education and Training System in Colleges and Universities

**4.1. OpenStack Cloud Computing Virtual Machine Optimization Test.** Virtual computing clusters are integrated with virtual machines. By standardizing the storage and local storage of the NFS server in the login phase of the cluster, the nodes can login remotely through the key. By establishing a parallel programming environment system, the management software of the cluster uses a resource manager with safety certification. This manager Sunac is used in supercomputers and massively parallel computing clusters. It is highly scalable and fault-tolerant, making it easy to manage

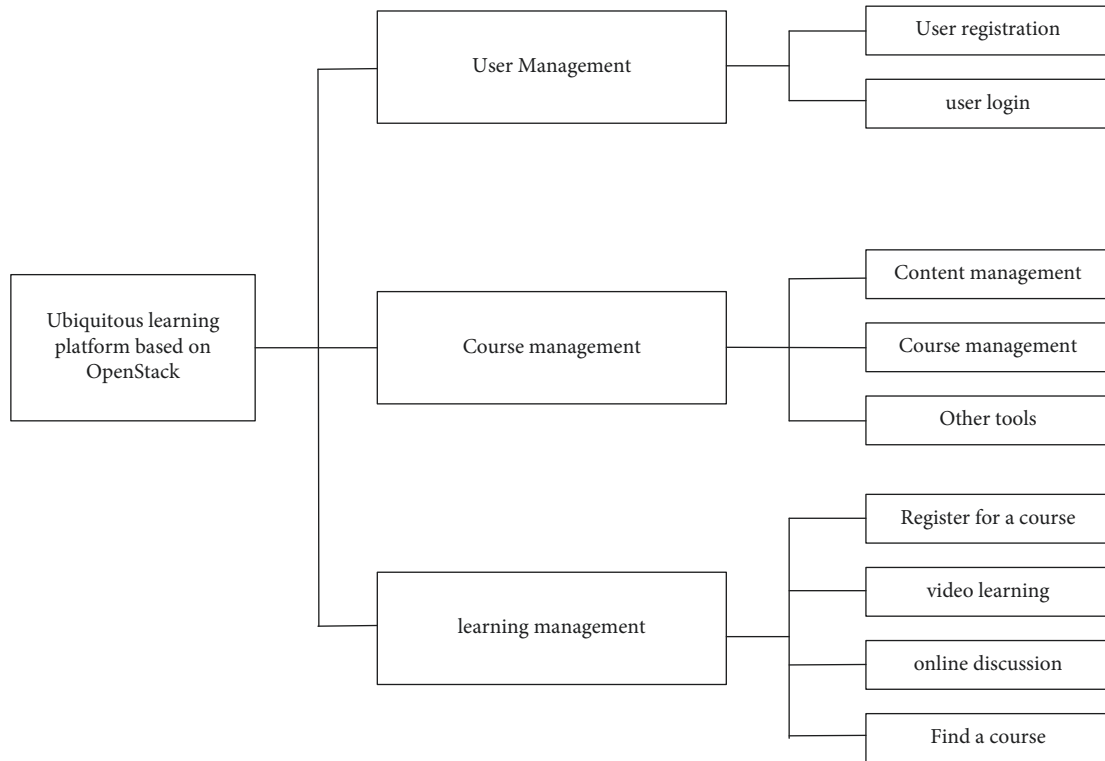


FIGURE 3: System function diagram of OpenStack’s open source ubiquitous learning environment.

TABLE 2: Detailed description of the job evaluation subsystem database table.

Data table name	Primary key	Illustrate
User table	User ID	Username, password, e-mail, account activation, login time, registration time, teacher, administrator
Configuration table	Configuration information number	User ID, name, gender, reason for registration, highest education program user ID, date of birth
Homework evaluation form	Evaluation method number assignment	Evaluation method number, homework evaluation method name, homework evaluation weight table, weight information number, user number, weight, course number
Detailed evaluation form	Evaluation detail number	Evaluation no., evaluation details no. evaluation no.

TABLE 3: Detailed description of the database table for learning the classic monitoring subsystem.

