

Innovation of teaching methods in university based on mobile cloud computing

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ABSTRACT: The traditional teaching pattern of university courses is very simple, but not necessarily effective or engaging. In order to improve students' interest and initiative in learning, the authors put forward an innovative idea to achieve mobile learning by introducing mobile cloud computing technology to university teaching methods. More specifically, as demonstrated in this article, the authors have designed and implemented a learner-centred network teaching platform based on a combination of Moodle and Wiki in the mobile cloud computing environment. Learners are able to access all functions, which are provided by the network teaching platform, through the mobile terminal anytime and anywhere, sharing and downloading teaching resources efficiently and reliably through the cloud storage service as the performance evaluation shows. The platform can also reduce the economic cost significantly.

INTRODUCTION

With the rapid development of science and technology, the progress created in these areas of the has pushed forward improvements in higher education. The strategy of invigorating a country by science and education has spread widely and talented graduates are sent continuously to all the high-end technology fields, which in turn can promote the development of science and technology. Thus, education and science have complemented each other and have become inseparable. Many education researchers have focused on how to use promising science and technology in university education to achieve reform and innovation in teaching.

The traditional teaching pattern of university courses is quite simple. It mainly uses the knowledge dissemination model that is classroom lecturing, asking questions, assigning homework, etc. Most students have no interest nor initiative in learning and, thus, cannot exercise their innovation and practical ability effectively. The key issue of university course reform is how to improve students' interest and initiative in learning, how to make them to understand courses' principles and content effectively, how to enhance their innovation and practical abilities, and how to enable them to apply knowledge to actual projects, in order to satisfy the requirements of modern society and future work.

In this article, the authors introduce mobile cloud computing [1][2] into university teaching methods, which integrates some new technologies in the IT field, such as wireless mobile networks, cloud computing and multimedia technology, and they propose an innovative method to achieve mobile learning, by which cloud services can provide ample education information and resources, while students can access them through portable mobile devices (like smartphone, PDA, laptop, etc), and communicate with teachers and other students anytime and anywhere. This learning method gets rid of time and space limits, and makes students more active.

To support such a learning method, the authors designed and developed a new network teaching platform, which focusses on learners, supports various types of portable mobile devices, and has been constructed on some important Web 2.0 applications (Moodle and Wiki) and in a cloud computing environment.

The platform has been implemented at the College of Computer Science of Wuhan University of Science and Technology in Hubei Province of China since 1 July 2015. The College now has about 2,000 undergraduates and the platform has been put into use for them to learn computer courses, such as Web application system design, Internet technology and distributed computing technology, all of which are important practical courses. The new approach achieves team collaborative learning, individual autonomous learning and open research learning effectively. Because information technologies develop rapidly, it is necessary to apply mobile cloud computing into university teaching methods, enhancing the teaching effect and satisfying the requirements of society for students' higher ability.

PRELIMINARIES

Mobile Cloud Computing

Cloud computing is a kind of large-scale distributed computing technology [3][4]. It combines a series of existing techniques and new techniques in the IT field, such as service-oriented architecture, virtualisation, etc, and implements computing infrastructure based on services, which provide computing and storage resources for users via the Internet. Users utilise terminal software or browsers to access a range of cloud services on a pay-as-you-go basis and, thus, realise the required work and business.

Among the devices that access cloud services, mobile devices, such as smart phones are the most widely used due to their portability and increasing computing power. With the rapid growth of the population using mobile devices to access the Internet, the number of mobile Internet users has exceeded the number of traditional Internet users. Subsequently, the demand for cloud services in mobile Internet usage has been significantly increased. Among the cloud services available, mobile cloud services have been one of the fastest-growing areas. In both domestic and international markets, major Internet corporations are scrambling to launch their cloud service platforms, such as Amazon Cloud Drive, Microsoft Azure, Apple iCloud, Google Cloud Platform, Baidu Yi Platform, etc.

