

Research Proposal

**Teaching and learning model vs. cloud education in college
algebra classes at Chinese universities**

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Purpose and Significance

The purpose this research is to test whether a cloud education model can be equivalent to the teaching and learning model in efficacy of teaching and learning in a college algebra class in Chinese universities. China is a developing country with the largest population in the world, and access to college education is a critical factor for Chinese youth.

Although Chinese universities tend to cost relatively little compared to American ones (e.g., approximately \$1,000-\$2,000 per term), even this cost can prove to be a barrier to Chinese secondary education. Cloud education platforms can be much less expensive to use to provide education, but it is important to make sure the effectiveness that has been shown using the teaching and learning model is preserved when using a cloud education platform.

The advent of cloud computing brought about challenges and opportunities for education. Immediate attempts were made to transform or convert the traditional teaching and learning model to a totally new approach. On one hand, cloud education technology creates the possibilities of sharing resources in the large scale globally and without time restriction. Experts in various fields from all over the world could be integrated into a faculty network to provide excellent teaching resources. In addition, students bored in a traditional classroom may be inspired by the ability for cloud education classes to be experienced at the student's own pace, where the student can choose when and what online resources available to use. More importantly, the world has changed, and the

internet puts much factual information at the fingertips of many people around the world. Cloud education could promote lifelong learning, both within and outside established online educational programs. Because online learning happens “anywhere, anytime”, students develop new patterns of consuming education. As they progress through life, the hope is that as new educational needs are identified (such as the need for an individual to update his/her knowledge of his/her field of expertise), students of cloud education would move forward using online learning to continue to develop. However, how to actually realize these potentials is not clear. First, developing an cloud education curriculum that achieves learning equally or better than the teaching and learning model in the traditional classroom poses a challenge. Some educational approaches, such as a lecture, are easily replicated online, while in-class discussions or activities would need to be modified for cloud education while preserving quality of learning.

Although cloud education is quite common in the United States, it has not been implemented or studied widely in China. Hence, my research will study how an implementation of a cloud education curriculum compares to a traditional implementation in a standardized course in Chinese universities.

Literature Review

Although the Internet has made the digital world seem ubiquitous, not all individuals have access to the same digital world. Cloud education has been a reality in the U.S. and Europe for some time, but challenges exist in countries such as China at developing this type of infrastructure (Rings et al., 2009). Although China is certainly using cloud

computing, the type of educational implementations are limited compared to those in the U.S. Through the U.S. and others' experience with cloud education, much has been learned about its comparison with traditional classroom education, and how to optimize learning online. Further, it has been shown that quality education can take place in a cloud environment at a cheaper rate (Pepper, 1978). For this reason, pursuing the implementation of cloud education in Chinese universities is a worthy cause.

Whether considering China, the U.S., or elsewhere, humankind has entered the "information age", and communication by way of technology has significantly changed. Based on a report from the Horizon Project (2013), higher education is being deeply affected by new technology. The Horizon Project identified six key technology trends in higher education such as tablet computing, massively open online courses, games and gamification, learning analytics, 3D printing, and wearable technology (Horizon Project, 2013). As the era of Web 2.0 came about, the philosophies and technologies of Web 2.0 were disseminated and applied widely. In the higher education field, this shifted the concepts of how the teaching and learning model should be applied. The cloud education model of teaching and learning emphasizes not only the acquisition of knowledge, but also improvement of skills necessary to make use of resources available online. The online student is forced to learn how to look for, select, and use the online resources necessary forward his or her own personal learning. As long as the internet is available, these skills are transferable to lifelong learning. Students with these skills will be likely to continue learning throughout life without the restrictions of location and time (Owen, Grant, Sayers & Facer, 2006).

In China, the trends of new technology and Web 2.0 employed in higher education have effected a critical transformation in China's post-secondary education in the past several years. China has developed the basic technology infrastructure to form a new digital teaching and learning model. For example, China has established the China Education and Research Network (CERNET), the China Education Satellite Broad Band Transmission Net (CEBSat), and several education networks in different cities and provinces to share the information and resources among educational institutions ("China Education and Research Network," n.d.). These networks connect all the universities in China and form a basic educational networking system. Among these networks, the CERNET is the largest national academic network in the world, connecting more than 2,000 educational and research institutions with more than 20 million users (*The national medium - and long-term plan for education reform and development 2010-2020*, 2010).

