

Construction of Basic Education Cloud Computing Platform Based on Virtualization Technology

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Abstract. The information technology of basic education is constantly popularized, basic education curriculum and textbook reform are carried forward step by step, high-quality educational resources are seriously deficient, and these factors directly affect sustainable development of basic education. 'Education cloud' concept is introduced in the paper by transferring cloud computing technology in education field. Service frames and functions in three types of education clouds are described with virtual technique as core, in addition, concepts and methods for constructing basic education cloud platform are provided on the basis.

Keywords: education cloud, virtualization technology, cloud services.

1 Introduction

The state, educational institutions at all levels; schools and enterprises invest manpower, material and financial resources greatly in promoting implementation of basic education informational project and construction of education resources with prevalence of network and promotion of education information technology in recent years. Although preliminary results have been achieved, there are still some problems in construction of basic education resources, mainly including the follows:

(1) Unbalanced proportion in educational resource investment. The investment is mainly based on hardware facilities in the aspect of primary and secondary education resource, which accounts for more than 80% of total fund investment. However, software investment proportion is relatively low.

(2) Educational resources are mismatched. Existing resources have more prominent problems in the aspect of systematization and match with text materials, etc. Schools and teachers also pay the most attention to these problems. In addition, high-quality education and teaching resources which are in line with the concept of curriculum reform, suitable for IT environment characteristics, and adapted to moral education and quality education demand are deficient.

(3) Shared educational resources do not have uniform technical standards. Educational institutions and a number of software resource enterprises in different regions adopt different technical standards in production of education and teaching resources due to difference in different versions of textbooks, users of educational resource, teaching methods and ideas, thereby forming teaching resource database platforms in separate ways and with own systems.

(4) The regions of education resource construction are imbalanced. IT infrastructure is constructed and invested weakly in economically underdeveloped provinces and rural areas. Teachers are apparently lack of material environment for applying digital teaching resources, and concepts of digitally constructing and sharing curriculum resources are deficient.

(5) Resource software is provided with uneven technical contents. Teachers in primary and secondary schools bear heavy teaching work currently, and they are lack of centralized time for creating teaching resources. Meanwhile, technology application level is not high as a whole; therefore interactive software fully reflecting advantages of computer and network technology are seriously deficient. [1]

Therefore, it is extremely critical to construct authorized, systematic, scientific, selective, open and high-quality education resource resources convergence platform which is adapted to characteristics of modern education, combines information technology and network technology development, realizes education teaching as main body, and achieves personal development, teaching tool resource base based on the platform and resource mode based on interconnection and communication should be established.

2 Concept

2.1 Cloud Computing

Large-scale massive data should be processed with the rapid growth of basic education information and data in Internet era. However, desktop computers, which handle these data alone at present, can not meet current demand for large data processing. System hardware performances and hardware amount can be generally increased to meet the growing requirements in system scalability. Cloud computing concept is proposed due to limitation of traditional parallel programming model application. New parallel programming frame which can be easily learnt, used and deployed is demanded, which not only can save cost, but also can realize system scalability. Cloud computing is further developed from distributed computing, parallel processing and grid computing. It belongs to a system which is based on Internet-based computing and provides various Internet applications with hardware services, infrastructure services, platform services, software services and storage services [1]. Cloud computer is produced by combining various traditional computer techniques and network technology development, computer techniques include virtualization, distributed computing, grid computing, etc. Computing resources (such as storage, hardware, platform and software) are shared under cloud environment, and the concept was firstly proposed by Google in 2007, which was rapidly developed since then. Cloud computing resources can be provided for users in three service modes: Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a service (SaaS). [2]

2.2 Education Cloud

Education cloud refers to transfer of cloud computing in education field, which provides cloud services for education field, including Cloud Computing Assisted Instructions (CCAI), Clouds Computing Based Education (CCBE) and other forms. Wherein, cloud computing assistant teaching refers that schools and teachers utilizes education 'cloud

services' to provide convenient conditions of teaching resource sharing and unlimited storage space through cloud services of cloud computing. Cloud computing assistant teaching is also known as 'education based on cloud computing', which assists education teaching activities by services provided by cloud computing in education teaching. Services provided by cloud computing is mutually supported and combined with basic classroom teaching, thereby providing corresponding education and other teaching resources as well as design and management in the teaching process.

Education cloud will be applied in infrastructure of education information technology in the future, including all hardware computing resource necessary for education information technology. These resources can provide education institutions, education practitioners and students with a good platform after being virtualized.