Mobile cloud computing is a new mode of Internet application, and combines cloud computing and mobile Internet. It has many advantages, including having a large number of open software services, providing powerful computing infrastructure, convenient data storage environment and low configuration requirement for terminal software. In particular, it is very popular for its mobility and portability. According to a survey from the Juniper Research company, the application market based on mobile cloud computing has grown by nearly 90% from 2009 to 2014 [5], while another company, ABI Research have estimated that over one billion enterprise customers had accessed cloud computing services through mobile devices by 2014, and that the number of customers would increase continuously [6]. With the rapid development of mobile cloud computing, the authors believe it will enrich related applications and, finally, will become a dominant running mode of mobile applications.

Moodle

Moodle [7][8] is a kind of network learning management system, which has been popular in recent years. Since it is free, open source and easy to operate, it has been recognised by many education experts. Moodle's full name is modular object-oriented dynamic learning environment. Its design is based on a social construction theory of education that allows teachers or students to think together and work cooperatively to achieve *collective wisdom* and *collective knowledge*. It is software that is used to construct a course learning Web site based on the Internet, and it covers the management of the whole teaching process to create a modularised and object-oriented dynamic learning environment with courseware, blogs, resource libraries, etc. On the one hand, Moodle sets up various course activities for teachers, such as fora, tests, votes, questionnaires and chat. Teachers can arrange teaching activities flexibly to match the teaching strategies and keep abreast of students' learning situation accurately to give guidance to students. On the other hand, the teaching design and management of Moodle are student-centred, and are suitable for personalised learning and collaborative learning between individuals. It can improve students' innovative and practical ability enormously.

Wiki

Wiki is a co-creation system and is maintained by many people cooperatively, in which everyone can give opinions or discuss and expand their common topics [9]. Specifically, Wiki is a kind of hyper-text system. One can browse, create, edit and publish the Wiki contents on the Web. The cost of operating on Wiki is far less than that of HTML. Meanwhile, Wiki supports community-oriented collaborative writing, offering necessary help for writers. Finally, writers in Wiki naturally form a community and Wiki provides the community convenient communicating tools to help people to share knowledge in some specific fields. Compared with other hyper-text systems, Wiki makes users in the community participate actively, create collaboratively and work together to finish teaching work and learning task efficiently due to its convenience and openness.

THE NETWORK TEACHING PLATFORM BASED ON MOBILE CLOUD COMPUTING

Platform Design

The network teaching platform is constructed on Moodle and Wiki. It combines them, making best use of their advantages and bypassing their disadvantages.

On the one hand, in the Moodle chat room or forum, learners can present their own opinions or reply to the opinions of others freely, which can enhance the learning effect through discussion. However, when many people participate in the discussion, everyone's opinion arises quickly, which makes the topic sink into chaos. This situation disturbs learners' thinking and leads to their knowledge points intersecting and becoming non-coherent, wasting a lot of learning time. However, by adding the functions of Wiki into Moodle, all the above shortcomings can be avoided. Compared with

Moodle, Wiki pays more attention to the structure and organisation of contents. It allows many people to create and edit content cooperatively into a single-topic Web page, which enables learners view the topic from various perspectives and makes the topic more comprehensive. Thus, teachers can ask their students to participate in discussion about a topic by creating it in a Wiki page. On the page, students can present new opinions or correct existing ones, and all modified versions will be recorded by Wiki automatically, as it is then convenient for demonstrating the topic and for stimulating further discussion. As a result, students can learn the whole resolution process of a topic clearly, keep their mind active in the discussion and, finally, grasp all the knowledge points more efficiently.

On the other hand, Wiki is a completely open system that allows any participant to add, update and delete the content of Wiki pages. Therefore, how to realise efficient privilege management is the key issue when applying Wiki to network teaching. When one can add the privilege management function of Moodle into Wiki, the issue can be solved well. Moodle can permit only access from learners of some courses and grant teachers the right of allowing entrance to Wiki pages from students. In addition, teachers can set more fine-grained access privileges for Wiki pages if necessary, such as setting no group, independent groups or visual groups, to grant different browse rights or edit rights of Wiki pages to different students. Therefore, the strong management capability of Moodle overcomes security problems when applying Wiki in teaching effectively, preventing the platform from being damaged by malicious users and also making the platform be more interactive for users.