China's digital educational resources, although they do not currently include cloud education, are well-developed. In the early 2000s, China initiated developing its digital educational resource system to cover every level of education, including both grade school and post-secondary education. This progress pushed the transformation of the digital teaching and learning model in China. In higher education area, most of the universities in China opened their teaching resources, such as libraries of writings and presentations, for sharing among instructors. In terms of educational resources available to general public, currently, China's universities include 1,800 libraries that are accessible online, and more than 3,800 national high quality courses offered online

(Turner & Acker, 2002). These are not grade-, certificate-, or degree-granting courses when offered publically. Without cloud computing, these courses amount to providing digital access to all the teaching materials used in the course, such as presentations, lectures, and readings. However, no testing or evaluation is available. Although the availability of these new educational resources in China encouraged the Chinese public to seek knowledge in various topics that was now made available, these new resources did not achieve a new method of cloud education.

To assign grades, certificates, and degrees, China has many established “TV and radio universities” which have not been as popular in the U.S. These consist of courses administered through the television or radio that are connected with local universities. These course programs are seen as equivalent to classroom instructions, and degrees are granted. Beijing Open University and Shanghai Open University are famous examples of TV and radio universities (“China Education and Research Network,” n.d.). However, because of the well-established infrastructure behind the television and radio course delivery, cloud education has not been developed here.

Converse, the cloud technology used in real teaching has been demonstrated as effective in many research studies, but these have taken place outside China. The Electrical Engineering and Computer Science (EECS) open courseware project claims that despite the challenging economic climate, cloud computing has actually enabled the project to expand the services it offers to faculty and students rather than cut them back due to the monetary efficiency involved in the educational delivery (DeCoufle, 2009). Delic &

Riley (2009) assessed the current state of Enterprise Knowledge Management and methods of sharing ideas and opinions based on cloud technology through different technology architectures and related applications. Mitchell (2008) used rational and logical analysis to show the challenges and opportunities of cloud technology in education. Mitchell concluded that current university professors and students are effectively sharing information through cloud technology, and that teaching can be effective. These are examples from research that demonstrate the possibilities of how cloud computing could be used distribute to improve access to secondary education by way of a cloud education teaching and learning model in China.

There are six main factors that illustrate how cloud technology could positively impact the teaching and learning model in Chinese universities. Firstly, all of the information is stored in the cloud drive, which is unlike the situation now, where individual library databases and other educational repositories can be accessed online. These are all located and maintained on separate drives, and therefore, cannot be integrated (Ren & Zhang, 2010). With cloud educational services, all the data from the cloud service are collected from worldwide onto one cloud drive. The large scale of information service makes it easier for each individual to access much more information, thus improving educational equity (Rong & Shi, 2001). Cloud-enabled open courses could provide high quality knowledge that enhances the knowledge that can be gained from accessing China's existing databases and educational infrastructure. Simply training the Chinese public in how to use cloud computing as well as access existing online resources could improve educational equity throughout China.

Secondly, cloud technology allows the professor and student to customize the teaching and learning experience without confusing the student, because cloud computing is so common, Chinese citizens use it every day in other areas (Maloney, 2007). Smartphones, tablets, laptop computers, and other digital technologies are widely adopted in China, and the Internet is widely used. Because of the high adoption already of TV and radio universities, the next step to cloud computing seems logical.

Next, cloud educational modules that are easily adoptable to the Chinese public can be designed using original “Grid Computing” technology (Ren & Zhang, 2010), and this can save money without requiring extra effort at the universities offering cloud education services. Using grid computing, educational providers do not need to own the basic equipment required for information technology support (such as data servers), but only rent the cloud service, which is offered by grid computing provider. In this system of cloud computing, every level of the cloud computing service components can be selected a la carte by each university to meet different level of needs (Inoue, 2007). Not only could grid computing allow universities to tailor their offerings, grid computing could also be enabled to collect information from students, and provide on-demand knowledgebase (Rings et al., 2009).