Data table name	Primary key	Illustrate
User table	User ID	Username, password, e-mail, account activation, login time, registration time, teacher, administrator
configuration table	Configuration information number	User ID, name, gender, date of birth, reason for registering
Class schedule	Course No	Course number, course name, name of the school offering the course
Worksheet	Job number	Assignment number, course number, assignment name, assignment evaluation method, assignment
User test form	User ID	Test question number, test question score, user’s score
Assignment submission form	Submit operation number	Course ID, assignment ID, student ID, assignment name, file path

large virtual computing clusters. The test of the simulation experiment is run on the NUDTSCI Cloud scientific cloud platform composed of 2 cloud hosts and the physical high-performance cluster composed of 2 nodes. Table 4 describes the configuration of physical nodes and cloud hosts.

In the experiment, 6 applications that are relatively representative in the test set are selected: (1) integer sorting (IS); (2) complex parallelism (EP); (3) multigrid benchmark (MG); (4) conjugate gradient formula solving; (5) block sparse formula solving (LU); (6) fast Fourier transform (FT).

TABLE 4: Physical cluster vs. virtual cluster single node configuration.

	Physical node	Cloud hosting
Processor	Intel Xeon E5-2640v4 10 cores	Intel Xeon E5-2640v4 10 cores
Number of CPU cores	40	16
Single node memory	132G	16G
The Internet	InfiniBand high-speed network	Gigabit Ethernet
Operating system	CentOS 6.8	CentOS 6.5
Resource management software	Slurm 2.2.5	Slurm 2.2.5

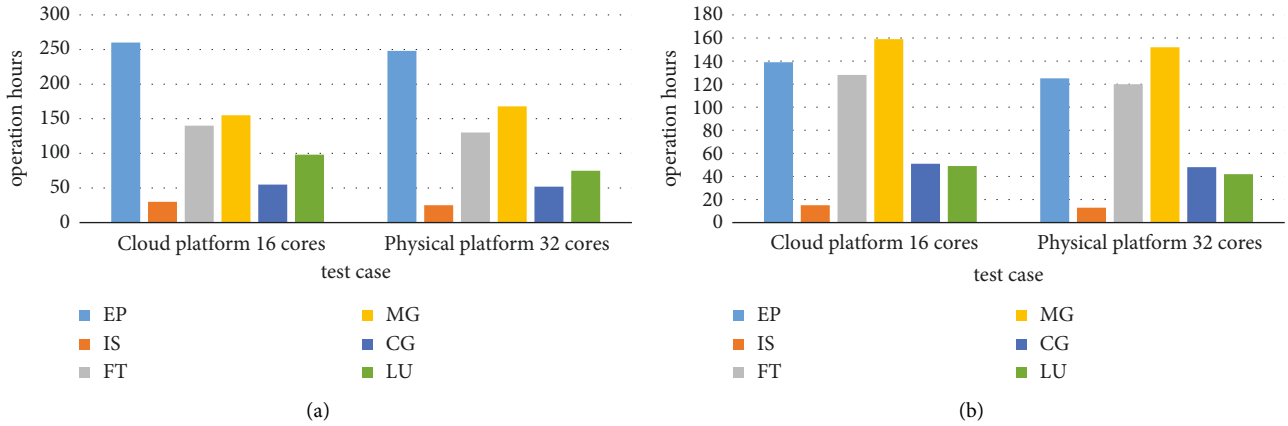


FIGURE 4: The server starts the virtual machine to run the NPB comparison test.

The test results of NPB are expressed in millions of floating-point operations performed per second, which can show the actual performance of general application programs. 4-Core and 8-core parallelism were started on a single node of 2 cloud computing, 4 physical clusters and high-performance computing cloud platform, respectively, and the running time of each test program in the NPB test set was recorded. They form a parallel virtual set of 16 CPUs and 32 CPU cores, respectively. It records the running time of each test program in the two clusters in the NPB test set as shown in Figure 4.

It can be seen from the experimental results that when the virtual machine exclusively occupies the physical node, the running time of the six test programs in the NPB test set is not much different between the physical node and the virtual machine. Among them, the FT program with the largest difference increased the running time by about 8.5% on the cloud platform after the introduction of virtualization overhead. It can be seen from this that, whether it is the performance of floating point and integer operations or the communication performance of sets, the extra overhead after the introduction of virtualization is within 10%.

Due to the lack of analysis of OpenStack's built-in algorithm, this paper elaborates the proposed multiobjective optimization algorithm based on the ant colony algorithm in detail. Due to the limitations of the laboratory environment, it cannot meet the requirements of the experiment. Therefore, we choose to simulate the algorithm on the mainstream cloud simulation platform CloudSim to verify the effectiveness of the algorithm proposed in this chapter. In order to comprehensively test the performance differences between

TABLE 5: Algorithm parameter settings.

