Researches on Cloud Computing-based Design of Online Mathematics Teaching System for Colleges and Universities

Jinyun Yang
College of Mathematics and Physics, Xuzhou Institute of Technology, Xuzhou 221111, China

Abstract

With the rapid development of society, traditional teaching models can no longer adapt to the modern social demand, and the online teaching is widely applied in all disciplines as an emerging model, which has completely changed the traditional teaching structure and obtained significant effects. Meanwhile, the cloud computing plays an important role in the educational teaching through its extensive application in various fields. In this article, influencing factors are firstly explained on the online mathematics teaching system of colleges and universities; then, characteristics of cloud computing are analyzed; next, from 2 aspects – cloud computing-aided teaching to enrich in-class teaching content and micro-class teaching to motivate students in learning, a design path is proposed to the online mathematics teaching system of colleges and universities and an evaluation system is offered to be set up for the cloud computing-based online mathematics teaching system of colleges and universities. In this way, the learning efficiency of students and the teaching quality by teachers will be both improved.

Keywords: Cloud Computing, College Mathematics, Network Teaching.

1. RESEARCH BACKGROUND

1.1 Literature review

In the context of the rapid development of information, there are still numerous deficiencies for the setup of online mathematics teaching system for colleges and universities. The online mathematic teaching systems in most colleges and universities are still somewhat limited, and no systematic and in-depth research results have been obtained on the online mathematics teaching in colleges and universities so far. However, the online teaching gradually breaks through the traditional teaching shackles in the education development, which leads students to think about questions in bran-new ways and explore the knowledge points included in these questions. The teaching focus shifts from grasping the basic knowledge and solutions to improving the comprehensive quality of students (Song and Li, 2015). The strong flexibility of online teaching allows teachers to freely change the content of questions as depending on the teaching content and courses, so as to lead students to think about questions from multiple perspectives. As the online teaching is now widely applied in mathematics education, teachers will prepare proper questions before class by conducting in-depth researches and select questions suitable for teaching and consequently allow students to fit in with scenarios created in questions and rather understand their learning statuses. The online teaching satisfies the new course reform requirements on “student orientation with the help of teachers”, which enables students to independently explore the knowledge points, do the training of divergent thinking and try to express their own opinions. In the learning process, students can clearly know their own shortcomings and evaluate themselves reasonably to make sure all the questions asked can be solved in the entire teaching process (Huang and Su, 2016).

1.2 Research objective

The cloud computing has been increasingly widely applied in the mathematics teaching of colleges and universities. Its application in the mathematics teaching of colleges and universities causes teachers to change their teaching methods, and it has also affected the teaching concept of teachers. Teachers can create a good learning atmosphere and motivate students during mathematics teaching (Wang, 2016), thus improving the study efficiency of students. Besides, the application of cloud computing in the mathematics teaching creates a new teaching model that breaks through the traditional teaching model, which greatly helps students to learn mathematic knowledge and improves their study efficiency. Meanwhile, it also greatly enriches the mathematics...
teaching content, fully exploit the learning interest of students and help students to cultivate correct learning habits and methods and consequently improve their study efficiency. The mathematics teaching model in colleges and universities also varies with the education reform. As the traditional teaching model can no longer adapt to the modern society, teachers start to gradually explore new teaching method in teaching practices. The rapid development of information technology nowadays enables teachers and students to be highly acceptable to the cloud computing technology (Cui and Wang, 2015). In this article, the importance of cloud computing application in teaching is analyzed, the influencing factors on improving teaching quality are illustrated, and corresponding strategies are proposed as well, which aims at better applying the cloud computing technology into the mathematics teaching in colleges and universities.

2. INFLUENCING FACTORS ON ONLINE MATHEMATICS TEACH SYSTEM FOR COLLEGES AND UNIVERSITIES

2.1 Backward teaching concept

Right now, when teaching mathematics in colleges and universities, some teachers do not put emphasis on training the comprehensive abilities of students as a result of their backward teaching concept in mind. When they explain mathematical questions, they just solve them for students and let students understand the mathematical principles included instead of leading them to think. Besides, considering the abstract characteristics of mathematics itself, teachers try to illustrate them in a concrete way but just ignore the inherent characteristics of mathematics itself (Jim, 2015). Teachers cannot motivate students in the study when teaching them with their backward teaching methods, and they ignore the application of multi-media information technology in the teaching and thus fail to keep pace with the development of the times. Besides, many colleges and universities cannot afford to introduce the expensive information-based teaching equipment, or they just spend their teaching fund on the vanity projects instead of enhancing the capabilities that need to be truly enhanced. Some colleges or universities become aware of the assistance of information technology to students in the mathematics study, but they adopt incorrect teaching and training methods and therefore decrease the learning interest of students (Wang and Yao, 2015).