2.3 Cloud Learning

'Cloud learning' refers that cloud knowledge, cloud tasks, cloud resources, cloud components, cloud website, learner cognitive structure and other key models are constructed around learning services in cloud computing environment with psychology, education, knowledge engineering and system engineering theories as guidance. [3] Software architecture and Web interactive technology are utilized for developing open, sustainably-developed, personalized and distributed learning system with interactive inquiry features, and it is technical code for developing, trading, operating and evolving interaction inquiry learning resources. Cloud learning system includes cloud learning platform and cloud terminal learning machine. Cloud learning platform, as 'cloud' resource network, is open all over the world, which is constructed, cooperated and shared by the whole society. 'Knowledge cloud' is formed by knowledge engineering, learning theory, semantic network, information technology and other components. Currently, cloud learning platform mainly includes cloud learning master station, IVIDEO interactive video website and cloud learning open platform. Cloud terminal learning machine can be adopted for interactively exploring and learning knowledge clouds anywhere and anytime. Cloud terminal learning machine belongs to a lightweight client, such as learning computer, Ipad, smart phone, browser, etc.

2.4 Virtualization Technology

Virtualization technology was derived in IBM mainframe system in 1960s, which became popular gradually in System 370 series in 1970s. Virtual Machine Monitor (VMM) program forms the core of the system. Various Virtual Machine examples with independent operation are virtualized in physical hardware. Virtualization technology is mainly divided into three categories, namely: Platform Virtualization, Resource Virtualization and Application Virtualization. [4] Platform virtualization technology refers to virtualization of computer and operation system. Resource virtualization technology refers to virtualization of specific system resources, such as memory, network resources, network storage, etc. Application virtualization technology includes explanation technology, phantom, simulation, etc. Virtualization technology refers to platform virtualization usually, which is also known as virtual machine technology. It usually operates control program (also known as Virtual Machine Monitor or Hypervisor), and hides physical characteristics of actual work platform, thereby providing users with abstract and simulated computing environment.

Currently, basic education resources are distributed dispersedly. Education administrators such as cantonal educational institutions and third party participants of education such as educational software development enterprises do not have uniform contents, technical standards and even file format in education and teaching resources, thereby developing teaching resource database platforms in separate ways and with own systems, primary and secondary schools have to accept various education resources in different technical standards. Hardware resource utilization rate statistics is adopted as an example:

Table 1. Education Platform Hardware Resources and Resource Utilization Rate in Primary and Secondary Schools

Education Platform	Hardware and Network Equipment	Storage	CPU Utilization	Memory Utilization
1	Six servers, two switchboards and two firewalls	2T	18.3%	24.6%
2	Five servers, one switchboard and one firewall	1T	9.4%	11.3%
3	Eight servers, two switchboards and two firewalls	2T	22.8%	29.2%
4	Six servers, two switchboards and two firewalls	2T	13.2%	18.8%
5	Four servers, one switchboards and one firewall	2T	14.7%	20.5%

3 Implementation Mode of Education Cloud Platform of Virtualization Technology

A series of operations will be implemented on education cloud platform, such as resource joint construction and sharing, teacher community construction (teaching and scientific research), home-school community construction, teacher-student community construction, school management, assessment modernization, etc., thereby optimizing course content, transforming teaching and learning mode, sufficiently sharing high-quality education resources, meeting individual educational needs of students, implementing quality education and innovative talent training strategies, improving quality of education teaching, promoting balanced development of education, and realizing the principle of fair education.

3.1 Construction of Education Information Public Support Environment (Basic Cloud IaaS)

IaaS basic cloud business platform is mainly composed of network, servers, storage systems, peripheral interfaces, etc. as shown in Figure 1. Mature virtualization technology is adopted on business platform to create multiple functional resource pools which can be managed, thereby sharing network, computing power (servers), storage resources, etc. Resource management can be standardized, resource regulation and distributed can be finer, coordination can be more flexible, convenient and rapid in the data center by realization of virtualization technology, thereby improving resource utilization rate, and reducing total cost.

IaaS service mode is adopted. Education or government departments can use existing equipment for purchasing and deploying multiple servers in a centralized mode for composing 'cloud' infrastructure. Memory, I/O equipment, storage and computing

power are integrated into a virtual network infrastructure resource pool, which is provided for cloud primary and secondary schools, especially schools in remote areas or private schools without procurement ability in measurement service mode, thereby providing these schools with demanded storage resources, virtualized servers and other services, saving school expense in basic hardware, and effectively realizing balanced development of education. [7]

For example, primary and secondary schools should invest in foundational network hardware and operation maintenance during construction of digital campus. Through cloud IaaS service mode, the education department can purchase scale storage array by education department and virtualization server. Combination of PaaS cloud platform and comprehensive show deployment model of SaaS cloud, which can realize zero input of the construction of campus network. Avoid the school network hardware problems of decentralized investment and repeated construction, reduce the operational cost of the network hardware, improve the efficiency of the use of the network hardware.