Overall, the uniting Moodle and Wiki makes the presentation of teaching content and the discussion of questions combine together closely. It inspires students' creative minds enormously and involves them in the spirit of mutual help. It also enriches the teaching resources of teachers and develops students' subjectivity of learning to strengthen their practical ability. However, the storage overheads of network teaching platform based on Moodle and Wiki are very large, and the computer resources used to configure regional network teaching platform can be tremendous. It will lead to heavy expenses having to be borne by the universities that have many teachers and students. Furthermore, it is difficult to access such network teaching platform through mobile devices due to these mobile devices' slow access speed. One can avoid this situation if one constructs a platform based on cloud computing. Using the cloud storage service can store teaching resources efficiently and stably, increase mobile devices' access speed substantially and reduce economic overheads significantly. Constructing the mobile network teaching platform is a kind of innovation for the university teaching mode, and it breaks the time and space limitation of learning since students can study anytime and anywhere.

Platform Function

The network teaching platform includes a teaching management module, a student module and a system management module. The function structure diagram is shown in Figure 1.

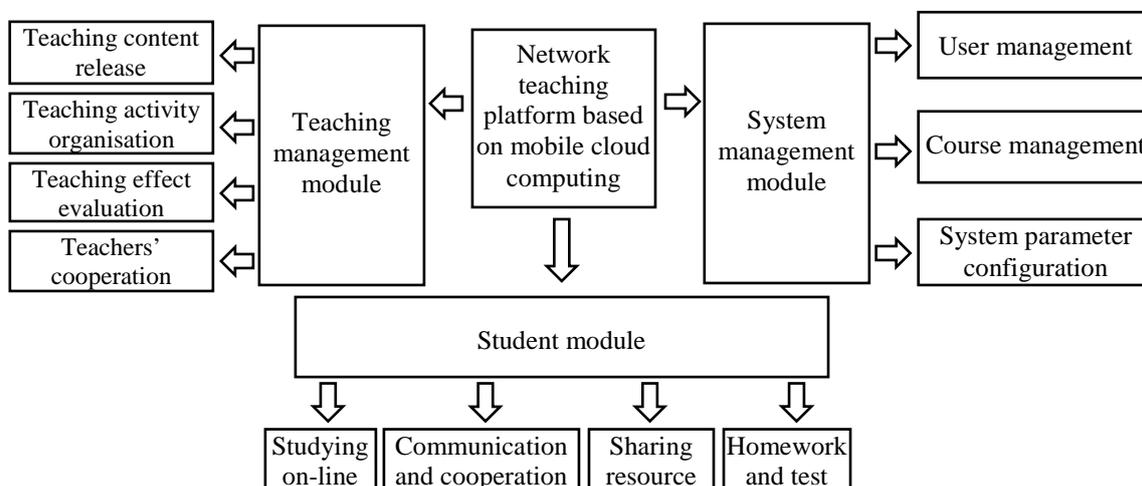


Figure 1: The function structure of the network teaching platform based on mobile cloud computing.

The system management module is aimed at system managers. A system manager has the supreme privileges of the whole platform. The main task for a system manager is to maintain the whole software and hardware environment. His/her main job includes, the configuration of:

- System parameters: setting Web site security, choosing theme styles, compiling language, adding modules, backing up sites, etc;
- User management: assigning user rights, adding or deleting users, setting groups, etc;
- Course management: applying for courses, classifying courses, adding or deleting courses, etc.

The teaching management module consists of functions, such as teaching content release, teaching activity organisation, teaching effect evaluation and teachers' cooperation:

- Teaching content release: teachers publish teaching resources, which are related to courses and include files, videos, etc, teachers also set corresponding experiments to make students combine theory with practice effectively;
- Teaching activity organisation: teachers carry out various teaching activities, for example, teachers divide students into different groups according to their interests and make these groups work on different experiments, which can improve students' learning enthusiasm and develop their cooperative ability; teachers communicate with students on-line through forum and chat room, triggering a *thinking collision* and helping students deepen their understanding of knowledge;
- Teaching effect evaluation: students evaluate the teachers' teaching effect, propose suggestions for improvement, evaluate their own learning effect and evaluate each other's learning effect;
- Teachers' cooperation: teachers strengthen communication and cooperation with each other through this function to accomplish the teaching task together better.

