A cloud computing-based college-enterprise classroom training method

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ABSTRACT: Owing to the mismatch between university teaching and enterprise demand, a pattern of college-enterprise collaborated training referred to as the college-enterprise classroom has been recognised by many Chinese universities. With the application of the college-enterprise classroom, problems caused by deficiencies of the conventional framework have surfaced. This article includes an overview of the bottleneck of the college-enterprise classroom. Stemming from the idea that a cloud based innovation could be used to realise a new pattern of virtualisation-assisted teaching, a VR (virtual reality) teaching platform and a cloud platform that combines innovative college-enterprise classroom is presented and discussed. The application of cloud computing ensures the validity and agility of this new pattern, which is confirmed in practical use cases. This pattern of the college-enterprise classroom can be instructive in practical teaching.

INTRODUCTION

Owing to the keen social competition in China, a student oriented, resource sharing or mutually developing joint training pattern has been widely accepted by most universities and enterprises. This requires universities and enterprises to make concerted efforts to achieve shared objectives using material and information exchanges. Meanwhile, to enhance classroom teaching validity and to adjust teaching organisation have been the key issues of pedagogical reform. Hence, the innovative college-enterprise classroom has been an important constituent of cooperation between schools and enterprises.

On account of the enormous stockpile of information and high demand for technology, a cloud computing-based framework has been raised due to its powerful and reliable computational capabilities, unlimited storage space and easier data exchange, as well as knowledge coordination [1][2].

Cloud Computing

In recent years, the term *cloud computing* has been prevalent in the world of information technology (IT). According to the definition by Chou, *Cloud computing is a recently developed information technology (IT) that utilizes resources virtualization approach to deliver IT services through Internet technology and on-demand mode* [3].

The National Institute of Standards and Technology (NIST) defined cloud computing, on its Web page, as ...*a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction* [4]. Considered from an evolutionary perspective, cloud computing is the successor of cluster computing and grid computing [5].

The benefits of using cloud computing in on-line education was discussed by Bouyer, who observed that ...*Applying cloud computing in higher education institutions improves the efficiency of existing resources usage, as well as the reliability and scalability of software tools and applications for e-education* [6]. Therefore, a cloud computing-based enterprise classroom inherits the efficiency and reliability of cloud computing.

Enterprise Classroom

An enterprise classroom is a type of collaboration framework signed by enterprise and universities. This training pattern places emphasis on practice, and it inspired the carriage of manufacturing processes and systems into the classroom, enabling students to study abstract theory in practical manufacturing circumstances. According to Chou and Hsiao,

a role-play learning strategy yields a significant effect on student learning [7]. On this occasion, the integrated practice and theory could be a type of core competitiveness to these students and universities in an environment that has the demand for experienced interns and employees of enterprises.

PROBLEMS OF TRADITIONAL ENTERPRISE CLASSROOM APPLICATION

The enterprise classroom focuses on teaching and practice through real manufacturing segments for which reason introducing manufacturing systems and enterprise production simulation are pivotal issues.

With the continuous update of enormous production software, the complex management and update of databases and systems are time and labour consuming. Thus, the actual enterprise production systems are not capable of training students in the classroom. To solve these problems, establishing a capable teaching and training platform and the transition from enterprise to classroom teaching are the points to breakthrough in the enterprise classroom.

Further, with the rapid development of industrialisation of China, technology elevation and application expansion lead to an intense demand for engineering talent. Meanwhile, most educated and experienced engineering talent would work for companies rather than teach in colleges, which will undoubtedly exaggerate the lack of teachers in professional domains. The lack of teaching resources cannot match the higher value of practice than theory in the enterprise classroom, and this conflict has definitely been a bottleneck of enterprise classroom application.

In recent years, the expansion of enrolments in China has brought more students to colleges and universities; nonetheless, the corresponding available resources and facilities cannot match the increasing demand; e.g. such as computer rooms. The limited availability of computer rooms cannot meet the heavy demand, especially, for colleges involved in information engineering. The limited number of computer rooms increased the difficulty to arrange practical training through information systems and, simultaneously, the occasional updating of the authorised software and distribution of professional systems applied in different domains to be used by different majors increased the administration cost. For these reasons, the lack of appropriate facilities has been a drawback of the traditional enterprise classroom to enter the campus.

CLOUD-BASED COLLEGE-ENTERPRISE CLASSROOM

Due to several application issues encountered in applying the traditional enterprise classroom, an improved pattern of the college-enterprise classroom is needed. Based on the accessibility and flexibility of cloud computing, the cloud has been introduced to make an applicable pattern of the college-enterprise classroom.

The cloud-based college-enterprise classroom uses cloud computing to prevent problems met in the application of traditional versions of training. It consists of three parts: a virtualisation assisted teaching system, a VR (virtual reality) teaching platform and a cloud platform. The framework of cloud-based college-enterprise classroom is shown in Figure 1.