2.2 Cognition deficiency of students

High school graduates just go to colleges and university for a short period of time with quite weak basic knowledge, so that they sometimes can hardly understand the abstract mathematical concepts when learning mathematics with so many complicated knowledge points, formulas and concepts. They just rely on the explanation that teachers provide on class, so that they do not firmly grasp the knowledge point and can hardly achieve the teaching objectives. The mathematics study in colleges and universities is a critical period for students to learning mathematics, during which students can accumulate the mathematical knowledge learned and further lay the foundation for more advanced mathematics learning. However, as a result of the abstract characteristic of mathematics, students do not develop a strong interest in learning it, which also affects the entire teaching quality on class. Their cognition of information-based teaching is also insufficient as they consider it as a kind of game in a less severe manner (Zheng, 2015).

3. OVERVIEW OF CLOUD COMPUTING

3.1 Basic concept of cloud computing

The cloud computing is a kind of new computing model based on distributed computing model, which is applied in various kinds of technical operation models to meet the demand of business model innovation. The cloud computing service has become the inevitable trend in the future development with the application of modern software and automatic information development. Without a definition that is commonly accepted, the cloud computing is generally defined as a kind of business computing model for assigning computing tasks in the computer, through which the computing capacity, the storage space and information services can be obtained as required in all application programs (Lang and Yang, 2011). In some sense, considering the necessary connection between the software and the hardware, the cloud computing allows application programs to be executed on different kinds of software through parallel computing. In this kind of computing mode, the computer only needs to send the demand command, and then tens of thousands of remote computers will complete the computation and the computation result will be displayed on the local computer. In the cloud computing mode, users can use various kinds of recourse transparently via the high-speed Internet without
caring about where the internal operation is done. The cloud computing can provide users with customized, reliable and maximized resources utilization services. Computing tasks are distributed on considerable distributed computer instead of being distributed on the local computer or remote servers, which allows users to switch resources to application programs that need to access computers and storage systems. The core technology of cloud computing is shown in Table 1.

<table>
<thead>
<tr>
<th>Technology</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>File system GFS</td>
<td>Providing massive data storage, access</td>
</tr>
<tr>
<td>File programming model MapReduce</td>
<td>Parallel processing of massive information</td>
</tr>
<tr>
<td>Distributed lock service Chubby</td>
<td>Synchronization problem of concurrent operation in distributed environment</td>
</tr>
<tr>
<td>Distributed structured data table</td>
<td>Massive data organization and management</td>
</tr>
</tbody>
</table>

### 3.2 Characteristics of cloud computing service

The resources used by users meet the business needs and are allocated in accordance with users’ dynamic requirements. Beside, users quickly request and purchase resources as actually required expanding the processing capacity, so that the service scale is dynamically changing and is quickly expanded to avoid resource waste. Problems such as data center management and large-scale data management can be avoided through the virtualization of resources such as storage and computation (Pan and Rong, 2017). The service provider monitors the use process of service resources and correctly charges for the service bills based on the capital use condition. Various kinds of terminals just need to access the cloud computing service through the browser, and the data is no longer stored on the hard disk but in the cloud computing service to prevent its loss and virus invasion. In the cloud computing mode, the data is stored in cloud service. All electronic devices just only need to be connected to the Internet to access and use the same number. This is a new way for share the infrastructure as it is stored in the phones, computer and all other devices (Chen and Huang, 2017). Considerable information and process resources are gathered together for co-working, and all computing tasks can be sent to servers via the Internet with personal computer and terminals, which consequently reduce the computing amount and improve the working efficiency. The relationship between cloud computing and related technologies is shown in Figure 1.