The student module consists of functions of studying on-line, communication and cooperation, sharing resources, homework and tests:

- Studying on-line: students read learning materials on-line in the platform and write down their attainment experience;
- Communication and cooperation: students communicate with other on-line students and teachers through tools such as chat room and forum, and finish experiment tasks with the help of other students in the same group;
- Sharing resources: students share their learning materials with others to achieve common progress;
- Homework and tests: students finish their homework and, then, submit it to their teachers; teachers provide feedback to students when they check and correct the homework; at the end of a course, students need to take the test; homework and tests are necessary tools to examine students' learning effort.

Platform Construction

The network teaching platform based on mobile cloud computing is divided into three parts: cloud storage system, teaching resources server and mobile client. The system architecture diagram is shown in Figure 2.

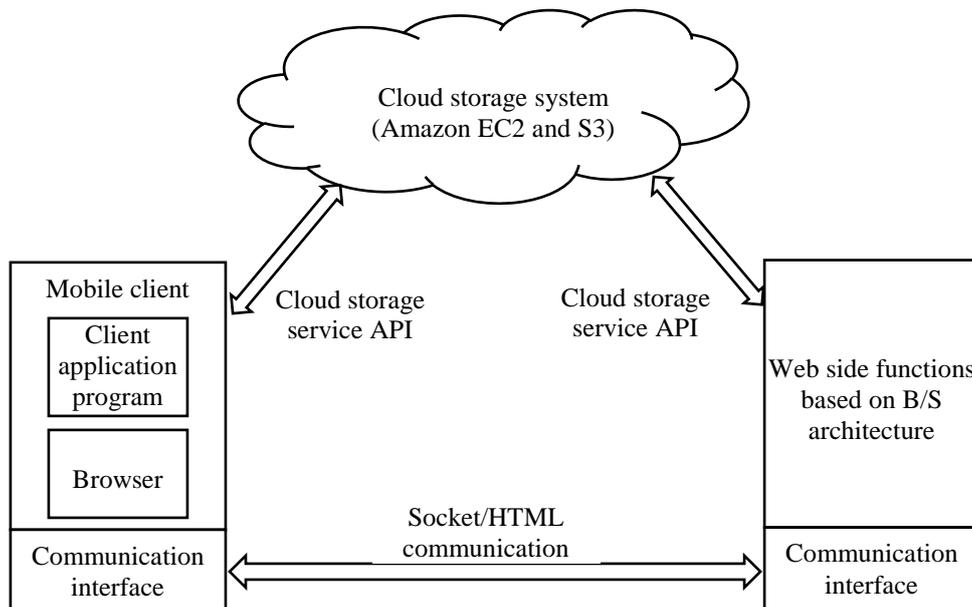


Figure 2: The system architecture of the network teaching platform based on mobile cloud computing.

The cloud storage system is responsible for storing and managing teaching resources. One can utilise Amazon Web Services (AWS) and the .NET SDK provides ways to design and develop the system. AWS contains Elastic Compute Cloud (EC2) and Simple Storage Service (S3) [10][11]. It is secure, efficient, scalable and cheap.

The teaching resource server implements the main functions of the network teaching platform. The program of the server is developed by ASP.NET technology to implement the Web side functions based on B/S architecture. The communication interfaces consist of the client interface and cloud storage interface. The client interface uses socket technology or HTTP protocol to implement the interaction with mobile client. The cloud storage interface adopts cloud storage service API to connect the cloud storage system.

The mobile client is realised by two methods. One is using .NET SDK to develop client application programs, and using socket technology to accomplish the interaction with the server. The other is using browser to interact with the server

through HTTP protocol. The client connects with the cloud storage system through cloud storage service API. Two different types of clients ensure that users can conveniently access all functions provided by the network teaching platform according to their preferences, and efficiently share and download teaching resources through cloud storage service.