Fourthly, cloud education changes the balance of roles and their responsibilities the teacher and the students when compared to the traditional teaching and learning model. In China, because of long-standing traditional precedents, even classroom teaching in

colleges is mainly lecture, with little interaction (Johnson & Johnson, 1986). This model is reflected in the education modules of the TV and radio universities. Therefore, the implementation of cloud computing will require teachers to learn new class interaction skills, as well as students to develop knowledge-seeking behavior (Stansbury, 2012). Those these challenges to current paradigms exist, cloud computing has the potential to break current barriers in China associated with this more “passive” teaching approach, and can extend the learning in new, interactive ways. Cloud computing will require teachers and students to become equally proficient with information acquisition and online interaction between in their respective roles (Sultan, 2010). The role of teacher will change from initiator to mentor, where the teacher is no long the center of the education process, and students become the momentum behind the progress of the class. When students need guidance, teacher will be recruited to support their educational needs and assist them with access to the vast platform of resources and information available, and self-learning by students will be expected. Educators will find it easier to utilize new media technology such as wikis, video tutorials and blogs from the Internet to share as educational materials with students. Students can decide when, how and where they want to access course materials, and will have the choice of contents, progress and timing (Stansbury, 2012).

Next, the cloud education platform offers more new teaching and learning activities and options that are not available in the traditional classroom. The cloud technology based on Web 2.0 technologies allows social networking popularized by Facebook as a feature (Maloney, 2007). Because online social networking is currently well-adopted throughout

the world, social interaction within cloud courses has been shown to be outstanding. Instead of the traditional process where the teacher lectures and the student listens, in cloud education, students can discuss and share with each other and with the teacher. Many researchers believe that learning is a social activity, and people retain knowledge better by sharing information and communication (Bruner, 1996; Lave & Wenger, 1991; Vygotsky, 1978). Research has also found that the interactive and collaborative learning method might help students absorb the knowledge in a more effective way and make knowledge more accessible (Johnson & Johnson, 1986).

Finally, cloud computing system service does not require the installation of a special operation platform or software applications. The basis stage for cloud computing is the Internet. Users who access cloud services and applications only need to use a common computer with an Internet browser ("The real cost of cloud computing services," n.d.). For these reasons, costs of a cloud computing system for a college is minimal, as special software and applications do not need to be maintained or provided. This feature of cloud computing is called "serve more for less cost", and can reduce tuition expenses from cost containment at the college level (Ercan, 2010).

In summary, cloud education has been shown to be effective with the teaching and learning model, and this has been successfully deployed in many countries in post-secondary learning, but not China. China appears ready for this change, as its citizens have a high level of digital literacy and have experience with distant learning. However,

cloud computing has never been attempted in Chinese universities. To that end, the following research questions are proposed:

1. Can Chinese students in a cloud-based course in college algebra perform comparatively to an identical course delivered in the traditional classroom?
2. Can this cloud-based course be provided more cheaply than the traditional classroom course?
3. Do Chinese students value having a choice between cloud-based education and classroom learning?
4. Do Chinese students who take the cloud-based course find themselves needing resources outside the class, such as tutors and books, in order to perform adequately in the class?

Research Content

This study will involve developing an online cloud-computing course in college algebra to be tested in three Chinese universities. The course will be standardized across universities, and one professor per university will be selected to teach the course. Each professor will teach a term that includes one traditional version of the course and one cloud version of the course to be taught simultaneously. To assess the effectiveness of the cloud educational approach, grades between the traditional and online classes will be compared. To quantify if there is a cost difference, comparisons in the cost of delivering the traditional vs. cloud course at each university will be compared. Students of both types of courses will be surveyed for their opinion as to whether they like the choice of traditional vs. cloud course, and students of the cloud course will be surveyed upon

course completion as to whether the resources supplied for the class were adequate to support their learning.

These research activities will be described in more detail below.

Developing the Algebra Course

A standardized algebra course that meets Chinese educational requirements will be selected from one Chinese university for cloud modification. This will be developed into the standardized traditional and cloud courses. At each university, these courses will remain identical, except the particular teacher chosen to teach the course will need to add minor customizations (e.g., record videos with the teacher lecturing). The cloud implementation of courses will follow established research as to most effective strategies to use in online teaching.

The technologic platform that will be designed for this project will follow a standard approach (see Figure 1). This shows how teachers, students, and course content is connected through the cloud system.

