Desktop Cloud Experimental Teaching System in Experimental Teaching

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Abstract. This paper takes the Desktop Cloud experimental teaching system developed by School of Software Engineering South China University of Technology as an example, it describes the overall architecture of the system, online technology, Cloud-Based technology and the characteristics like low operation and maintenance costs, ease of use, etc. For the shortcomings in current traditional experimental teaching, this paper proposes to promote the application of an innovative Experimental Teaching Model—the Desktop Cloud experimental teaching system, in order to improve the deficiencies existed in traditional Experimental Teaching such as inefficient and high maintenance costs.

The Use Mode of PCs in Experimental Teaching today

There are lots of inefficient links existing in traditional Experimental Teaching process. For example, teachers must to go to the laboratory management to apply for a certain period of the lab access, they also need to discuss the experimental time, laboratory room and software tools with laboratory teachers. Then they need to install the experimental software which the course is demanded on every PC, they do these things over and over again, repeating operation inevitably leads to low efficiency [1]. Furthermore, experimental operations require a high host configuration, to satisfy this, schools are demanded to upgrade the host configuration regularly or to buy new hosts to replace, these requirements also increase the costs of Experimental Teaching. There are two main aspects.

High Hardware Costs

Take 200 PCs as an example. The acquisition cost is about 1,000,000 RMB. If there are 40 software major courses opened every year and every course takes 16 hours, so there will be 128,000 hours provided one year. We assume that one PC will be used for 5 years until be replaced, the sum of hours which the PCs provide will be 640,000 hours. If calculating in this way, the cost of every PC hour is about 1.5 RMB, the hardware costs is relatively high.

Too More Management and Maintenance Spending

Software and System need to be maintained and upgraded at the beginning of every semester. Using Network Clone costs 2 to 3 days and the network cannot be broken halfway, otherwise we can only do it from the beginning again. If we want to add some software into the system, the computer room will be suspended for 2 to 3 days for the installing operation, it is really inconvenient and it makes the increasing of the management and maintenance spending, too.

The Advantages of Desktop Cloud Technology

According to the problems above in use and maintenance, this paper proposes the use of the Desktop Cloud technology. Desktop Cloud is a kind of application of cloud computing, mainly to decouple the user terminal device and the desktop environment. Each user's desktop environment is put on the server side and users use the terminal device to access the desktop environment through network [2]. Now we will introduce a Desktop Cloud experimental teaching system developed by School of Software Engineering South China University of Technology. After two-years running
and testing, this system shows its usability, practicability, stability, and it proves that Desktop Cloud technology is a great solution.

**Online Technology**

Online technology means making the preliminary preparation process of the Experimental Teaching online. Including traditional laboratory applications, verifications and other processes shifted offline to online. Teachers can see every-week allocations of all laboratories in real time and they can also apply for a certain period of time to use the laboratory on their own. Administrators can view all laboratory periods which are applied on the system and perform permissions. Course students can login the website to see all checked laboratory using periods, so that teachers no longer have to notify students the location and time of the courses. The operations are simple and intuitive which greatly improve the efficiency of Experimental Teaching.

**Cloud Based**

Cloud Based means migrate all of the Experimental Teaching resources including desktop operation systems, software and other experimental tools from the local host to the cloud server, then deliver them to the local user through Remote Desktop Protocol. We can build a high-performance server cluster as a virtual resource pool to provide an actual physical environment for the virtual machine [2]. There are few requirements on configuration of laboratory machine or dormitory machine (if the course allows students to do the experimental operation in dormitories), because local side does not need to install any related experimental software or tools, instead the only requirement is installing a Cloud-Based platform client as an entrance for resources. Administrators can also use the client to complete the supervision and management of cloud mirrors and cluster host. Besides, this cloud platform can record the students’ login situation of every experimental course so teachers can easily do some attendance management for students. All these features avoid the the duplication of effort in installing experimental software which is the main reason of increasing the spending of human maintenance.

**System General Architecture**

Pictures of system general architecture (refer with: Figure 1) and System function architecture (refer with: Figure 2) are shown below.