Algorithm parameters	Value
Pheromone heuristic factor	$\alpha = 1$
Visibility heuristic	$\beta = 4$
Pheromone volatility coefficient	$\sigma = 0.4$
Number of iterations per trial	$R_{\max} = 30$
Number of ants	$\delta = 25$
Initial pheromone intensity	$\mu_{ij}(0) = 3$

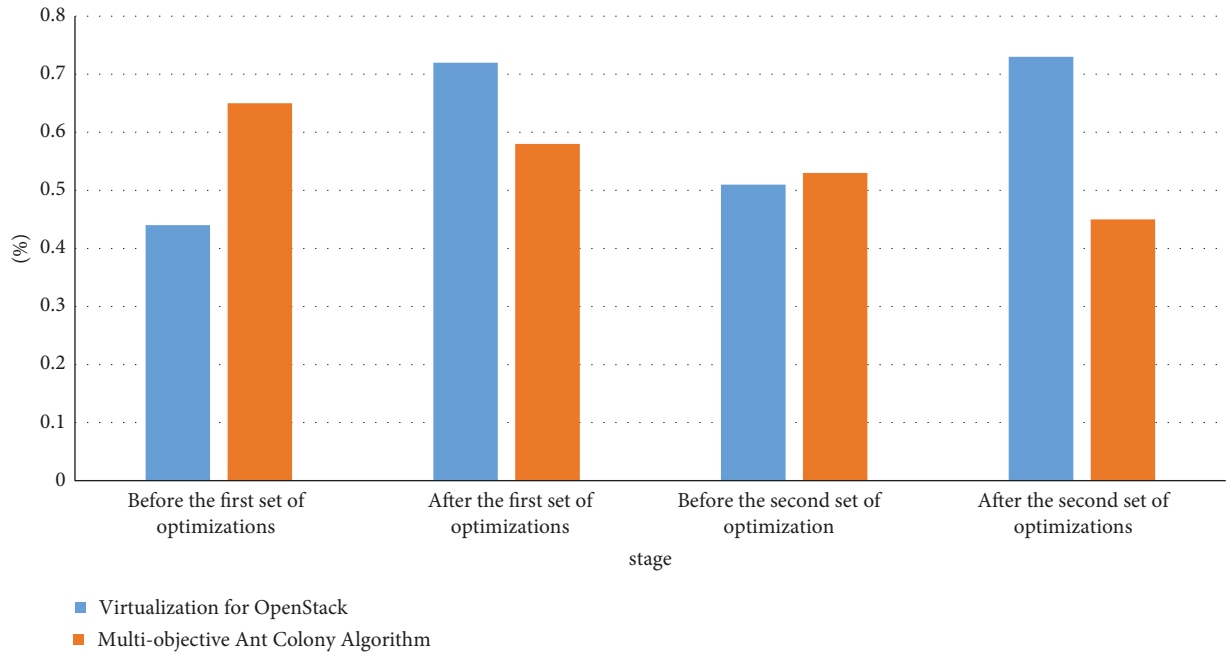
high-performance cloud platforms and physical clusters, this paper designs the following experiments from different aspects. Start two virtual machines on each physical node and set the parameters as shown in Table 5.

It is the percentage of incidents resolved within the agreed SLA time, which checks the performance of the IT service desk against the service level agreement with the user. The comparison of user SLA violation rate, power consumption, and OpenStack virtualization test of multi-objective ant colony improvement algorithm scheduling strategy is shown in Figure 5.