![Figure 1. The Relationship Between Cloud Computing and Related Technologies](image)

### 4. CLOUD COMPUTING-BASED DESIGN OF ONLINE MATHEMATICS TEACHING SYSTEM FOR COLLEGES AND UNIVERSITIES
4.1 Cloud computing-aided teaching to enrich in-class teaching content

The cloud computing-aided teaching, as the extension and new development of computer-aided teaching, refers to build a personalized cloud computing teaching environment on the basis of cloud computing platform in the cloud computing environment, so as to help teachers to teach students, facilitate the communication between teachers and students and help students to learn the knowledge collaboratively. The application of cloud computing teaching model in the mathematics teaching practices must be implemented on the mathematics learning platform under the network environment. The setup of mathematics teaching platform under the network environment is important to the mathematics teaching models based on cloud computing, because most mathematics teaching models need to be executed on this platform. The mathematics teaching platform should include modules of teaching resources, teaching materials and exchanges and interaction, and it can also be designed with some interesting content about mathematics and the mathematics practice module (Cen and Cai, 2017). The mathematics teaching platform should be equipped with the background monitoring system to make the comprehensive data statistics about the scanning and learning operations from the students’ registered accounts on the platform and consequently provide objective evidence as reference for generating the result of mathematics teaching evaluation. On the mathematics teaching platform, an autonomous learning environment before class can be created for students, and some difficult mathematical learning points will be visualized acoustically and graphically, so that students can intuitively understand the meanings and connotations of mathematical knowledge points. The online platform is set up to help students find out focal learning points and clearly define their learning objectives. The teaching basis and key point is to determine the teaching objectives in line with requirement that should be met by students at each stage, because determining the teaching objectives will help students participate in the teaching. According to feedbacks from the teaching platform and by referring to the teaching materials and the teaching program, teachers properly allocate study tasks to students. Considering the combination between teaching focus and teaching difficulty and clearly defining the teaching content, teachers should ask questions related to the focal points in the teaching content, lead students to independently think about questions, help them deepen their understanding of the teaching content and enable them to feel the fun of independently exploring and learning mathematical knowledge (Jin and Ding, 2017). Students are encouraged to discuss and exchange opinions with each other, and thus their learning desire will be stimulated. The mutual exchanges between teachers and students as well as among students will be facilitated on this teaching platform. The system architecture of the education platform based on cloud computing is shown in Figure 2.

![Figure 2. System Architecture of Education Platform Based on Cloud Computing](image)

4.2 Micro-class teaching to motivate students in learning

In the traditional teaching model, students are very passive, because teachers explain all the related mathematical concepts and examples and arrange all teaching activities well. Students learn the knowledge under the dominance of teachers so that they cannot build their own thinking system. On the mathematics class in colleges and universities, students need to grasp a lot of difficult knowledge within very limit time, such as basic concepts and theorems, formula derivation, solutions, question type conversion and extra-curricular advanced questions, etc (Guo and Yuan, 2013). Facing this heavy mathematics learning task, many colleges and universities choose to arrange countless exercises for students, which further increases their resistance to learn mathematics. The micro-class teaching is so flexible that it re-arranges the class time and reflects the
cumbersome knowledge into the extremely elegant courseware or teaching videos. The micro class is centered on students, who have the initiative of learning on their hands. Since there are numerous mathematical knowledge points and quite difficult mathematics questions in colleges and universities, the mathematics class is often tedious in a serious atmosphere. The micro class, by focusing on students, sufficiently considers their interests to liven up the class atmosphere. Instead of being taught in the traditional spoon-feeding way, students will be taught how to flexibly solve questions and be trained for drawing inferences about other cases from one instance (Huang, 2012). The advantage of micro-class teaching lies in its reasonable arrangement of class time, as part of it can be saved for students to ask questions and focus on advanced questions. It can take the actual levels of student into consideration by design questions at different difficulty levels for individual teaching. In this way, the self-esteem of students is protected, the boring class becomes vigorous, and consequently the motivation of students increases. The functions of cloud computing-based online education platform for colleges and universities are shown in Figure 3.

![Image](image.png)