![System general architecture](image)

**Hardware Investment.** Four severs (this system uses DELL R720 with GPU), two storage servers (uses IBM V3500), one fiber channel switch, installing and debugging system and some software for general experimental need. After experimental test, this set of servers can promise 200 PCs to do experiments at the same time, and the demand of PC’s performance is relatively low, PCs with low configuration or even old PCs can be used unless its hardware has broken. Calculating in this way, the costs of hardware is reduced and experiment funds are saved effectively.
300-thousand-yuan server plus 400-thousand-yuan PCs (200 sets), 40 software major courses every year and 16 hours per course, so there are 128,000 hours provided every year. If the server and PCs can be used for 10 years, the sum of hours is 1,280,000 hours while each hour cost 0.6 RMB. Compared with the cost (1.5 RMB per hour) of traditional experiment model, using this system can reduce hardware costs by 2.5 times which is a sharp reduction in hardware costs.

Human Maintenance Investment. Every semester we only need to spend one night or few hours finishing the tasks of maintaining and update the servers’ software without caring about PCs. Adding or updating software halfway is convenience as well, as long as we take two hours at night we can complete that. Even though we may not finish some new tasks because of accident, it will not affect other experimental software. This system has a large advantage in this aspect, it is well suited to be used for laboratory’s teaching and management.

This System can be Customized for a lot of Functional Modules for the Laboratory

The Experiment Report Module: make the publishing and submitting of the experimental assignments more convenience; The Statistics Module: this module can count the number of experimental courses, students and credit hours, etc., it’s easy to provide data to the upper-level decision makers, which exactly meets the demands in today’s Experimental Teaching and management; The Monitoring Module: it monitors the use of resources such as CPU and memory and provide data so that we can get powerful and visible data on time when we need to add some resources to the laboratory.
The Prospects of Promoting to Colleges and Educational Institutions

As one of the main applications of cloud computing technology, Desktop Cloud decouples the user terminal device and the desktop environment. Each user's desktop environment is put on the server side and users use the terminal device to access the desktop environment through network. On one hand, Desktop Cloud allows users access their desktop environment via the display terminal anytime, anywhere; On the other side, all desktop environments are managed by back-end server uniformly and it can lower the configuration requirements of local terminals and reduce the data management costs. Desktop Cloud has become a significant means of cloud resource delivery. As one of the most important parts in college and university education, the effective and smooth operation of Experimental Teaching course has its fatal practical significance. Traditional Experimental Teaching has many inefficient links such as teachers have to go to the laboratory management to apply for a certain period of the lab access and administrators need to install the experimental software which the course is demanded on every PC. Furthermore, experimental operations require a high configuration of host and schools need to upgrade the host configuration regularly or to buy new hosts to replace, these requirements make the costs of Experimental Teaching commensurate high. In short, there are many deficiencies exist in traditional Experimental Teaching process, this system has reasonably optimized them and designed special functions to meet different demands, it makes the Experimental Teaching process easy and durable to execute. After two-years running in Engineering Laboratory of School of Software Engineering, we can smoothly open about 40 experimental courses offered to more than 1,200 students, we also count data conveniently and report it to corresponding departments of the university which effectively improved the deficiencies existed in traditional Experimental Teaching like inefficient repeating installing work and high maintenance costs. So this Desktop Cloud technology is really suitable to generalize to Experimental Teaching in colleges and universities. It is also a great education way for computer education in primary and secondary schools. As this Desktop Cloud System effectively reduce the hardware costs and maintenance costs, especially the human maintenance spending, it’s particularly important for primary and secondary schools, because in the computer education part, they always arrange little computer teacher (technicians), for these schools, a system with usability, durability and low human maintenance costs will be more willing to choose. So this system has a bright promotion prospect.

Summary

Desktop Cloud technology not only improve the level of Experimental Teaching and management effectively, but also apparently reduce the operating and maintenance costs, it’s such a kind of cloud computing technology which is worth to be promoted. It’s suitable for Experimental Teaching in colleges and universities, and it is also appropriate to be applied in computer education in primary and secondary schools.

References