Platform Performance

Since 1 July 2015, the outlined here network teaching platform has been implemented at the College of Computer Science of Wuhan University of Science and Technology for six months, and it is used for some practical computer courses, involving about 2,000 undergraduates. According to the usage of the platform, one can evaluate its performance by measuring the average response time of file updates, which is the most consuming and frequent operation, every half month from July to December of 2015. The authors also compare the result with that of traditional teaching Web site without mobile cloud computing technology that is used in the College from January to June of 2015. Figure 3 shows the results. In the figure, the abscissa represents the timeline of every half month in 2015; for example, 7/1(L) denotes the time frame from 1 to 15 July for the proposed network teaching platform, while denotes the same time frame in January for the traditional teaching Web site; 7/1(U) denotes the time frame from 16 to 30 July for the former, while denotes the same time frame in January for the latter; and other symbols in the abscissa have the similar meanings.

It can be seen from Figure 3 that in the new network teaching platform, the average response time of file update operation is much shorter than that of traditional Web site, about 1/4 of the response time in the traditional Web site, since the services of AWS EC2 and S3 in the new platform provide high efficient and stable data storage environment. With the increase in the number of students, the traditional Web site will operate even less efficiently for the limited processing capability or needs to use more expensive local computer servers, whereas the new platform can achieve more powerful and convenient performance since one can apply for more cloud services with stronger computing and storage capacity on the basis of actual need and, thus, reduce the economic cost significantly [10]. In addition, it is very easy to apply for new cloud service instances and it takes about 70 seconds to start up a data storage service instance in AWS. Thus, the network teaching platform can operate efficiently, satisfying the teaching requirements of large-scale universities.

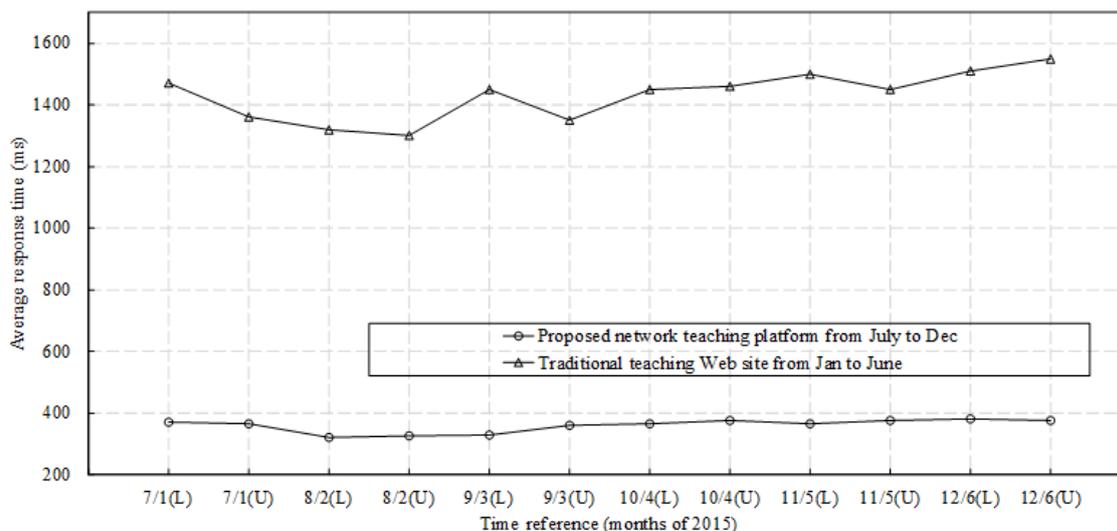


Figure 3: The average response time of file update operation in every half month of 2015 in the proposed network teaching platform and traditional teaching Web site.

CONCLUSIONS

Since the traditional teaching pattern of university courses is quite simple, in this article, the authors have proposed a learner-centred network teaching platform based on mobile cloud computing. The platform is constructed on the combination of Moodle and Wiki, and includes teaching management module, student module and system management module, which enables students to study by themselves, discuss questions, share resources, do homework and tests efficiently, and also enables teachers to publish teaching resources, organise activities, etc. It allows teachers to communicate with students on-line, and makes students evaluate the teaching effect conveniently [9].

In the current university environment in China, it is a kind of innovation to construct the mobile network teaching platform for university teaching methods. Students can access the platform to study anytime and anywhere through mobile terminals, which improves their learning interest and initiative, and strengthens their innovation and practical ability significantly.

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