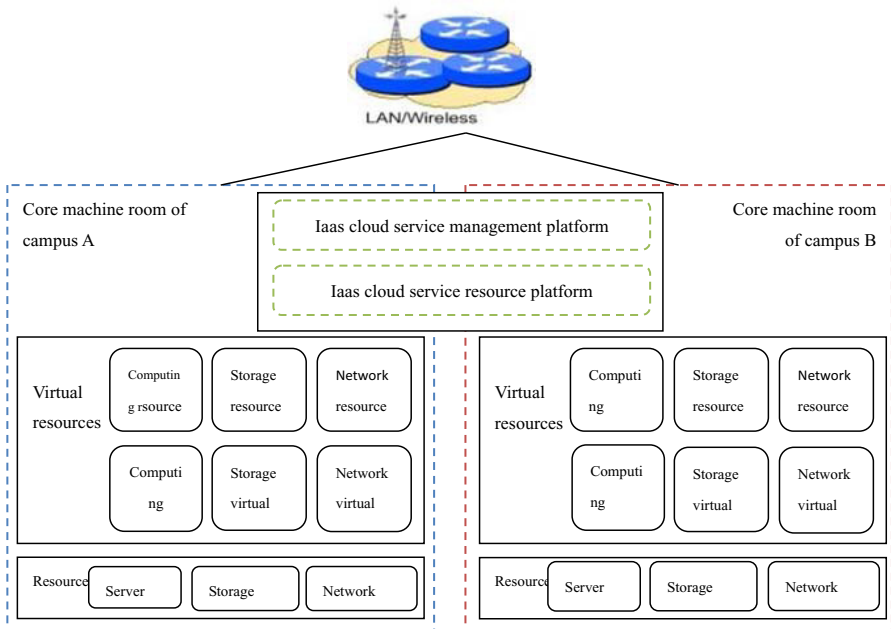


Fig. 1. Public Facility Environment Drawing of Education Cloud

3.2 Construction of Educational Public Service Platform (Platform Cloud PaaS)

Currently, primary and secondary schools independently uses a part of application software basically, thereby leading to high purchase and operation maintenance costs, low efficiency, poor reuse and other phenomena with investment waste. Small and medium-sized schools can not afford some outstanding application software due to the high cost. Common application service of school can be realized by cloud service PaaS mode, thereby improving school digital education, digital scientific research and digital management level by services with low cost and high quality. [8] PaaS cloud

service provides platform to develop environment services and also provides development template. Various school users at all levels can customize own application programs under the cloud platform development environment, such as: digital campus portal website, teaching management system, and school letter passes services. These services are opened to cloud users through servers in cloud service center. Personalized, self-developed and customized middleware platforms can be provided for various school units of basic education through PaaS services.

Most primary and secondary schools generally have difficult technical problems such as digital campus website construction or complex code application development of various teaching affair management systems. Manpower and financial resources are demanded. These problems can be solved by program package services and customization services provided by PaaS cloud platform. Data centralization and management can be achieved.

3.3 Intelligent Learning Platform and Other Applications (Software Cloud SaaS)

SaaS software cloud service mode is adopted. Education management department purchases standard teaching resources of education teaching software, application software, etc., which are secondarily developed. The education teaching resources can be unpackaged into application module according to application category, which are packaged in the mode of independent software services, thereby forming software service package, teaching courseware and tools which can be deployed independently. The software services packs are deployed on servers of cloud data center in a centralized by the platform. School users, as clouds, can deploy, download and customize desired education teaching application software services from the education cloud platform service center through Internet according to individual demand. [9] Primary and secondary schools do not need to invest much to buy the same education teaching or resource software based on SaaS mode, thereby effectively avoiding wastage of funds to purchase and deploy software repeatedly. Meanwhile, massive investment of the schools in supporting hardware equipment, software maintenance, etc. can be saved.

Education administrative departments do not need to repeatedly constructing hardware and software education resources as well as scattered investment purchase, etc. in various primary and second schools by SaaS service mode. Schools save the cost of software, and do not need to pay the cost of purchasing operation system, database and other platform software, thereby saving costs in software project customization, development and implementation. Meanwhile, they do not need to assume expenditures and cost of maintaining and updating software, thereby embodying resource data comprehensive construction and comprehensive sharing more effectively. Investment in scattered purchase of software can be avoided on one hand, and high-quality resource sharing and services also can be improved at the same time.