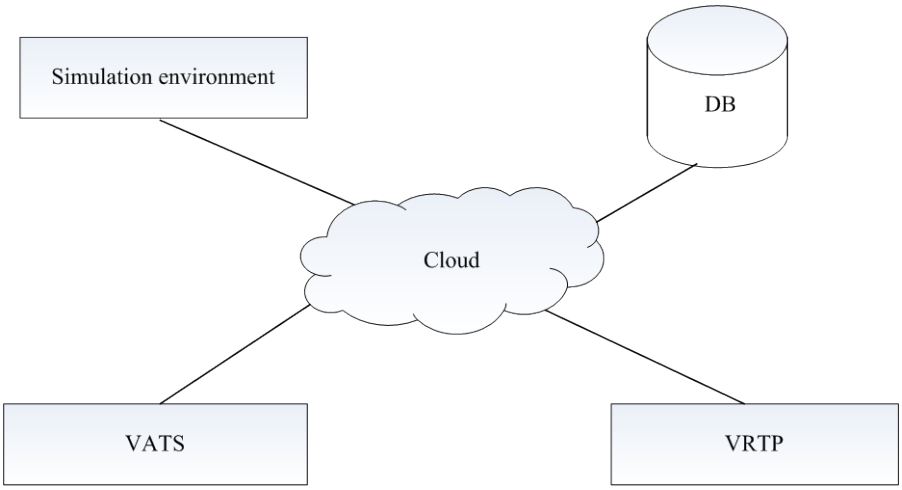

Figure 1: Framework of cloud-based college-enterprise classroom.

Virtualisation Assisted Teaching System

Virtualisation assisted teaching system (VATS) is an important component of the innovative college-enterprise classroom. A specific teaching system for a specific domain should be developed according to specific training objectives and business processes. VATS enables colleges to establish a specific teaching system with less cost through the transplantation of an existing similar lightweight teaching system or even a practical enterprise management information system. Meanwhile, teachers can make targeted teaching and practice plans according to students' class hours, knowledge backgrounds, mastery of knowledge and recognition ability.

If one takes port and maritime logistics as an example, one can observe that students cannot get easy access to operate practically in ports and terminals. However, in a college-enterprise classroom, corresponding business models and production procedures for different kinds of port and maritime logistics system can be visualised. Students can even operate ports and shipping companies in the simulation environment. At present, VATS in this domain consists of a shipping agency management system, a port operation management system, etc. With a complete set of operation systems of the port logistics system, students can get easy access to the complex operation logic.

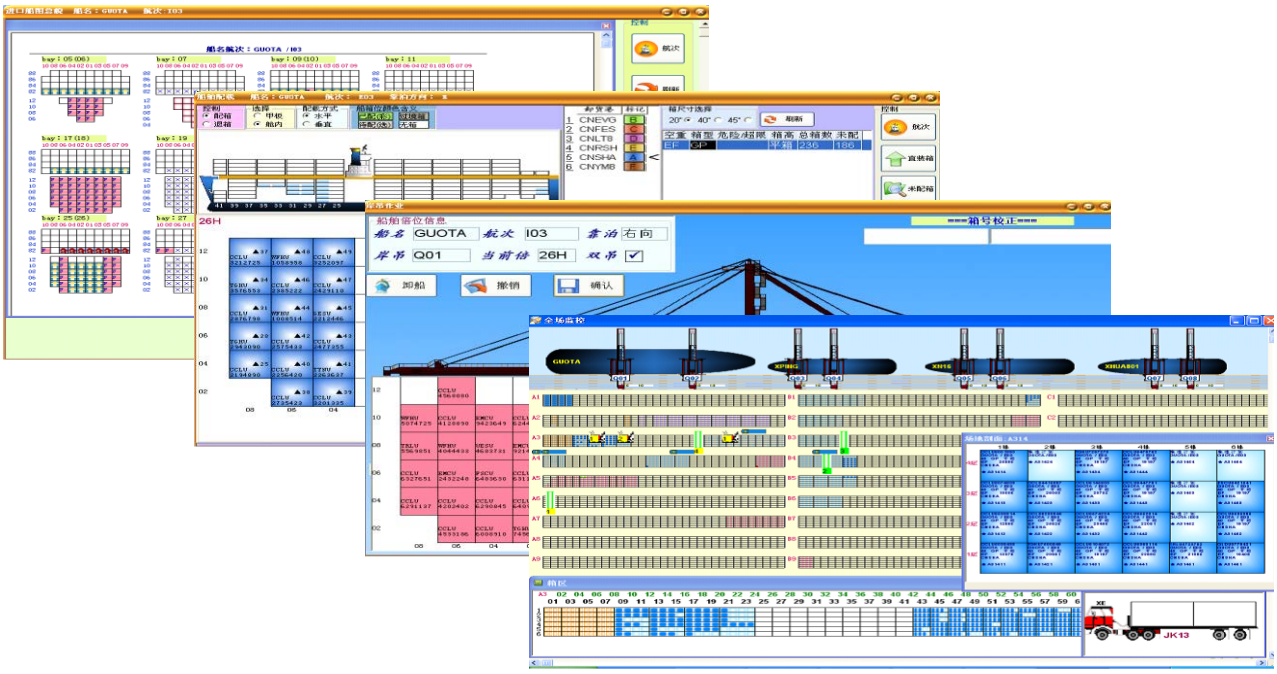

Figure 2: Full set of operation systems.