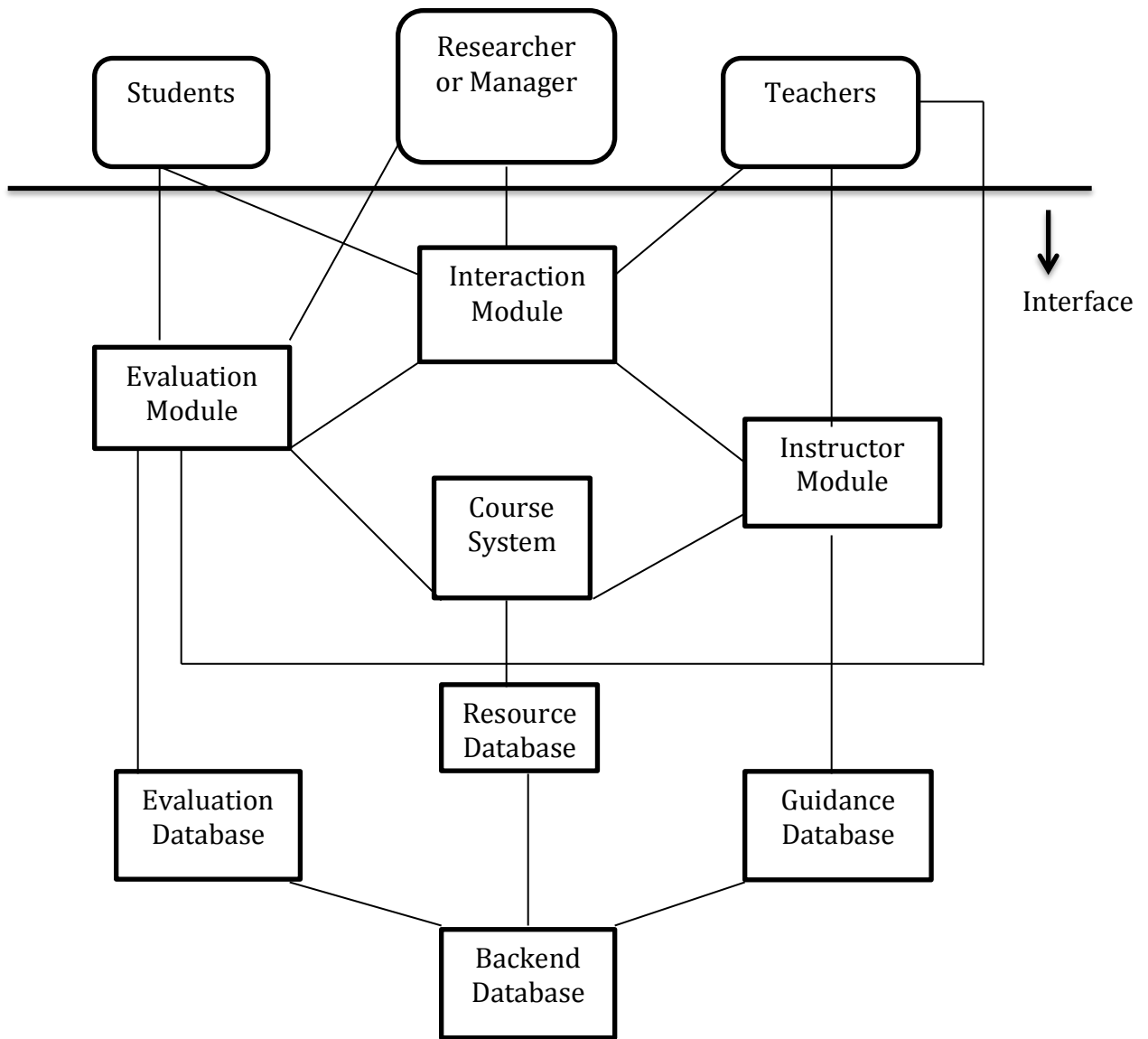


Figure 1. Teaching and learning architecture behind the cloud education platform

Selection of Universities, Professors, and Course Terms

The three universities selected for this experiment are Peking University, Shaanxi Normal University, and Shaanxi TV and Radio University. These universities were selected because they represent three different types of universities. Peking University is a large,

high-tiered, prestigious university offering many courses and much traditional instruction. Shaanxi Normal University is a second-tier university, but is smaller, and provides more focused instruction in teaching. Finally, Shaanxi TV and Radio University is the lowest-tiered university, but offers easily accessible, independent courses to a large cohort of students at a reasonable price.