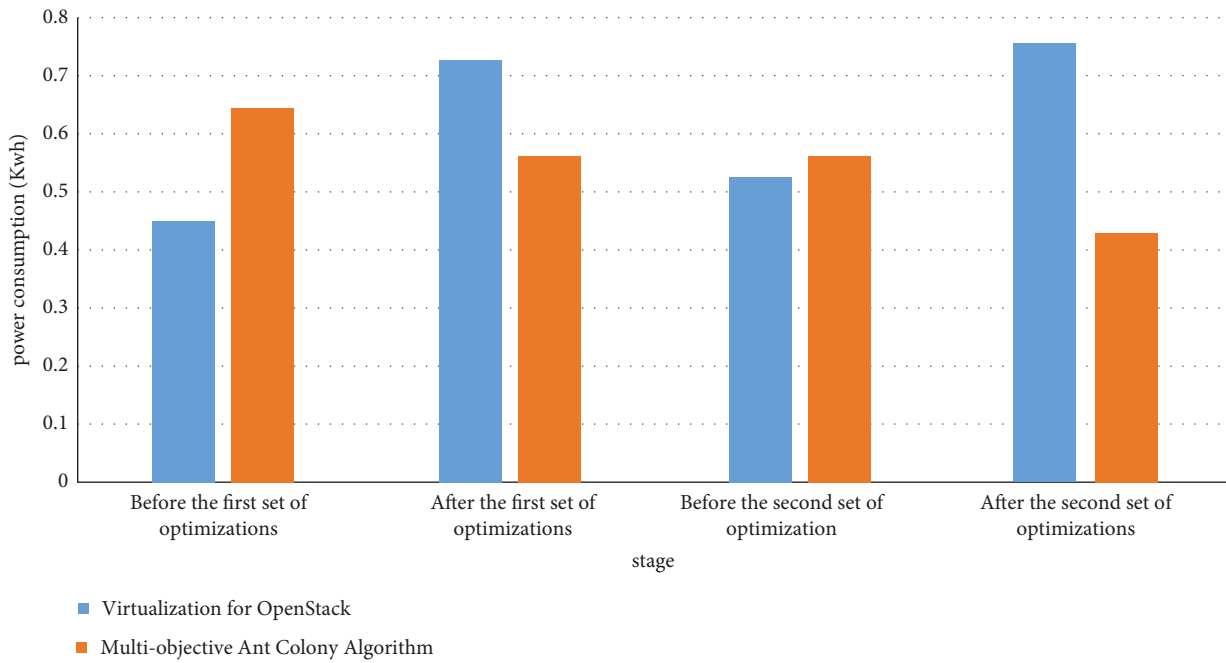
It can be seen from Figure 5 that compared with the previous two groups of experiments, the virtual machine dynamic scheduling algorithm proposed with the multi-objective ant colony improved algorithm has improved about 20% in terms of power consumption and user SLA violation rate. It proves the rationality and effectiveness of the designed virtual machine dynamic migration scheme.

#### 4.2. Performance Test of Innovation and Entrepreneurship Education and Training System in Colleges and Universities.





(a)



(b)

FIGURE 5: Comparison of server user SLA violation rate and power consumption.

According to the analysis of the functional requirements of the innovation and entrepreneurship education and training system in colleges and universities, this paper focuses on testing the performance stability of each node under high system load. The test environment is offline. This paper simulates 10 physical machines, 5 meta virtual machines, and one object storage device in a cloud data center.

This article uses MDTest to test the system IOPS of the file system, increases the pressure on the server node

through open/close/stat operations on the file, and runs a large number of client programs at the same time to cause access pressure to the server. Through eight hours of uninterrupted operation, the throughput and load of the cluster are counted during this article. The simulated data center configuration table is shown in Table 6.

The five MDSs are named as MDS1–5, respectively. Taking MDS1 as a reference, their performance ratio is 1 : 3: 17 : 1.5 : 4, the number of consecutive times is  $N=2$ , and the trigger threshold  $\theta$  is set to 0.2. This article records the load

TABLE 6: Cloud data center parameters.

Cloud data center parameters	Value
Number of physical machines	
Physical computer CPU computing power	{1000, 2000, 3000}
Physical machine memory (GB)	4
Physical machine bandwidth (Gbps)	Physical disk capacity (GB)
1024	Number of virtual machines
300	{0.25, 0.5, 0.75, 1}
Virtual machine CPU computing power (GHZ)	512
Virtual machine memory (M)	200
Virtual machine disk capacity (GB)	250
Virtual machine bandwidth (Mbps)	Value