On account of the complexity and diversity of logistics systems, interfaces between these systems and simulation software are defined for the convenience of accessing the production data from various kinds of simulation software. Simulation is then used for evaluation, analysis and optimisation of the production plans. This platform will not only be a valuable training platform, but also it can be used to carry out scholarly research.

VR Teaching Platform

VR (virtual reality) has become a popular concept, and in this platform, it serves as a kind of visualisation method to transform indigestible business logic and data into visible operations. A concept of interest teaching is introduced to stimulate the students' study enthusiasm without sacrificing the quality of practical teaching. Intricate theories and complex logic are developed into a video game in which students play a role to finish business operations, e.g. in container terminal scheduling training, a 3-dimensional virtual port is developed, combining VR technology. Real time production status is shown in a 3-dimensional model in which students can drive a truck to transport a container. Figure 3 shows the teaching game using the case of horizontal transportation.

Figure 3: 3D operation model.

According to Lee et al, students' interest in learning has a significant interactive influence on the learning outcomes in Taiwanese colleges [8]. The application of game-based training shows the potential [9]. In this case, a sense of novelty will drive students to explore the process of loading and unloading of containers, and to study the different handling processes of different transportation machinery. This platform guarantees the validity of practical training while keeping students interested in handling the process.

Cloud Platform

As the application of information teaching goes deeper and further, more and more classes are taken in information teaching fashions like Internet teaching. The cloud platform or cloud storage platform is raised to better construct an information-based college-enterprise classroom. Resources from teachers and students are stored on the cloud platform for the convenience of information sharing. These resources typically comprise two parts: instructional videos and e-textbooks.

For lessons like database development, programming methodology, programming on computers it is an essential part of training. The conventional approach to this is based on help documentation. This approach can be quite difficult for starters not merely because it is time consuming, but because it eliminates students' interest in these domains. Instructional videos recording the programming details could help more, and are more popular among students. E-textbooks are the complement of videos for their convenience in updating, which provides quite a remarkable advantage in this era of rapid development.

INNOVATION POINT OF CLOUD-BASED COLLEGE-ENTERPRISE CLASSROOM

The application of cloud-based college-enterprise classroom is an innovation in teaching patterns and an important tool of implementation of the intelligent campus. Here are the main innovation points:

Application Virtualisation

The development of mobile Internet technology argues for flexible access to systems. When virtualised, enterprise-level client/server application can be converted to Web application without much cost, and Web-based functions with better experience can be realised without redevelopment of BS-based Web system.

Cross-platform Application

The application of cross-platform technology enables students to get access to training systems without a limit of space. Not only PCs from computer rooms at college can run these training systems, but almost every smart device including iPhones, iPads and Android devices can be a training tool. This technology reforms the teaching methodology and breaks through the limitations of training facilities. Problems caused by the lack of teaching and training facilities can be solved.

Innovation of System Structure

The conventional structure of training systems needs a lot of updating work once the main system is updated, while cloud-based structure eliminates various kinds of plugging like databases and management information systems (MIS). High-performance service no less than fat-client can be accessed without much complex configuration.

Centralised Deployment

Centralised deployment means the critical application runs only on the central server. In this case, a training system can be of low maintenance cost and difficulty.

Innovation of Practical Teaching Pattern

Application of cloud computing enables teachers to use a vivid system to instruct students to operate large professional utilities and leading operation control systems.

Project Driven

These applications and systems are driven by living enterprise projects with an integration of theory and practice. Comprehensive capability of students can be attained using this combined training.

USE CASE OF CLOUD-BASED COLLEGE-ENTERPRISE CLASSROOM

At present, the Practice Teaching Cloud-Computing Service Cluster of Shanghai Maritime University (SMU), which consists of one database server and one cloud-platform server was jointly developed by the Logistics Engineering

Department of SMU, and the Informatisation Office and Engineering Research Centre of Container Supply Chain. The applications (teaching systems) based on cloud-computing with independent intellectual property rights of SMU formally deployed on the cluster include a container terminal operation system (TOPS), a general cargo terminal (bulk dock) operation system, a container yard operation system of Tianjin port, a CFS transportation management system of Tianjin port, etc, have been applied in many port enterprises, such as Tianjin port, and others.

CONCLUSIONS

The college-enterprise classroom is the co-product of college-enterprise collaboration and teaching innovation. A breakthrough in practical teaching is made by the cloud-based college-enterprise classroom; meanwhile, a huge step is taken towards having an intelligent campus. This framework enables students to do enterprise practice inside the campus and elevate both theoretical knowledge and practical ability. Further study can be launched on applying data mining methods to analyse teaching feedback, and constructing a reinforced learning environment of enterprise practical teaching based on the cloud platform.

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