All three of these universities currently offer a college algebra course. Each section of this course accepts 30-50 students per term. Once the standardized course is established and ready to be delivered, during one experimental term, two sections of college algebra will be replaced with the experimental, standardized algebra class, one with the cloud education version, and one with the traditional version. In each university, one professor will be selected to deliver the traditional and cloud versions of the standardized college algebra course. The professor selected will have at least five years experience teaching college algebra at the college where they work.

Measuring Outcomes

Class performance

To compare class performance between the traditional and cloud conditions, grades of students in each class taught by the same professor will be compared. This is a fair comparison because the courses should be identical except with respect to traditional vs. cloud. Grades in the traditional classes will be provided from the professor, while grades in the cloud-based classes will be harvested from the cloud system online.

Cost

Cost of developing and deploying the standardized curriculum at each college will be calculated and compared.

Value of Choice

How much the Chinese students will value being able to choose between traditional and cloud education will be measured by way of survey. At the beginning of the experimental term (before any assignments are given), professors will first lead both the traditional and online classes in consuming the training materials aimed at students to help them learn to use the cloud education platform. This training will be delivered by the cloud education platform for the cloud-based classes, and in person for the traditional classes. The purpose of training all students, regardless of condition, in the cloud education technology is so they can express their opinion about how much they would value a choice between the two. Immediately after the training, a survey will be administered to the students measuring their interest in having a choice between the two learning approaches. This survey will be administered in person in the traditional class, and online in the cloud-based class.

Need for Outside Resources

Even if students in the cloud condition perform as well as those in the traditional, and the cloud condition is cheaper, and the students value a choice, the cloud education platform cannot be seen as adequate if students of the cloud-based class found themselves needing outside support found in the traditional class, such as tutors and extra textbooks. To

assess the need for outside resources in the cloud education group, an online survey will be given to this group at the end of the course asking if outside resources were needed to complete the course.

Other Data Available

Through this system, the cloud platform will record the process of students and teachers. Although main outcomes will not be measured this way, these data will be a great value for the study. Students and teachers can leave comments and evaluation in the evaluation module, and these can be mined later for better understanding. Also, data from teachers using the instructor module to manage students' assignments and guide their studies can be analyzed.

Statistical Analysis

To answer the main question as to whether Chinese college students in a standardized cloud-based course in college algebra can perform comparatively to an identical course delivered in a traditional classroom, grades will be compared. At each university, for the experimental term, the mean number of points in the traditional class will be compared to the mean number of points in the cloud-based class using Student's t-test at the level of $\alpha = 0.05$. If the cloud-based mean is statistically significantly lower than the traditional mean, the cloud-based course will be considered inferior, and work will need to be done to improve it. If the cloud-based mean is statistically significantly higher than the traditional class mean, further analysis will be done to try to assess why the cloud-based class appears superior. If the cloud-based mean is not statistically significantly

different than the traditional mean, student performance in the courses will be considered comparable.

To compare cost, at each university, the cost of implementing the traditional vs. cloud-based class will also be compared using Student's t-test. It is hypothesized that the cloud-based class will be statistically significantly cheaper to implement than the traditional course.

To assess if Chinese students value having a choice between cloud-based education and classroom learning, results from the survey given to students in both course conditions at the beginning of class will be analyzed. Factor analysis can be used to confirm that the questions in the survey directed toward specific domains (ease of access to resources, convenience of accessing from any location, etc.) load on those factors. Questions included in this survey will be quantitative, and students will answer questions in yes/no format or on Likert scales.

Finally, to assess if the cloud-based students were adequately supported by the cloud-based resources during the class, a final survey will be conducted to see if outside traditional resources, such as tutors and books, were required by the student to perform adequately in the class. Again, questions will be quantitative, and students will answer in yes/no format or on Likert scales.

Limitations

In this study, the universities and amount of the sample are not as large as the reality. The outcomes will be affected by many several factors and situations such as the students' status and attitude, the environment of the study. There are many concerns relating to its security, reliability and portability (to mention but a few). In this study, author designed research for Chinese three different levels of universities. However, before outcome is reached, more work is required in order to address the concerns that currently prevent some educational institutions from embracing cloud computing. Some of the laws and rules, such as IRB that govern issues of data protection and human beings involved experiments can be subject to different interpretations.

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