**Figure 3.** Functions of Cloud Computing-based Online Education Platform for Colleges and Universities

5. SETUP OF CLOUD COMPUTING-BASED ONLINE MATHEMATICS TEACHING EVALUATION SYSTEM FOR COLLEGES AND UNIVERSITIES

The mathematics teaching in colleges and universities is the focus in the school education, and building a reasonable evaluation system can help related educators in their work. Teachers can know about the real conditions about students, and they can improve and update their teaching methods as required in the evaluation system to enhance their sense of mission. With the increasing international exchanges and the continuously changing national conditions upon the economic and political rise of China, the mathematics teaching in colleges and universities is facing great difficulties. A reasonable quality evaluation system for mathematics teaching will provide teaching objectives for teachers, standards for related teaching work and references for mathematics teaching, thus reducing the teaching difficulty for teachers (Fan and Sun, 2012). For the academic records of students, statistics is made. Suppose the real number in certain data set is $X_1, X_2, X_3, \ldots, X_n$, and their average value is $\psi$. Then the calculation formula of average number is: $\psi = \frac{1}{K}\sum_{h=1}^{K}X_h$. Suppose the variance is $Y(X)$, $Tac(X)$ or $Ys$, and then the calculation formula is: $y(\eta) = \sum_{h=1}^{K}J_h \times (\eta_h - \psi)^2$, where: $y(\eta)$ is the variance, $J_h$, is the variable probability, $\eta_h$ is the individual characteristic variable, and $\psi = G(X)$ which represents the average number of values. The calculation formula of standard deviation is:

$$\lambda = \sqrt{\frac{1}{K}\sum_{h=1}^{K}(\eta_h - \psi)^2}$$

and then the calculation formula of average number is $\omega = \frac{1}{Q}\sum_{h=1}^{K}L_h$, where: $\sigma$ is the average value, and $s_j$ is the single characteristic variation. The standard deviation is the square root of variance method. If $U(L-U)^2/\exists$exist, then it will become the variance of: $W(K) = \sum_{h=1}^{K}k_h \times (K_h - \lambda)^2$, where $W(K)$ is the variance, and then the calculation formula of standard deviation is: $\theta = \sqrt{\frac{1}{Q}\sum_{j=1}^{Q}(\beta_j - \omega)^2}$;

variance contribution rate $q(X) = \frac{\sum_{h=1}^{H}var(\bar{X}_h)}{\sum_{h=1}^{H}var(\bar{X}_h)} = \frac{\sum_{h=1}^{H}L_h}{\sum_{h=1}^{H}k_h}$. Standardize the raw data and establish the
The evaluation criteria for mathematics teaching in colleges and universities are not fixed, and related evaluation indexes can only be used to evaluate the mathematics teaching effects on students for a recent period. As there is no fixed model for mathematics teaching, the evaluation indexes for mathematics teaching in colleges and universities should be adjusted as the teaching content varies, and the effectiveness of quality evaluation on mathematics teaching should be focused with no formalism. The evaluation indexes for mathematics teaching are created to cultivate the comprehensive abilities and quality of students, so that they should be positioned to improve their comprehensive quality on the human-first principle. Besides, the evaluation rationality and fairness should be noted for assessing students in a multi-level and multi-perspective way. The evaluation principles can be flexible in such way that no same criteria are adopted on different students.

6. CONCLUSION

As indicated from the study on the influencing factors on the online mathematics teaching system of colleges and universities, the inevitable direction for the development of mathematics education in the new times and also the core strategy for improving the mathematical literacy of students. By means of cloud computing-aided teaching and the micro-class teaching, the teaching quality can be effectively enhanced and the comprehensive abilities of students can also be cultivated to help them develop good learning habits. As a kind of flexible teaching method, the online teaching is of in-depth significance to the mathematics teaching in colleges and universities. Through incessant practice and exploration as well as the application of cloud technologies, the online mathematics teaching for colleges and universities can be applied more widely for the all-sided development of students.

ACKNOWLEDGEMENTS

Foundation items: The work was Supported by Teaching reform project of College Mathematics Teaching and Development Center (Grant No.CMC20160411); Education teaching research project of Xuzhou Institute of Technology (Grant No.YGJJ1637); 2017 The Project of Philosophy and Social Science Research in Colleges and Universities in Jiangsu Province (Grant No.2017SJB1030).

REFERENCES

Fan L., Sun J.B. (2012). Design of University Experimental Teaching Platform Based on mobile cloud computing, Fujian computer, 28 (08), 14-16.
Huang W.L. (2012). Innovation of IT talents training mode in Universities in the era of cloud computing, Computer age, (03), 59-61+64.
Song X.Y., Li H. (2015). Research on graduate education model for collaborative innovation entrepreneurship - Taking Graduate School of engineering of Zhejiang University as an example, Graduate education research, (06), 29-32.
Wang H.Z., Yao J. (2015). Research and exploration of remote laboratory system for process control based on cloud computing, Laboratory, 34 (04), 103-106.
Wang Y.Z. (2016). Experimental teaching, Laboratory Science in Universities under cloud computing environment, 19 (05), 102-105.