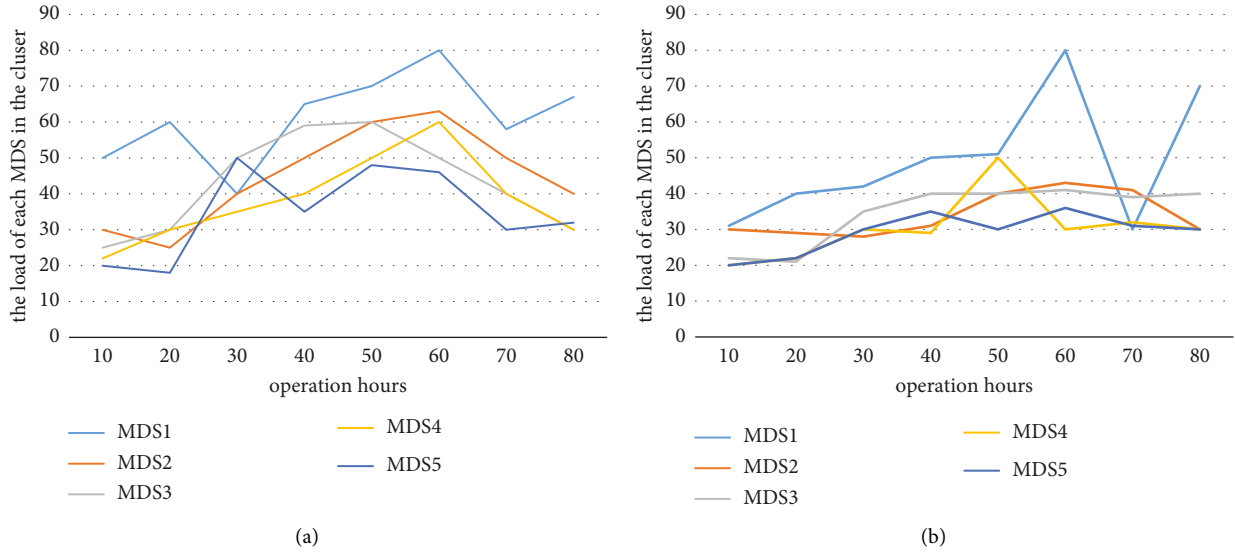


FIGURE 6: The load of each server when it is turned on and not turned on.

value of the load balancing strategy without and with the load balancing policy turned on, respectively. The calculation formula of the system load balancing degree is

$$PD = \sqrt{\sum_{i=1}^n (Li - \bar{L})^2}. \quad (11)$$

PD is the load balance degree value, and  $L_i$  is the load value of node  $i$ . In the experiment, a test script was written to record the system load value, including the central processing unit and the internal storage device.

After the system runs for 8 hours, the average processor load is calculated according to the load balance calculation formula. During the 8-hour test, load data were recorded every hour. Finally, this paper calculates the processor and memory utilization. Assuming that the processor accounts for 60% of the performance and the corresponding memory accounts for 40% of the performance, the cluster pressure is gradually increased. It obtains the load of the cluster when the load balancing strategy is not enabled and enabled, respectively, as shown in Figure 6.

As can be seen from Figure 6, the load of each server is not related to a certain extent, and the load is generally high;

even the utilization rate of MDS5 exceeds 80% for a period of time. This also shows that, during this period, the access performance of the node will also decrease. It can be seen that the situation without load balancing is very unstable and the load is high. It can be seen from the experimental results that the overall load has decreased and the load of each MDS is relatively close, and the system has achieved the expected expectations.

## 5. Discussion

In order to study the dynamic scheduling mechanism of virtual machines, this paper firstly analyzes the built-in scheduling strategy of OpenStack and points out the shortcomings of the scheduling strategy. Aiming at this deficiency, this paper builds a model and sets constraints. Finally, through the simulation comparison on the cloud simulation platform, this paper verifies the effectiveness of the algorithm in improving the load balancing of the system, reducing the violation rate of users, and reducing the power consumption of the system. Through the relevant design of innovation and entrepreneurship education courses, users can not only enjoy resources at a low cost but also reduce entrepreneurial risks.

This paper conducts an indepth research and analysis on the mechanism of OpenStack virtual machine resource scheduling through cloud computing virtual machine technology. It also uses the improved ant colony algorithm to optimize the initial deployment of the virtual machine. This paper designs a dynamic migration multiobjective optimization algorithm for virtual machines. The algorithm can achieve a balance among multiple conflicting goals, such as resource balance, user SLA violation rate, and system power consumption, so as to achieve optimal system performance.

## 6. Conclusion

This paper uses the cloud platform to optimize the innovation and entrepreneurship education and training system in colleges and universities. This paper uses OpenStack virtual technology, improved ant colony algorithm, and OpenStack ubiquitous learning environment system to improve the cloud platform of innovation and entrepreneurship training education system. This paper tests the system of OpenStack's ubiquitous learning environment. According to the test results of the system load, the system can still achieve the expected effect. Regarding system stability, there is still room for improvement.

## Data Availability

No data were used to support this study.

## Conflicts of Interest

The authors declare that they have no conflicts of interest.

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