4 Overall Program of Education Platform Based on Cloud Computing

Information infrastructure of various education institutions at all levels should be sufficiently integrated and utilized during construction of regional basic education cloud platform. Open basic education cloud environment characterized by comprehensive

coverage and rational distribution should be constructed for supporting the formation of hierarchical structure, including cloud basic platform, cloud resource platform and cloud education management service platform. The education cloud basic platform should be able to support effective deployment and application of education cloud resource platform and management service platform. Education basic cloud services can be provided for IPv4 and IPv6 users at the same time. [10] IDC machine room (Internet Data Center) can be transformed and upgraded for realizing IDC services supporting cloud computing in the specific implementation process. Education users are served in SaaS form through main network. Meanwhile, service and education resource sharing services aiming at individual education should be introduced at the same time. Users in the network can be served through integrating, customizing and constructing education cloud platform.

Cloud-based service framework model is shown as follows based on the functions provided by education cloud platform, as shown in Figure 2.:

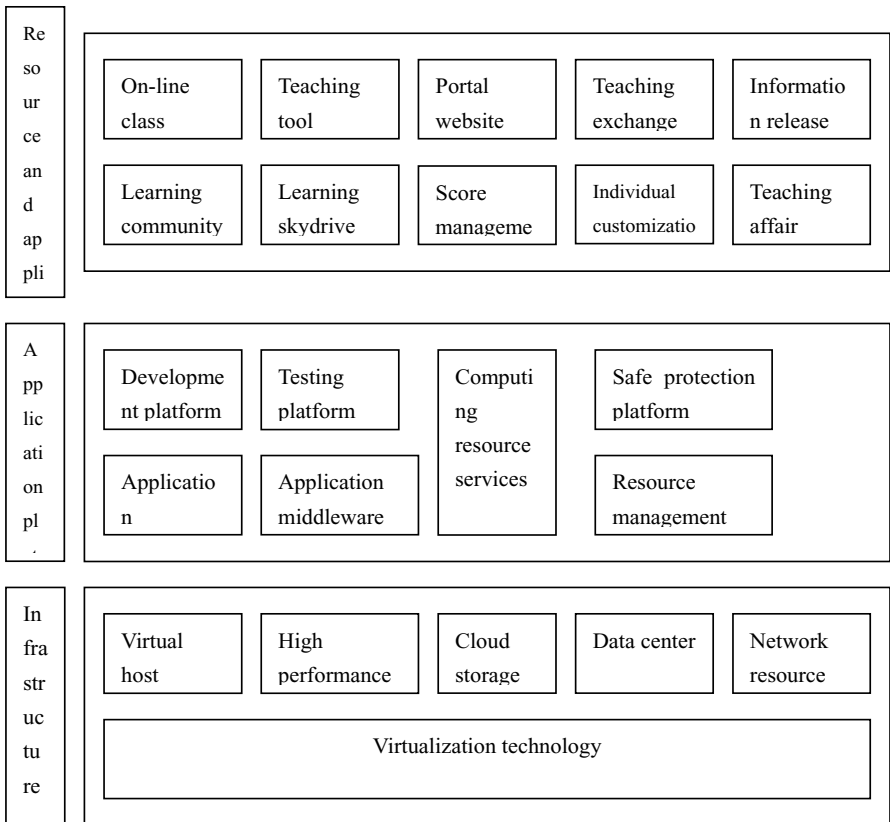


Fig. 2. Education Cloud Platform Service Framework

5 Conclusion

Advantage compensation, risk mutual assumption and resource sharing of digital education teaching resource construction can be comprehensively realized by establishing education cloud. Since resource construction is related to various fields of education, politics, economy, culture, business, scientific research, etc., forces from various fields such as government departments, universities, primary and secondary schools, various associations, foundations, companies, etc. should be integrated by relying on government organizations, thereby establishing exchange mechanisms in various forms, and constructing dynamic development trend of self-improvement. The education cloud platform, education resources, rules, protocols and related certification standards should be planned as a whole and coordinated from the national level. Development, synchronous integration, sharing mechanism and effective investment guarantee mechanism capable of sustainable development should be established, thereby fundamentally solving the problems of deficient high-quality resources and structure shortage. Experience from various industries shows that scale, productivity and economic benefit of related industries can be improved by standardization. Similarly, better sharing among different resource databases should be considered in the former stage of standardized formulation of educational resource database. Only in a unified mode, education resources to be able to better compatibility, duplicate, extension, the exchange and transplant, so as to realize the real meaning of sharing.

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